

Saskatchewan Onsite Wastewater Disposal Guide



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1 DEFINITIONS AND ABBREVIATIONS

Above-grade means a soil treatment field designed and installed such that all or part of the infiltrative surface is located at or above original ground elevation using appropriate imported material; a final cover of suitable soil stabilizes the completed installation and supports vegetative growth; includes mounds, areal fill and at-grade; see also at-grade and below-grade.

Absorption means the process of incorporation or assimilation by which one substance is physically taken into and included with another substance; for example, bacteria assimilating nutrients from effluent.

Aerobic means having molecular oxygen (O_2) as a part of the environment, or a biological process that occurs only in the presence of molecular oxygen.

Alarm means a device that provides information on the status of a component using a visual and/or audible device; can either be on site or remotely located.

Anaerobic means the absence of molecular oxygen (O_2) as a part of the environment, or a biological process that occurs in the absence of molecular oxygen; bound oxygen is present in other molecules, such as nitrate (NO_3^-) sulfate (SO_4^{+}) and carbon dioxide (CO_2).

Anion means a negatively charged ion.

Anoxic means a condition in which all constituents are in their reduced form (no oxidants present); conditions in a septic tank are generally anaerobic, but not anoxic.

As-built means a written plan prepared after system installation that reflects the actual construction and indicates differences from the original design.

Aquifer means a porous water-bearing geologic formation capable of yielding a supply of water.

At-grade means an above-grade soil treatment field designed and installed such that some part of the infiltrative surface is located at the original ground elevation.

Baffle means a physical barrier placed in a component to dissipate energy, direct flow, retain solids and FOG, and/or draw water from a specific depth.

Berm means the raised area around a mound or around a lagoon.

Below-grade means a soil treatment area designed and installed such that the infiltrative surface and most of the sidewall are below the original ground elevation.

Biochemical oxygen demand (BOD) means the amount of oxygen required by bacteria while stabilizing, digesting, or treating wastewater under aerobic conditions. It is an indirect measure of the amount of organic matter in wastewater and a measure of the relative strength of wastewater expressed in mg/L.

Biochemical oxygen demand, five-day (BOD5) means a measure of the amount of oxygen consumed by bacteria while stabilizing, digesting, or treating organic matter under aerobic conditions over a five-day incubation period. It is expressed in milligrams per liter (mg/L).

Biochemical oxygen demand, five-day carbonaceous (cBOD5) means a measure of the amount of oxygen consumed by bacteria while stabilizing, digesting, or treating the organic matter under aerobic conditions over a five-day incubation period while in the presence of a chemical inhibitor to block nitrification. cBOD5 is expressed in milligrams per liter (mg/L).

Blocky means soil structural units typically with six faces that are roughly the same size. Edges and faces may be sharp and distinct or mainly rounded.

Boot means a flexible device attached to piping to provide a watertight seal.

Building means any structure used or intended for supporting or sheltering any use or occupancy.

Building drain means the horizontal piping including any vertical offset that conducts sewage, clear-water waste or storm water in a building to a building sewer.

Building sewer means a pipe connected to a building drain starting 1 m (3.25 ft) outside a wall of a building and that leads to a public sewer or private sewage system.

Cation means a positively charged ion.

Certified means tested by a nationally recognized testing agency and Certified as conforming to a National Standard of Canada or other Standard recognized by the Administrator.

Chamber means a pre-formed manufactured distribution medium with an open-bottom configuration commonly used in soil treatment areas.

Clay means a type of soil where the particles are <0.002 mm in equivalent diameter.

Cleanout means a device designed to provide access for removal of deposited or accumulated materials, generally from a pipe.

Clear-water waste means waste water with impurity levels that will not be harmful to health and may include cooling water and condensate drainage from refrigeration and air conditioning equipment and cooled condensate from steam heating systems, but does not include storm water. For the purposes of this guide, clear-water waste also includes discharge water from water softening devices and reverse osmosis water treatment systems.

Coarse-fragment means mineral particles in the soil that exceed 2.00 mm in diameter.

COLE (coefficient of linear extensibility) means the percentage decrease in the length of a bar of soil formed from a disturbed soil sample at its liquid limit (saturation limit) after being dried in an oven.

Colour means the apparent colour of a soil and is typically defined using the Munsell System of Color Notation that defines colours based on hue, value and chroma.

Compaction means the rearrangement of soil grain particles that decrease void space and result in the degradation of soil structure and/or water infiltrative capacity.

Conforming means the process of ensuring that a material, appliance, system or equipment meets the performance requirements of this guide and may be accomplished by testing, certification, registration, evaluation, and qualification. Demonstration of conformance requires the submittal of information suitable to each local authority.

Consistence means an attribute of soil expressed in degree of cohesion and adhesion or in resistance to deformation or rupture. Consistence includes the resistance of soil material to rupture, resistance to penetration, the plasticity, toughness, or stickiness of puddled soil material, and the way the soil material behaves when subjected to compression. Soil consistence can be described under three standard moisture conditions: dry, moist, or wet. Classifications of dry soil consistence include loose, soft, slightly hard, hard, very hard, extremely hard, and rigid. Classifications of moist soil consistence include loose, very friable, friable, firm, very firm and extremely firm. Classifications of wet soil consistence are based on plasticity and stickiness.

Control panel means a component that contains electrical devices that provide information on system operation and may allow adjustment of settings for operation of electrical devices.

Daylight means to come to grade, as with drainage piping.

Diameter, unless otherwise indicated, means the nominal diameter by which a pipe, fitting, trap or other item is commercially designated.

Design means the process of selecting, sizing, locating, specifying, and configuring treatment train components that match site characteristics and facility use as well as creating the associated written documentation of size, location, specification and configuration of a system.

Designer means a service provider who creates plans for the installation, alteration, extension, or repair of a wastewater treatment system.

Disinfection means a process used to destroy or inactivate pathogenic microorganisms in wastewater to render them non-infectious.

Dissolved oxygen (DO) means the amount of molecular oxygen (O₂) dissolved in water, wastewater, or other liquid. It is commonly expressed as a concentration in milligrams per liter (mg/L), parts per million (ppm), or percent of saturation.

Distribution box (D-box) means a level, watertight structure that receives septic tank effluent and distributes it via gravity in approximately equal portions to two or more trenches or two or more laterals in a bed.

Distribution header means a non-perforated pipe connected to an effluent line from a septic tank which distributes effluent to distribution laterals, gravity or weeping lateral pipes or gravity weeping lateral trenches.

Distribution lateral pipe means a perforated pressurized pipe used to distribute effluent throughout the entire length of a trench or over a surface area in a sand filter or mound.

Dosing, demand means a configuration in which a specific volume of effluent is delivered to a component based upon patterns of wastewater generation from the source.

Dosing, timed means a configuration in which a specific volume of effluent is delivered to a component based upon a prescribed interval, regardless of facility water use.

Dosing event means an occurrence of effluent delivery after a rest period.

Down-gradient means the direction water flows by gravity or a location down-slope.

Drain, interceptor means a subsurface drain used to intercept and divert laterally moving groundwater or perched water away from the soil treatment area or other system component to an effective outlet.

Drain, perimeter means a subsurface drain installed around and outside of an individual soil treatment area or zone and designed to actively or passively lower the water table.

Drain media (as used in a sand filter) means clean washed gravel, clean crushed rock, or other media for distributing effluent.

Drop box means a device used for serial or sequential distribution of effluent by gravity flow to a lateral of a final treatment and dispersal component.

Dwelling means a suite operated as a housekeeping unit used, or intended to be used, as a domicile by one or more persons and usually contains cooking, eating, living, sleeping and sanitary facilities.

DWV pipe means a class of piping certified for use in plumbing systems as drain, waste, and venting piping.

Effective size means the particle diameter of which 10 percent of the sample is finer by weight as determined by a sieve analysis. This is also known as D₁₀.

Effluent means the discharge from any on-site sewage treatment component.

Effluent sewer means piping for the flow of effluent through the action of gravity.

Equivalent dwelling units (EDUs) are units of measure that standardize all land use types (housing, retail, office, etc.) to the level of demand created by one single family dwelling.

Expansive soil means soil that undergoes significant volume change upon wetting and drying, usually because of a high content of expansive clay minerals.

Field capacity means the amount of water in a soil after drainage due to gravity following a thorough wetting event.

Field header means a main gravity lateral pipe that also distributes effluent to other gravity lateral pipes in a level disposal field.

Filter fabric means a synthetic woven or spun-bonded sheet material used to impede or prevent the movement of sand, silt and clay into the spaces between larger media but does not impede the movement of air or water.

Fines means silt or smaller soil particles which would pass through a 200 sieve, or are less than 80 microns in particle size.

FOG (fats, oils, and grease) means a constituent of sewage typically originating from foodstuffs (animal fats or vegetable oils) or consisting of compounds of alcohol or glycerol with fatty acids (soaps and lotions), typically measured in mg/L.

Float means a sensor installed in a pump vault or tank which opens or closes an electrical circuit in response to changing liquid levels, thereby controlling equipment operation.

Flow splitter means a device used to divide effluent and direct flow to multiple components.

Freeboard means the vertical distance between the normal maximum level of the water surface in a lagoon and the top of the sides of the berm, which is provided so that waves and other movements of the liquid will not overtop the berms.

Gleyed means a characteristic of a soil that has undergone gleysation, a soil-forming process that occurs under poor drainage conditions and results in redoximorphic features (the reduction of iron and other elements and in bluish, greenish or gray soil colours, and/or rust or gray coloured mottles). It is indicative of soils that are saturated or waterlogged for significant periods of time, which limits the suitability of soil for a soil treatment field.

Greywater means water captured from non-food preparation sinks, showers, baths, spa baths, clothes washing machines, and laundry tubs.

Gradient means the slope, or rate of ascent or descent.

Groundwater means water beneath the surface of land.

Groundwater mounding means the localized increase in the elevation of a water table that results from the downward percolation of additional liquid toward groundwater.

Head means energy, either velocity or potential, possessed by each unit weight of a liquid, expressed as the vertical height through which a unit weight would have to fall to release the average energy possessed; used in various compound terms such as pressure head, elevation head, velocity head, and friction head; typically measured in feet or meters of liquid.

Head, total dynamic (TDH) is a measure of the cumulative energy that a pump must impart to a liquid to move it from one point to another, consisting of the sum of friction head (as based upon piping diameter, system configuration, and flow rate) and static head (the sum of elevation head and operating pressure).

Head loss means the change in pressure between two points in an operating system as a result of friction and/or a change in elevation.

High water level means the highest water level or mark of historical record or as may be determined by the local health authority.

Hydraulic conductivity (soil) means the ability of the soil to transmit water in liquid form through pores.

Hydraulic loading rate (HLR) means the speed with which a specific volume of wastewater can be applied to the infiltration surface area (soil) per unit of time. This rate is typically expressed in imp. gal/day/ft² or L/day/m² and is dependent on the soil characteristics of the infiltrative surface.

Impermeable means not permitting the passage of fluid through pores; in practical terms, some small level of hydraulic conductivity may occur, but at so low a level (e.g., 1×10^{-7} cm/s) that it is considered to be negligible.

In situ means in the natural and original position.

Infiltration means the entry of water or effluent into the soil or an undesirable inflow or seepage of water into a system component; for example, infiltration of surface water into a tank through a leaking pipe, pipe penetration, or through an access riser/tank seam that is not water-tight.

Infiltration distance means the depth of suitable in situ soil below the native soil infiltration surface to the restrictive layer.

Infiltration surface means the soil medium (i.e. sand, native soil) that wastewater effluent is applied to in an onsite wastewater system.

Infiltrative surface edge is defined as follows:

- The wall of an infiltration trench.
- For sand mounds, the edge of an infiltration bed.
- For an LFH At-Grade system, the edge of the required basal area.
- For a lagoon, the edge of the maximum water level (the inside top of the berm).

Influent means liquid entering a component or device.

Inspection port means an access point in a system component that enables inspection, operation and maintenance.

Installer means a service provider compensated to construct a wastewater treatment system.

LFH At-Grade means a private sewage works that uses the three layers of organic material resulting from the breakdown of leaf and other organic matter (LFH horizon – Litter, Fermented, Humic) that is present in forested areas to disperse and treat the effluent.

L (Litter) - Structure of organic material (needles, leaves, twigs) are recognizable (litter layer).

F (Fermented) - The accumulated organic material is partly decomposed (fermented layer).

H (Humic) - The original structures of the organic material are unrecognizable (humus layer).

Landscape position means the specific geomorphic component of the landscape in which a site is located; two-dimensional landscape positions may be summit, shoulder, backslope, sideslope, footslope, or toeslope; three dimensional views of geomorphic landscape position can be described as headslope, noseslope, sideslope, base slope, etc.

Lagoon means a constructed basin lined with either soils with very low permeability or a synthetic material, surrounded with berms and which contains at least 1.2 m of wastewater which utilizes sunlight, wind or mechanical aeration, and natural bacteria to break down waste via physical, chemical, and biological processes.

Lateral means a pipe, tubing or other conveyance used to carry and distribute effluent.

Lateral volume means the amount of liquid required to fill a lateral.

Lift station means a structure containing relatively large pumps and associated piping, valves, and other mechanical and electrical equipment for pumping liquid.

Limiting condition means a soil or site characteristics that reduces the efficiency of wastewater treatment including a soil layer (i.e limiting layer) that significantly reduces the ability of wastewater to move through the soil.

Linear loading rate means the volume of wastewater effluent applied to the soil below the infiltrative surface expressed in gal/day/ft or litres/day/meter and which moves through the soil in a manner

typical of subsurface water flow, often oriented horizontally and affected by slope and other site and soil conditions.

Local Authority means the local authority appointed pursuant to section 6 of *The Public Health Act, 1994* for the purposes of enforcing *The Private Sewage Regulations*.

Maximum Occupancy means the maximum design occupancy of a facility.

Manifold means a pipe or assembly of pipes and fittings with one or more inlets and outlets that is used for portioning and distributing wastewater into a soil treatment field.

Media means a solid material that can be described by shape, dimensions, surface area, void space, and application.

Media, distribution means media used to provide void space through which effluent flows and is stored prior to infiltration.

Media, treatment means non- or slowly-degradable media used for physical, chemical, and/or biological treatment in a wastewater treatment component.

Moisture means the quantity of water contained in a material reported as dry, moist or wet.

Mottling means a soil zone or chemical oxidation and reduction activity, appearing as splotchy patches of red, brown, orange or grey in the soil, that may indicate the presence of a water table.

NSF Standard 40 means National Sanitation Foundation (NSF) standard applied to certain residential wastewater treatment systems having rated capacities between 400 gallons (1,514 Liters) and 1,500 gallons (5,978 Liters) per day.

NSF Standard 46 means National Sanitation Foundation (NSF) standard applied to filtration devices for residential gravity flow septic tanks (effluent screens).

Nominally level means level, so as to not affect the performance of the system.

Non-woven filter fabric means a fabric having a unit weight of at least 3.0 oz./yd² (per ASTM D-5261), a permittivity of at least 1.0 sec-1 (per ASTM D-4491), a trapezoid tear strength of at least 35 lbs. (per ASTM D-4533), and have a mesh size equal to U.S. Sieve No. 70 (A.O.S.)(ASTM D-4751).

On-site means on the property.

Onsite Wastewater Treatment System means a private sewage works (as defined in *The Private Sewage Works Regulations*) that discharges effluent to a soil-based treatment component.

Organic layer means nonliving organic material and microscopic organisms associated with it.

Organic loading rate (to infiltrative surface) means the rate of application of soluble and particulate organic matter. It is typically expressed on an area basis as grams of BOD₅ per square meter per day (g/m²/day) or pounds of BOD₅ per square foot per day (lbs/ft²/day).

Orifice shield means a part or device used to protect an orifice from external blockage.

Package treatment plant means a manufactured unit that is used to substantially improve the effluent quality beyond the quality of effluent expected of a septic tank.

Particle size distribution means the relative amounts or proportions based on size, of various inorganic separates in a sample, often expressed as mass percentages.

Percolation test means a test performed to determine a rate at which soil will absorb water.

Permit means permission or authorization in writing by the local authority to perform work regulated by *The Private Sewage Works Regulations*.

Plan view means a view from above; also known as bird's-eye or aerial view.

Plans means drawings showing locations and details of a system and its components, specifications, and other information as needed for bidding, staging, installation, inspection, and operation and maintenance of a system.

Plastic limit means the moisture content at which soil can be rolled into 1/8 inch diameter wire without breaking; represents the soil moisture content above which manipulation will cause compaction or smearing. It is measured by ASTM Standard Test Method ASTM D4318 (2005).

Plasticity means the degree to which a soil can be molded or deformed continuously and permanently using relatively moderate pressure without appreciable volume change or rupture; or Soil consistence term defined under wet conditions.

Potable means safe for human consumption.

Pressure head means the pressure existing in a fluid expressed as the height of a column of water that would exert an equal pressure.

Primary effluent means effluent discharged from the second (effluent) compartment of a septic tank and has a quality that shall 80% of the time have a $cBOD_5$ concentration less than 150mg/L, Total Suspended Solids less than 100mg/L, and an oil and grease content less than 15mg/L.

Prismatic means a soil structure where the vertical axis more prominent resulting in a pillar-like shape with a flat or level top of the columnar structure.

Private sewage works means a privately owned sewage works, other than a pit privy or seepage pit, located on one property that is:

- (i) intended to be used for the collection, storage, transmission, treatment or disposal of sewage, effluent or both that does not contain industrial waste; and
- (ii) exempt from the requirement to have a permit pursuant to section 21 of *The Environmental Management and Protection Act, 2002* or successor legislation

but doesn't include the building drain or sanitary drainage system upstream of the building drain.

Professional Engineer means a person licensed to practice professional engineering or professional geoscience pursuant to *The Engineering and Geoscience Professions Act*.

Property means land described in a Certificate of Title issued under *The Land Titles Act, 2000*.

Privy means a small building having a toilet pedestal or bench with a hole or holes, through which human excretion falls into an excavated pit or waterproof vault.

Recreational area means:

- (i) a camp ground, institutional camp or tourist camp; or
- (ii) a regional park; or
- (iii) a provincial park; or
- (iv) a commercial facility for the accommodation of persons intending to ski, fish, or swim, or be engaged in other recreational activities while being so accommodated; or
- (v) a building or buildings being used or intended to be used for recreational purposes whether on a private or commercial basis and includes any such building whether occupied on a permanent or part-time basis.

Redoximorphic means a soil feature such as mottling where colour patterns result from the oxidation or reduction of elements such as iron and manganese. This is typically the result of saturated soil conditions and can be indicative of the depth of seasonally high water table.

Reserve area means an area of land with demonstrated capacity for use as a final treatment and dispersal component upon which no permanent structure should be constructed and which is intended for replacement of the original system if needed.

Residential unit means a unit of measure equivalent to an EDU.

Residential strength sewage means sewage which has a BOD₅ of less than 300 mg/L, T.S.S. of less than 350 mg/L, and oil and grease content of less than 25 mg/L.

Restrictive layer means a soil layer or site condition that restricts the vertical movement of water, air and the growth of plant roots. Examples of a restrictive layer include hardpan, some compacted soils, bedrock, glacial till, unstructured clay soils, soils with a consistency stronger than Firm (moist), or harder than Moderately Hard (dry) and saturated soils (ground water table).

Sand (when referring to a treatment or disposal component) means a soil texture composed of soil particulate between 0.05mm to 2mm and defined for use in the component.

Sand layer (when referring to a Type II mound) means the required 300 mm (1 ft) layer of sand that will receive the effluent from a gravel bed or chambers above the sand layer.

Saturated soil means a soil where voids are filled with water. Saturation does not require flow.

Scarify means the process of abrading or scratching the infiltrative surface prior to installation of a final treatment and dispersal component.

Scum means a layer of floating material on a liquid surface.

Secondary effluent means effluent discharged from a package treatment plant that at least 80% of the time has a strength of 25 mg/L of cBOD₅ or less, 30 mg/L of TSS or less, and 10 mg/L of oil and grease or less.

Secondary effluent with disinfection means certified to achieve Secondary Effluent and Level 3-DII effluent quality as defined by NSF 40.

Setback means the minimum horizontal separation distance between system components and site/facility features.

Serial distribution means a disposal field design where discharged effluent is forced to travel through one weeping or gravity lateral trench to get to another weeping or gravity lateral trench.

Sewage means any liquid waste other than clear-water waste or storm water. For the purposes of this Guide, sewage is the composite liquid and water-carried wastes associated with the use of water for cooking, cleaning, washing, hygiene, sanitation or other domestic purposes; includes greywater but does not include liquid waste from industrial processes.

Shore means the edge of a body of water and includes the land adjacent to a body of water that has been covered so long by water as to wrest it from vegetation or as to mark a distinct character on the vegetation where it extends into the water or on the soil itself.

Silt means mineral particles that range in diameter from 0.002mm to 0.05mm.

Site evaluation means a comprehensive analysis of soil and site conditions for a given land use.

Size unless otherwise indicated means the nominal size by which a pipe, fitting, trap or other item is commercially designated.

Smectitic soil means a soil that has characteristics significantly influenced by smectite clays, which are a group of 2:1 layer silicates with high cation exchange capacity and variable interlayer spacing.

Sodium adsorption ratio (SAR) means a ratio of sodium, calcium and magnesium that is used to express the relative activity of sodium ions in exchange reactions with the soil. Effluent having a high SAR leads to breakdown in the physical structure of the soil in smectitic soils.

Soil means an unconsolidated mineral and/or organic material on the immediate surface of the earth that serves as a medium for the growth of plants; or an unconsolidated mineral or organic matter on the surface of the earth that has been subjected to and shows effects of pedogenic and environmental factors of climate (including water and temperature effects), and macro- and microorganisms, conditioned by relief, acting on parent material over a period of time.

Soil colour means the colour features of a soil that indicate soil formation processes and conditions such as the level of aeration typically defined using the Munsell Colour System.

Soil horizon means a layer of soil or soil material approximately parallel to the land surface and differing from adjacent related layers in physical, chemical, and biological properties or characteristics such as color, structure, texture, consistence, kinds and number of organisms present, degree of acidity or alkalinity, etc.

Soil infiltrative surface means the surface of soil receiving effluent for final treatment but doesn't include the infiltration surface of an engineered media or soil intended to improve the quality of effluent prior to infiltration into the soil for final treatment (i.e. sand layer in a mound). Native in-situ soil infiltration surface is the surface of native in place and undisturbed soil receiving effluent.

Soil morphology means the physical constitution of a soil profile as exhibited by the kinds, thickness, and arrangement of the horizons in the profile; and by the texture, structure, consistence, and porosity of each horizon; or the visible characteristics of the soil or its parts.

Soil profile means a vertical section of the soil through all its horizons and extending into the parent material.

Soil texture means the percent of sand, silt and clay in the fine earth ($\leq 2\text{mm}$) fraction and reported as one of the following classes:

- COS – Coarse Sand
- LVFS – Loamy Very Fine Sand
- MS – Medium Sand
- S – Sand
- COSL – Coarse Sandy Loam
- LCOS – Loamy Coarse Sand
- SL – Sandy Loam
- LS – Loamy Sand
- FSL – Fine Sandy Loam
- SI – Silt
- SCL – Sandy Clay Loam
- CL – Clay Loam
- SICL – Silty Clay Loam
- SC – Sandy Clay
- C – Clay
- SIC – Silty Clay
- FS – Fine Sand
- VFSL – Very Fine Sandy Loam
- LFS – Loamy Fine Sand
- L – Loam
- VFS – Very Fine Sand
- SIL – Silt Loam
- HC – Heavy Clay

Soil structure means the aggregation of sand, silt and clay into aggregates that are cemented together and called peds. Soil structure is described using shape and grade.

Soil structure shape is reported as one of:

- PL – Platy: Flat plate-like units
- PR – Prismatic: Vertically elongated units with flat tops
- BK – Blocky: Polyhedrals with faces that intersect at sharp angles (angular blocky) or with subrounded and planar faces lacking sharp angles (subangular blocky)
- GR – Granular : Small polyhedrals with curved or very irregular faces
- M – Massive: No structural units and the material is a coherent mass
- SG – Single Grain: No structural units and the material is noncoherent (e.g. sand)
- COL – Columnar: Vertically elongated units with rounded tops that are commonly bleached.

Soil structure grade is reported as one of:

- 0 – Structureless: No discrete units observable in place or in hand sample.
- 1 – Weak: Units are barely observable in place or in a hand sample.
- 2 – Moderate: Units well-formed and evident in place or in a hand sample.
- 3 – Strong: Units are distinct in place and separate cleanly when disturbed.

Soil treatment field means the physical location and area where the dispersal of effluent into the soil and final treatment of the effluent in the soil occurs.

Storm water means water discharged from a surface as a result of rainfall or snowfall.

Swale means a shallow trench or constructed ditch that diverts surface draining around a system.

Tank means a watertight structure or container to hold wastewater for aeration, equalization, holding, sedimentation, treatment, mixing, dilution, addition of chemicals, or disinfection.

Tank, dosing means a tank or compartment which provides storage of effluent and contains a device (pump or siphon) and associated appurtenances used to convey effluent to another pretreatment process or a final treatment and dispersal component.

Tank, septic means a water-tight, covered receptacle that receives the discharge of sewage from a building, separates settleable and floating solids from the liquid, digests organic matter by anaerobic bacterial action, stores digested solids through a period of detention, allows clarified liquids to discharge for additional treatment and final dispersal, and attenuates flows.

Topography means the physical features of the land surface including elevations and geometry.

Total suspended solids (T.S.S.) means the quantity of solids (expressed as mg/L) which can be readily removed from a well-mixed sample with standard laboratory filtering procedures.

Uniformity coefficient means the description or specification of particle size distribution calculated by dividing the diameter of particle (millimeters) of which 60% by weight is smaller, by the diameter of particle (millimeters) of which 10% by weight is smaller; expressed mathematically as D60/D10.

Unsaturated flow means the movement of water in a porous soil or media that is not filled to capacity with water; the water flow is along the surface of the particles, allowing air and gases to move through the interior of the larger pore space.

Unsaturated soil means the soil in which the pore spaces contain water at less than atmospheric pressure; typically, smaller pore spaces contain water because of tension and larger pore spaces contain air and other gases.

Vadose zone means the depth of soil from the top of the ground surface, in which soil water has a pressure head less than atmospheric pressure and is retained by a combination of adhesion and capillary action, to the depth at which soil water is at atmospheric pressure.

Vertical separation means the depth of unsaturated soil measure from the infiltration surface to a restrictive layer such as a water table or impervious layer of rock or soil.

Wastewater means sewage.

Water course means:

- (a) a river, stream, lake, creek, swamp, marsh or other natural body of water marked by the shore; or,
- (b) a canal, reservoir or other manmade surface feature intended to contain water for a specified use, whether it contains or conveys water continuously or intermittently.

Water table means the highest elevation in the soil where all voids are filled with water, as evidenced by the presence of water, soil mottling, or other indicators.

Weeping lateral pipe means the perforated pipe used to distribute effluent by gravity within a disposal field trench. Also called a gravity lateral pipe.

Weeping lateral trench means a trench in a disposal field that receives effluent and provides an infiltrative soil surface.

Working capacity means that part of the septic tank in which the liquid volume of sewage that will remain in the septic chamber when the tank is properly installed and in normal use, but does not include the air space, siphon chamber, pumping chamber or effluent chamber or the space used by sludge and scum.

Note: Annexes are designated normative (mandatory) or informative (nonmandatory) to define their application.

2 INTRODUCTION

The Saskatchewan Onsite Wastewater Disposal Guide has been developed with the assistance of inspection agencies and industry who have expertise in the field of wastewater disposal or treatment. This guide replaces the Saskatchewan Private Sewage Disposal Guide, 1995 and previous editions of the current Guide. The intent is to provide regulators and installers with basic design and installation information for private sewage works that are regulated by *The Private Sewage Works Regulations*.

A private sewage works may only be constructed under the authority of a permit issued by the local authority pursuant to the regulations. Anyone planning on constructing, installing, altering, or renovating a private sewage works must contact their local Saskatchewan Health Authority Public Health Inspection office. Contact information can be found online at:

<http://www.saskatchewan.ca/residents/health/public-health/public-health-inspectors>

2.1 DISCLAIMER

This Guide was prepared to assist persons wishing to construct and install a private sewage works. It is merely an illustrative and explanatory tool intended to provide a basic understanding of the regulatory framework in Saskatchewan respecting onsite wastewater systems and some basic information on the various systems. It is not intended as nor is it a substitute for technical or engineering advice and assistance, nor for individual assessment of things such as appropriate design; climatic conditions; effluent quality; wastewater flows and volumes; construction and installation requirements; and soil characteristics. Adjustments to separation distances and loading calculations may be required to reflect physical constraints, land area, soil, weather and any other environmental conditions.

This is not a permit and the information contained herein does not override, substitute or replace the requirements of *The Private Sewage Works Regulations* and all other applicable federal and provincial legislation and municipal bylaws.

The user of this Guide waives and discharges the authors of this Guide including the Government of Saskatchewan, the Saskatchewan Health Authority (SHA) and its respective employees, officers and agents from any claim they may have based upon use or reliance on this Guide. Notwithstanding the issuance of a permit, the approval of plans or specifications, approval or inspection or any other act of the local authority, the permit holder of the private sewage system is responsible to ensure that all work undertaken complies with the requirements of *The Public Health Act, 1994* and its regulations; manufacturer's requirements; and is completed in a manner that does not cause an unacceptable impact on the environment or human health.

2.2 ACKNOWLEDGMENTS

The Saskatchewan Onsite Wastewater Disposal Guide Committee would like to acknowledge the following agencies/departments for the use of their reference material and for contributing to the development of this guide:

- Saskatchewan Ministry of Health
- Saskatchewan Health Authority
- Saskatchewan Onsite Wastewater Management Association
- Seeley Engineering and Consulting Inc.

Development of this version of the Saskatchewan Onsite Wastewater Disposal Guide relied heavily on:

- CIDWT Decentralized Wastewater Glossary. Available online at: <http://www.onsiteconsortium.org/glossary.html>.
- CIDWT. 2009. Installation of Wastewater Treatment Systems. Consortium of Institutes for Decentralized Wastewater Treatment. Iowa State University, Midwest Plan Service. Ames, IA.
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- Manitoba Sustainable Development. Onsite Wastewater Management System Program website. Accessed from <http://www.gov.mb.ca/sd/envprograms/wastewater/>.
- Michigan Department of Environmental Quality, Water Division, Land Division and Local Health Department Support Program. 2003. Pressure Mound Systems Technical Guidance for Site Suitability, Design, Construction and Operation and Maintenance.
- Nova Scotia, Ministry of Environment. 2017 On-Site Sewage Disposal Systems Standard.
- Office of Water, Office of Research and Development, U.S. Environmental Protection Agency. 2002. EPA/625/R-00/008 Onsite Wastewater Treatment Systems Manual.

2.3 SPECIAL ACKNOWLEDGMENTS

Special thanks to the Alberta Safety Codes Council and Alberta Municipal Affairs for their permission to use portions of the Alberta Private Sewage Systems Standard of Practice documents when developing this guide. The Saskatchewan Onsite Wastewater Disposal Guide Third Edition 2018 is a Ministry of Health document intended to be used by stakeholders in the onsite wastewater industry. The document is available for free download and printing on the Ministry of Health's website <http://www.saskatchewan.ca/residents/environment-public-health-and-safety/environmental-health/plumbing-sewage>. Re-printing of the guide is permitted provided that the Ministry of Health's visual identity aspects remain and the content is unchanged.

Cover photo showing the construction of a Type II Mound courtesy of the Saskatchewan Onsite Wastewater Management Association.

For more information, please contact your local Saskatchewan Health Authority office. <http://www.saskatchewan.ca/residents/health/public-health/public-health-inspectors>

3 GOALS & OBJECTIVES

The contents of the Saskatchewan Onsite Wastewater Disposal Guide were developed with the intent of meeting the following goals and objectives:

- Goal 1:** The objective of this guide is to provide information on the design and installation of private sewage systems to help:
- a. Minimize impacts on ground water and surface water;
 - b. Protect the environment;
 - c. Support health protection;
 - d. Protect recreational areas and recreational water quality;
 - e. Minimize nuisance, unsightliness, and unpleasant odours;
 - f. Prevent fly and mosquito breeding; and,
 - g. Exclude rodents and other animals.
- Goal 2:** This guide was developed to:
- a. Implement risk management approaches; and,
 - b. Provide acceptable designs.
- Goal 3:** The guide includes requirements and recommendations that are:
- a. Supported by science and evidence; or,
 - b. Generally consistent with standard practice in North America.
- Goal 4:** Properly designed, installed, and maintained private sewage systems are intended to be an economical long-term solution. Therefore, the guide incorporates:
- a. Design and documentation standards to support full record of the system design and specifications; and,
 - b. Features and equipment that facilitate maintenance and monitoring of systems.

4 OTHER REGULATIONS/BYLAWS

4.1 THE SHORELAND POLLUTION CONTROL REGULATIONS, 1976

(These regulations are currently under review. Please contact the local authority for information on any updates to these regulations.)

Parcels of property located within a shoreland development area must comply with sewage disposal restrictions outlined under *The Shoreland Pollution Control Regulations, 1976* (Table 1 in *The Shoreland Pollution Control Regulations, 1976*).

Shoreland Development Area is an area of land:

- designated as a reservoir development area by regulations made under *The Water Resources Management Act, 1972* (now known as *The Saskatchewan Watershed Authority Act, 2005*); or
- that is within 457 m (1500 ft) from the high water mark level of a lake, river, stream or other body of water and upon which is situated an urban municipality or, a summer resort or, is established as a recreation area.

The Shoreland Pollution Control Regulations, 1976 allow for other disposal methods (i.e. privy pits, grey water seepage pits) in certain circumstances. Additionally, the regulations contain specific requirements for setback distances from the high water level. For more information, contact your local authority and/or consult the regulations available online at www.publications.gov.sk.ca.

4.2 BYLAWS

Permits granted under *The Private Sewage Works Regulations* only provide lawful authority to establish, construct, extend, renovate, alter or repair a private sewage works, as the case may be, pursuant to *The Private Sewage Works Regulations*. The permit does not displace or override other legislative requirements or restrictions, which may exist pursuant to applicable federal or provincial legislation, or municipal bylaw. For example, municipal bylaws may be more restrictive than provincial laws. Installers of private sewage works should check with the local municipality to determine if any such bylaw is in effect.

5 PRIVATE SEWAGE WORKS IN SENSITIVE AREAS

Multiple private sewage works constructed within a localized area can have a cumulative impact on local groundwater supplies, typically in the form of increased nitrate concentrations. It is important to consider these cumulative impacts in developments that largely, or fully, utilize private sewage works as a method of sewage disposal. The density of development within an area, along with the sensitivity of the location as described below, limit the types of private sewage works that can be installed.

5.1 DESCRIPTION OF SENSITIVE AREAS

The overall goal of this manual is to protect human health and the environment. This section describes the sewage disposal restrictions and options that apply to various types of locations. Both the density of a development and the characteristics of the development's location, affect the types of private sewage works that can be constructed.

Private sewage works regulations and guidelines are intended to minimize the impact of sewage effluent on water supplies, communities, and neighbours. In areas far removed from communities, water supplies, and neighbours, the risk of contamination or nuisance creation is low. These are considered low sensitivity areas and sewage disposal requirements are less rigorous than they are in more sensitive areas. It should be noted that sewage holding tanks are acceptable in any area and may be installed by non-certified contractors. In areas where *The Shoreland Pollution Control Regulations, 1976* apply or where municipal bylaws are in effect, the following guidance does not apply.

The local authority should be consulted for further clarification if there is uncertainty about a proposed private sewage works in a specific area.

After determining the location characteristics and density of the area, each applicant may be obliged to meet the requirements in Table 5-1. It should be noted that the requirements in Table 5-1 are a minimum and the designer and owner of the proposed system should consider the treatment capabilities of any proposed system alternatives. For example, gravity systems may be adequate for some locations however; pressure systems perform a higher degree of treatment for organic matter and microbes.

The proponent of the private sewage works must submit plans to the local authority for approval. See section 7 Administrative Requirements.

5.1.1 Location

Each application for a private sewage works is determined to be in one of the following two locations.

Adequate Location

An adequate location is all locations that are not considered sensitive.

Sensitive Location

Sensitive location means a location designated by the local authority to be a sensitive area due to:

1. The presence of coarse soils over an unconfined aquifer, that is of sufficient quality and quantity to be used as a drinking water source. The presence of high levels of aesthetic constituents should not be used to determine drinking water suitability.
2. The presence of subsurface water (seasonal or permanent), which is less than 1.5 meters (5 ft) below natural ground surface elevation.
3. Historical concerns with well water quality (in particular nitrate) believed to be due to human activities.
4. The existence of any other circumstances that, in the opinion of the local authority, causes the area to be in need of protection from activities that may cause an adverse effect to the area.

5.1.2 Density

The density of the surrounding development will be considered by the local authority when reviewing each application for a private sewage works. Though the discussion below mentions a ¼ section, this can be viewed as any continuous area ½ mile (800 m) by ½ mile (800 m). The average land size is determined by using the sizes of those lots subdivided from the existing piece of land.

The density of surrounding development, including future phases of proposed or existing developments, may affect the approval of a private sewage works as determined by the local authority. This determination is based on, but not limited to, considerations including existing knowledge of the surrounding area, consultations with the local municipality, and records of subdivision approvals/final development plans.

Low Density Area

All subdivisions are considered low density where:

1. Less than 5 existing or proposed residential units are located on a ¼ section; **or**
2. The average land size associated with each existing or potential residential unit is greater than or equal to 4 hectares (10 acres), with no portion of land being smaller than 1 hectare (2.5 acres).

If a subdivision is not a low density development then compare its characteristics to the high density definition.

High Density Area

All subdivisions that are not low density are considered high density where:

1. 40 existing or proposed residential units or more on a ¼ section; **or**,
2. The average land size associated with each existing or potential residential units is less than 1 Ha (2.5 acres).

Medium Density Area

If a development is neither a low density development nor a high density development, it is considered a medium density area. In general, a medium density development is characterized by between 5 and 39 existing or potential residential units and/or smaller lot sizes.

5.2 PERMISSIBLE SOLUTIONS

Permissible solutions are listed in Table 5-1 – Acceptable Sewage Systems. Unless otherwise approved by the local authority, only the listed systems should be constructed on sites in a particular density and location. In the case of sensitive locations and high density developments, the assessment completed at the time of subdivision approval should determine the types of systems permissible. If an assessment is not available, the local authority may permit systems such as holding tanks, pressure absorption/chamber systems, type II mounds, lagoons (≥4 Ha only), and package treatment plants with disposal. In every situation, the proponent of the private sewage works must submit plans to the local authority for approval.

Table 5-1 - Acceptable Private Sewage Systems

| | | Location | |
|---------|--|---|--|
| | | Adequate | Sensitive |
| Density | Low <5 residential units on ¼ section; or land sizes ≥ 4 Hectares (10 acres) with no lot < 1 Hectares (2.5 acres) on ¼ section. | Acceptable Systems ¹ Holding tanks, Pressure/Gravity absorption field systems, Type I and II mounds, Lagoons (≥4 Ha only), Package treatment plants with Disposal LFH At-Grade | Acceptable Systems Holding tanks, Pressure/Gravity absorption field systems, Type II mounds, Lagoons (≥4 Ha only), Package treatment plants with Disposal LFH At-Grade |
| | Medium All developments not considered to be high density or low density. (Generally, those locations with between 5 and 39 residential units and average lot sizes between 1 and 4 Ha.) | Acceptable Systems Holding tanks, Pressure/Gravity absorption field systems, Type I (except Alternative Type 1) and II mounds, Lagoons (≥4 Ha only), Package treatment plants with Disposal LFH At-Grade | Acceptable Systems Holding tanks, Pressure/Gravity absorption field systems, Type II mounds, Lagoons (≥4 Ha only), Package treatment plants with Disposal LFH At-Grade |
| | High 40 or more residential units on a ¼ section; or land size is < 1 Ha (2.5 acres) on ¼ section | Acceptable Systems Holding tanks, Pressure/Gravity absorption field systems, Type II mounds, Lagoons (≥4 Ha only), Package treatment plants with Disposal LFH At-Grade | Acceptable Systems As determined ² |

1 Jets are permitted in low density areas provided the land size is greater than 4 Ha (10 acres) and there is no other municipality³ within 1 km. Four existing or proposed jets may be installed within a rolling quarter section.

2 Acceptable private sewage works required for high density developments in sensitive locations are determined from the detailed assessment completed at the time of the subdivision approval. If no assessment is available, the local authority may permit systems such as holding tanks, pressure absorption systems, type II mounds, lagoons (≥4 Ha only), and package treatment plants with disposal. However, the local authority should be consulted to determine appropriate systems.

3 A municipality includes any city, town, village, organized hamlet, park subdivision or approved subdivision containing at least 2 parcels/lots.

6 SITE EVALUATION

Before constructing a private sewage works, the designer must complete a site evaluation. A site evaluation includes a site investigation and a soils investigation. A site investigation is required in all cases. A soil investigation is recommended in all cases but only required where a soil treatment field (i.e. mound, absorption field, etc.) is installed.

A soils investigation is required in order to determine whether the soils at this location will be suitable to sufficiently renovate effluent. A site assessment, soil investigation, and applicable system design worksheet shall be included with each permit application form and provide a complete summary of information required in this section. A sample site assessment and soils analysis form can be found in Annex 10 – Site Evaluation Report (Informative). The characteristics of each soil profile investigated should be described using the Canadian System of Soil Classification nomenclature.

As part of a site investigation, every lot where a private sewage works is proposed, should be examined separately to determine the proper design and installation of the system. The boundaries of the lot should be clearly and accurately flagged with survey tape.

The outcomes of the detailed site evaluation are to assist the designer or installer in determining the ability of the proposed system to be sited on the property, maintain proper setback distances, and to operate as designed.

Soil samples from the limiting layer in each test pit completed must be submitted for soil texture analysis to a recognized laboratory. The laboratory usually completes particle sizing by hydrometer. However, where a sand fraction modifier is used such as coarse, medium, fine or very fine sand, the laboratory must also complete a sand fraction size distribution. Percolation tests can be used in place of laboratory analysis to determine the hydraulic loading rates for a soil treatment field.

Designers/installers should note that percolation tests have a high degree of error and variability in results (see Annex 2 for more information).

6.1 REQUIREMENTS

6.1.1 Soils Investigation

- 1) A soils investigation shall include test pits at a minimum of two representative locations.
- 2) Test pits shall be:
 - a) Located near the proposed treatment area but not impacting on the infiltrative surface or likely drainage path of effluent.
 - b) At least 300 mm (12 in) deeper than the vertical separation distance required below the proposed soil treatment field.
- 3) The soils investigation in each test pit shall include:
 - a) a description of the location of the test pit;
 - b) a description of the soil profile, including:
 - i) each soil horizon with its texture, structure, moist consistence, percentage of coarse fragments and colour,
 - ii) zones of compaction,
 - iii) saturated zones and other soil moisture conditions,
 - iv) estimated high-level of seasonally saturated soils,
 - v) bedrock or near-impermeable soil layers, and
 - vi) restricting layers;

- c) a description of key features and their measured depths, including soil redoximorphic features (gleyed or mottled soil), roots, depth of each test pit and presence of any water; and
- 4) To assist in selecting a design hydraulic loading rate and linear loading rate either:
 - a) soil samples are to be collected at the limiting layer in each test pit for particle sizing and submitted to a recognized laboratory. (See Annex for information on test pits); or,
 - b) percolation tests are to be completed in accordance with Annex 2.

6.1.2 Site Investigation

- 1) A site investigation shall evaluate and note:
 - a) Lot boundaries, property size, and dimensions;
 - b) Springs, dugouts or wells accessing an unconfined aquifer providing water for domestic purposes within 800 m of the proposed system;
 - c) Private sewage works, any existing systems, and any reserve areas on the lot/subdivision;
 - d) Test pits, bore holes or percolation tests and GPS coordinates for each;
 - e) Proposed or existing septic tanks, services, break-outs/drains, trees and building structures;
 - f) Easements or rights-of-way;
 - g) Existing and proposed roads or driveways on the property;
 - h) Vegetation types that favours wet or saturated soils;
 - i) Vegetation that impacts the system selection or requires removal prior to system construction;
 - j) Swale, depressions and drainage features that may impact system selection;
 - k) Permanent or intermittent surface water within 100 m (330 ft) of the proposed system;
 - l) Rock outcrops within 50 m (165ft) of the proposed system;
 - m) Site topography including slope, slope type and slope location for the proposed disposal area;
 - n) The change in elevation between the location of the soil treatment field and the initial treatment component(s); and
 - o) Unsuitable (e.g. Large fills, steeply sloping areas, etc), disturbed or compacted areas (e.g. driveways, etc.).
- 2) A site drawing of each lot must be submitted and include:
 - a) All items noted in 6.1.2 Site Investigation
 - b) Set back distances from proposed or existing systems to all existing or proposed pertinent features such as wells, buildings, right of ways, etc.
 - c) GPS locations of all test pits.

Recommendation: A permit application should also include information for any stormwater management plan present on the lot or in the subdivision

7 ADMINISTRATIVE REQUIREMENTS

7.1 SEWAGE DISPOSAL IN SASKATCHEWAN

Private sewage works are installed where a plumbing system cannot be connected to a communal or municipal sewage works. In Saskatchewan, private sewage works are regulated by *The Private Sewage Works Regulations* in the case of small works (e.g. a works connected to a house or small tourist accommodation facility) or *The Waterworks and Sewage Works Regulations* in the case of a large works (e.g. a works that generates more than 18 m³ sewage flow per day).

The Private Sewage Works Regulations and this guide are intended to minimize the impact of sewage effluent on water supplies, communities, and neighbours. Most private sewage works are not just temporary installations that should be replaced eventually by centralized sewage treatment services, but permanent approaches to treating wastewater for release and reuse in the environment. Many private sewage works are recognized as potentially viable, low-cost, long-term, decentralized approaches to wastewater treatment if they are planned, designed, installed, operated, and maintained properly.

The Private Sewage Works Regulations apply to all private sewage works in the Province of Saskatchewan. Subsection 4(1) of this regulation states:

4(1) ... no person shall establish, install, construct, extend, renovate, alter or repair a private sewage works, except pursuant to the authority of a permit.

Applications for permits are made with the local authority and are to be accompanied by design specifics, location details and satisfactory evidence that the proposed private sewage works has been designed by a qualified person. For more information, see Section 6 Site Evaluation.

Note: As per subsection 5(1) of *The Private Sewage Works Regulations*, only a person recognized as qualified by the local authority is eligible to apply for a permit.

7.2 REQUIREMENTS

7.2.1 Site Evaluation Report

- 1) Each application to construct a private sewage works must be accompanied by a site evaluation report (see Annex 10 – Site Evaluation Report (Informative) for an example).
- 2) Soils investigations are not required for sewage holding tanks, septic tanks, jet-type disposal systems, and lagoons.
- 3) The site evaluation report shall be submitted by:
 - a) A qualified individual as determined by the local authority.
 - b) A professional engineer registered to practice in the province of Saskatchewan **or** a person considered qualified by the local authority to accurately determine sewage effluent strength and volumes, where the proposed private sewage works serves:
 - i) a non-residential facility,
 - ii) a facility that generates sewage with a composition that varies from an average residential dwelling (greater than the values in 8.1.1).
- 4) A site evaluation report shall include:
 - a) Site evaluation information including the date and time of the evaluation as well as weather conditions.
 - b) System Owner Information including the name, contact information, and location of the installation.
 - c) System Designer Information including the name of the designer and contact information.

- d) System Design Information including the proposed type of system, design peak wastewater flow, mass loading concentration for non-residential systems, property size, and proposed system size.
 - i) Sources of increased mass loading concentrations shall be identified.
 - e) Soils Investigation including all information indicated in 6.1.1 Soils Investigation and including test pit or bore hole logs.
 - f) Site and soils interpretations including an estimation of the depth to:
 - i) the water table on the date of the evaluation;
 - ii) the estimated seasonal high water table;
 - iii) the restrictive layer;
 - iv) the limiting layer; and,
 - v) The bottom of the organic layer, if present.
 - g) Site drawing as described in 6.1.2 Site Investigation.
 - h) Any other information necessary to justify or support the findings of the site evaluation.
- 5) A site evaluation report shall be completed to the satisfaction of the local authority.
- 6) A copy of the final site evaluation report shall be provided by the contractor to the homeowner.

7.2.2 Construction Drawing

- 1) In addition to the site drawing contained in the site investigation report, a final-build construction drawing shall be provided to the owner of the private sewage works.
- 2) The construction drawing may be hand drawn or computer generated however it must be legible and show system features with a level of detail adequate to construct the system, including:
 - a) plan view of the configuration including the location of all components within the property boundaries;
 - b) cross section drawings showing the planned elevations of the trenches and the sand media depth, if any;
 - c) detail drawings of the system that show the key features to the installer;
 - d) the location of all components, with horizontal separations shown on the drawing or as measurements; and
 - e) labels of system components.
- 3) The construction drawing shall be:
 - a) drawn to scale, with a scale bar and true north meridian; or
 - b) if not to scale show all relevant dimensions.
- 4) The construction drawing shall be labelled with a title and legal description of the property.
- 5) For residential systems, the construction drawing can be combined with the site drawing.
- 6) A copy of the final site construction drawing shall be provided by the contractor to the homeowner.

7.2.3 Operation and Maintenance Manual

- 1) Prior to putting the private sewage system into operation, an operations and maintenance manual shall be made available to the owner by the permit applicant including:
 - a) the capacity of the system;
 - b) the principles of operation;

- c) the construction details, including a site plan showing the specific as-built location and area occupied by the treatment components;
- d) pump capacity requirements, control settings, float elevations, and dosing volumes as applicable;
- e) all operating and maintenance requirements; and
- f) instructions on managing an alarm condition.

8 SEWAGE VOLUME AND QUALITY

The volume and quality (strength) of sewage influent and effluent are important considerations when designing a private sewage works. These considerations will ensure the private sewage works will be an effective long-term treatment option. Failure to design a system with accurate volume and quality information will reduce the life span of the system and can result in problems including, but not limited to, ponding of sewage on the ground surface and contamination of groundwater.

Any private sewage works, from holding tank to lagoon, must be sized according to expected sewage volumes. In most instances, sewage holding tanks must have a capacity of at least 1000 gallons; however, this may be insufficient for larger homes or businesses. Septic tanks also need to be sized according to the expected volume of sewage. If undersized, sewage effluent will pass through the septic tank chambers too quickly resulting in improper settling of solids. Excess solids that naturally accumulate in a tank over time can damage and drastically decrease the lifespan of soil-based treatment fields if not pumped out on a regular basis. For soil-based private sewage works, the volume of effluent entering the treatment field must not exceed the size of the system and capacity of soil to provide treatment. If too much sewage is applied, the soils may become saturated and the system can fail.

Careful consideration must be given to high capacity plumbing fixtures. Large bath tubs (Jacuzzi tubs, hydrotherapy tubs), multi-head showers, and garburators are examples of plumbing fixtures that can significantly increase the volume of sewage. The peak design flow needs to be increased when designing a private sewage works that receives effluent from these types of fixtures (see Requirements below). Average daily flow is also required to be calculated to determine dosing of sewage effluent in applicable system designs.

The strength of sewage affects the ability of soil based treatment systems to treat the effluent before it reaches groundwater and has an adverse effect on the soil itself. Sewage effluent that is stronger than typical residential sewage may result in more dissolved organic material and suspended solids entering the soil based treatment system. Dissolved organics may encourage excessive biomat formation and together with suspended solids will clog soil pores and rapidly reduce the life expectancy of the field. Increased sewage strength can also result in higher concentrations of nitrogen entering the soils that can lead to contamination of ground water supplies. For other types of systems like ejectors and lagoons, higher strength sewage can cause unpleasant odours. To reduce the strength of sewage, package treatment plants or other filtration options may be required.

8.1 REQUIREMENTS

8.1.1 Influent Quality

- 1) The influent shall have a wastewater strength that
 - a) 80% of the time does not exceed:
 - i) BOD₅ of 220 mg/L
 - ii) TSS of 220 mg/L, and
 - iii) Oil and grease content of 50 mg/L
 - b) Does not exceed maximum values of:
 - i) BOD₅ of 300 mg/L
 - ii) TSS of 350 mg/L, and
 - iii) Oil and grease content of 70 mg/L
- 2) Residential wastewater is assumed to have wastewater strength that conforms to the above.
- 3) Where a garburator is installed, a 30% increase in raw wastewater strength shall be assumed.

- 4) Where other non-residential wastewater is generated, such as that from a home-based business, the raw wastewater strength shall be increased.
- 5) If the wastewater strength is projected to exceed the values set out in Article 8.1.1.1, the system shall include additional treatment capacity either prior to or as part of downstream components.
- 6) If the development is non-residential, the projection of wastewater strength shall be determined by a professional engineer registered to practice in the province of Saskatchewan or a person considered qualified by the local authority to accurately determine sewage effluent strength and volumes.
- 7) The following types of waste water must be excluded from a private sewage works that uses a soil treatment field unless the design is stamped by a professional engineer:
 - a) Storm water;
 - b) Surface water;
 - c) Abattoir waste;
 - d) Subsurface seepage water (e.g. sump pit discharge);
 - e) Clearwater waste;
 - f) Water drained from pools/hot tubs;
 - g) Commercial or industrial process wastes;
 - h) Iron filter backwash; and,
 - i) Waste flow from water softeners and reverse osmosis filters.

8.1.2 Design Flows

- 1) Private sewage works shall be designed to accommodate peak daily sewage flows.
- 2) Peak daily flows shall be calculated as below except they shall be adjusted as indicated in [Article 5](#) below.
 - a) 341 L per person per day (75 imp.gal per person per day) at maximum occupancy for residential occupancies or,
 - b) Following good engineering practice for all other occupancies as indicated in Annex 1 – Expected Volume of Sewage per Day (Normative).
 - c) At least 1.5 times the mean metered flow mentioned in [Article 3](#) except where a larger factor should be used to accommodate increases in flow due to future changes in use or uncertainties.
- 3) Average daily flow values shall be calculated as below except they shall be adjusted as indicated in [Article 6](#):
 - a) 227 L per person per day (50 imp.gal per person per day) at maximum occupancy.
 - b) mean metered wastewater flow from:
 - i) the facility to be served based on at least 30 consecutive days of monitoring during the peak flow period of the year.
 - ii) A similar facility as that to be served based on at least 30 consecutive days of monitoring during the peak flow period of the year and adjusted to accommodate differences in the facility monitored versus that to be served.
- 4) Maximum occupancy shall be based on:
 - a) 2 people per bedroom for houses with 2 bedrooms or less and 1.5 persons per bedroom for 3 bedrooms or more; or,
 - b) An alternate occupancy agreed upon by the local authority.

- 5) The peak daily flow should be increased to accommodate flows from high-volume fixtures including but not limited to large capacity tubs, multi-head showers, and garburators.
 - a) Large capacity fill and drain tubs – the volume of the tub that is above the volume of a standard residential tub multiplied by the number of uses in a maximum day as determined by the designer.
 - b) High volume showers – the flow rate of the shower that is above the flow rate of a standard shower multiplied by the number of uses and duration of shower in a maximum day as determined by the designer.
 - c) Garburators – 5% increase in flow.
 - d) Water treatment devices - increase in flow to accommodate wastewater generated by the devices function.
 - e) Other high volume fixtures cause the flow to be increased by the expected usage in a maximum day as determined by the designer.
- 6) The average daily flow should be increased to accommodate flows from high-volume fixtures including but not limited to large capacity tubs, multi-head showers, garburators.
 - a) Large capacity tubs – the volume of the tub above the volume of a standard residential tub multiplied by the number of uses in a typical day as determined by the designer.
 - b) High volume showers – the flow rate of the shower that is above the flow rate of a standard shower multiplied by the number of uses and duration of shower in a typical day as determined by the designer.
 - c) Garburators – 5% increase in flow.
 - d) Water treatment devices – increase in flow to accommodate wastewater generated by the device function.
 - e) Other high volume fixtures cause the flow to be increased by the expected usage in a typical day as determined by the designer.
- 7) If the daily water use of a facility is expected to vary substantially between days of the week, the system may use a flow equalization and management method to reduce the peak daily flow and average daily flow provided that the facility owner is aware and agrees with the limitations to the facility.

9 PIPING

9.1 DESCRIPTION

There are several types of piping in a private sewage works. First, the building sewer connects the building drain to the first component of the system, which is usually a septic tank. Second, there is the effluent sewer piping from the septic tank to a soil treatment field. The effluent sewer pipe can be replaced by a pressurized pipe from a pump to the soil treatment field. Lastly, there are distribution laterals in the soil treatment field.

The building drain is that portion of piping that exits the building and is considered to end 1 m outside the wall of a building. The building sewer starts 1m outside the wall and conveys sewage to a communal or private sewage works. Where no private sewage works is present, both the building sewer and building drain must comply with the National Plumbing Code as adopted in Saskatchewan.

Where a private sewage works is present, the building sewer is considered part of the private sewage works. This pipe conveys sewage from the building drain to the septic tank or the first private sewage works component. The building sewer pipe must comply with the requirements of the Saskatchewan Onsite Wastewater Disposal Guide, which for all intents is the same as the National Plumbing Code requirements for a building sewer as adopted in Saskatchewan.

Regardless of where they are in the private sewage works, pipes, where the sewage flows by gravity, have minimum diameters and slopes to ensure that raw sewage is properly conveyed.

All pipes must be watertight to prevent any leaking of raw sewage, effluent, or allow root intrusion or water infiltration. This requires proper gluing or fusing techniques or the use of appropriate mechanical joints. Upon completion, a pressure test is recommended before the piping is backfilled.

9.2 INSTALLATION

All pipe should be placed on a solid base with the proper slope. When the pipe is placed, there must not be any bellies or dips that can cause liquid and material to accumulate in the pipe and contribute to clogging or freezing. The base can be granular fill or, where appropriate, natural unexcavated soil. If the soil is excavated and then backfilled, it should be compacted in 150 mm to 300 mm lifts. If the backfill material contains organics or is not compacted properly, it will shift, and low spots could result. Organics cannot be properly compacted and will cause pipe movement with changing temperatures and moisture conditions. This may result in leaks.

Where a pipe must cross a deep excavation such as to enter or leave a sewage tank or other pretreatment device, the contractor should consider supporting the pipe with compacted granular fill.

Backfill trenches and excavation above the pipe with a good material. The backfill material protects the pipe and helps to maintain the pipe slope. Large stones and frozen material should be avoided during backfilling. These types of material can deform the pipe and lead to failure.

Contractors should consider insulation for pipes to protect them from freezing. In many cases, sufficient cover provides the necessary insulation however, where a pipe runs under a driveway or some other hard surface area, insulation should be provided.

9.3 REQUIREMENTS

9.3.1 General

- 1) Piping shall not leak except where intended in the design.
- 2) Piping shall be sloped and sized to accommodate the designed flow of wastewater or effluent and the drainage of piping when required to prevent freezing.

- 3) Every joint between pipes and fittings of dissimilar materials or sizes shall be made by adapters, connectors, or mechanical joints manufactured and certified for that purpose.
- 4) Piping used in pressure applications shall be approved for a pressure rating of at least 1.5 times the maximum pressure it may be subjected to in the system.

9.3.2 Protection from freezing

- 1) The system shall prevent freezing of liquids in the piping.
- 2) A building sewer or effluent sewer having less than 1200 mm (4ft) of soil cover where it crosses under a ditch, driveway or path shall be protected from freezing by a frost box, culvert or other equivalent means.

9.3.3 Pipe Supports

- 1) Piping shall be sufficiently supported to prevent sagging, withstand expected mechanical forces and withstand forces resulting from movement of liquid in the system.
- 2) Effluent sewer and distribution header piping shall be evenly and continuously supported.

9.3.4 Backfill

- 1) Backfill shall be carefully placed to prevent damage or dislocation of piping.
- 2) Backfill shall be free of stones, boulders, cinders and frozen earth for a minimum depth of 150 mm (6 in.) above the piping.

9.3.5 Piping connections to tank

- 1) Piping connections to any tank or vessel used in the treatment system shall be water-tight, flexible connections that will prevent infiltration and exfiltration.
- 2) Piping connected to any tank or vessel shall be supported to within 300 mm of the tank outlet or inlet on a solid soil base or equivalent.
- 3) Gravity drainage piping connected to a tank shall be DWV pipe or piping or equivalent structural strength for at least 1800 mm (6ft) from the tank.

9.3.6 Gravity Piping

- 1) Effluent sewer piping and weeping lateral piping shall not be smaller than 75 mm (3 in.) in diameter.
- 2) A building sewer or effluent sewer pipe shall have a minimum slope of:
 - a) 1% for a 100 mm (4 in.) diameter pipe; and
 - b) 2% for a 75 mm (3 in.) diameter pipe.
- 3) Between clean-outs, a building sewer shall not:
 - a) change horizontal direction by more than 5° every 3 meters; and
 - b) have a cumulative change in horizontal direction of more than 45°.

9.3.7 Pipe Certifications

- 1) The piping used in a pressure application shall be certified to one of the following standards
 - a) For pressure effluent line:
 - i) CAN/CSA-B137.1 "Polyethylene Pipe, Tubing and Fittings for Cold Water Pressure Services" (Series 160 with compression fittings or Series 75, 100 or 125 with insert fittings),
 - ii) CAN/CSA-B137.3 "Rigid Polyvinyl Chloride (PVC) Pipe for Pressure Applications", or
 - iii) Other pipe deemed equivalent by the Local Authority.

- b) For pressure effluent distribution lateral pipe:
 - i) CAN/CSA-B137.3 “Rigid Polyvinyl Chloride (PVC) Pipe for Pressure Applications”,
 - ii) CAN/CSA-B137.6, “CPVC Pipe, Tubing and Fittings for Hot and Cold Water Distribution Systems”, or
 - iii) Other pipe deemed equivalent by the Local Authority.
- 2) The piping used in a non-pressure application shall be certified to one of the following standards:
 - a) For an effluent sewer or gravity distribution header
 - i) CAN/CSA-B181.1, “ABS Drain, Waste, and Vent Pipe and Pipe Fittings”;
 - ii) CAN/CSA-B181.2, “PVC Drain, Waste, and Vent Pipe and Pipe Fittings”;
 - iii) CAN/CSA-B182.1, “Plastic Drain and Sewer Pipe and Pipe Fittings”;
 - iv) CAN/CSA-B182.2, “PVC Sewer Pipe and Fittings, (PSM Type)”;
 - v) Other pipe deemed equivalent by the Local Authority.
 - b) For a weeping lateral pipe
 - i) CAN/CSA-B137.3 “Rigid Polyvinyl Chloride (PVC) Pipe for Pressure Applications”;
 - ii) CAN/CSA-B182.1, “Plastic Drain and Sewer Pipe and Pipe Fittings” (plastic sewer pipe perforated or non-perforated);
 - iii) CAN/CSA-B182.2, “PVC Sewer Pipe and Fittings, (PSM Type)”;
 - iv) CGSB 41-GP-31, “Tubing, Plastic, Corrugated, Heavy Duty, for Subsurface Disposal of Sewage Effluent” (Corrugated Polyethylene pipe perforated or non-perforated); or
 - v) Other pipe deemed equivalent by the Local Authority.

10 SYSTEM ALARMS, CONTROLS AND MONITORING SYSTEMS

10.1 DESCRIPTION

Monitoring systems are devices that monitor conditions within a private sewage works. They can include devices such as level sensors, temperature sensors, pump cycle counters, and flow meters.

Alarms are specialized monitoring devices that warn the private sewage works owner when specific conditions occur. For example, high water level in septic tank can indicate a number of different technical issues and it is important to address these issues before the tank overfills and spills to either the surface or into a building.

Controls are devices that control the operation of a private sewage works and are typically a required component when a pump is included in the system.

Pumps and the associated controls allows a designer to have more control over the system's operation. For example, when and how much to dose can be controlled with a pump and appropriate controls. This ability provides significant flexibility when designing a system. Further, it allows the designers to better manage flow and assists with the prevention of freezing.

Common controls include:

- Floats
- Tank level sensors
- Control panels for controlling timed or demand dosing and recording operational information
- Alarms for high water levels, filter maintenance

When installing controls in a tank or treatment system, it is important to be able to maintain them separately from other equipment. Therefore, never use a pump discharge as a float mast.

10.2 REQUIREMENTS

10.2.1 Monitoring Systems

- 1) Water level indicating devices shall be mounted so that
 - a) removal or adjustment of the devices does not require disconnection of other system components, and
 - b) they can be reinstalled at a constant reference elevation.

Recommendation:

Where a package treatment plant is used, it should include a component capable of:

- detecting daily flow volumes, and
- collecting 30 days of operational data that, at a minimum, includes failures, high level conditions, and flow volume.

10.2.2 Alarms

Recommendation:

All private sewage works, excluding lagoons should include an audio and visual warning for high liquid levels in tanks.

- 1) In a timed dose system, audio and visual alarms shall be included that indicate that the wastewater flow is exceeding the design settings.

- 2) All visual alarms shall be located in a conspicuous area when viewed from the building that is the source of sewage.
- 3) All audio alarms shall be located so that the signal is conspicuous from outside the building that is the source of sewage.
- 4) All alarm systems shall be located on a separate electrical circuit from the private sewage works or shall have a battery back-up that provides a minimum of four hours of operation.

10.2.3 Control Systems

- 1) All systems shall have controls designed that allow them to be operated in accordance with their design.
- 2) Where control systems for a private sewage works include a pump “on-off-auto” switch, the control system shall include redundant off water level controller that prevents the pump from running when levels in the tank are below a minimum level.
- 3) System controls and electrical connections shall be suitable for the environment in which they are located.

11 HOLDING TANKS

Sewage holding tanks do not provide any physical or biological process for its contents. For this reason, holding tanks are primarily used on developed properties where no other alternative methods of wastewater disposal are feasible or allowed by regulation. Properties that do not have an adequate area for a wastewater treatment system, properties located along a lakeshore, or properties with unusual circumstances may need to utilize a holding tank. Proposals for the installation of holding tanks are reviewed on the basis of public health requirements and municipal law and the proponent may be asked to indicate why other methods of wastewater treatment are not feasible.

11.1 DESIGN

Holding tanks must provide safe and adequate temporary storage of sewage, with scheduled and approved pumping services and disposal of the stored sewage.

Figure 11-1 - Typical Concrete Holding Tank

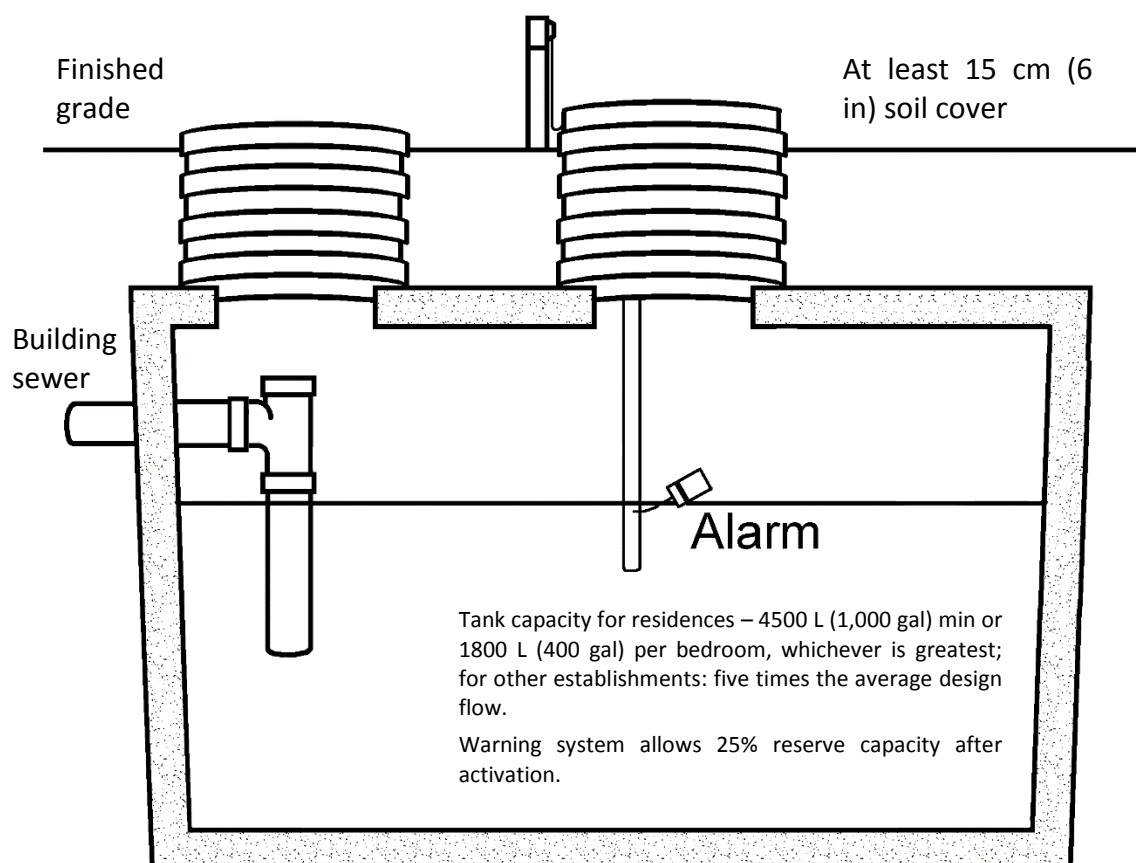


Image credit: onsiteconsortium.org

11.1.1 Capacity

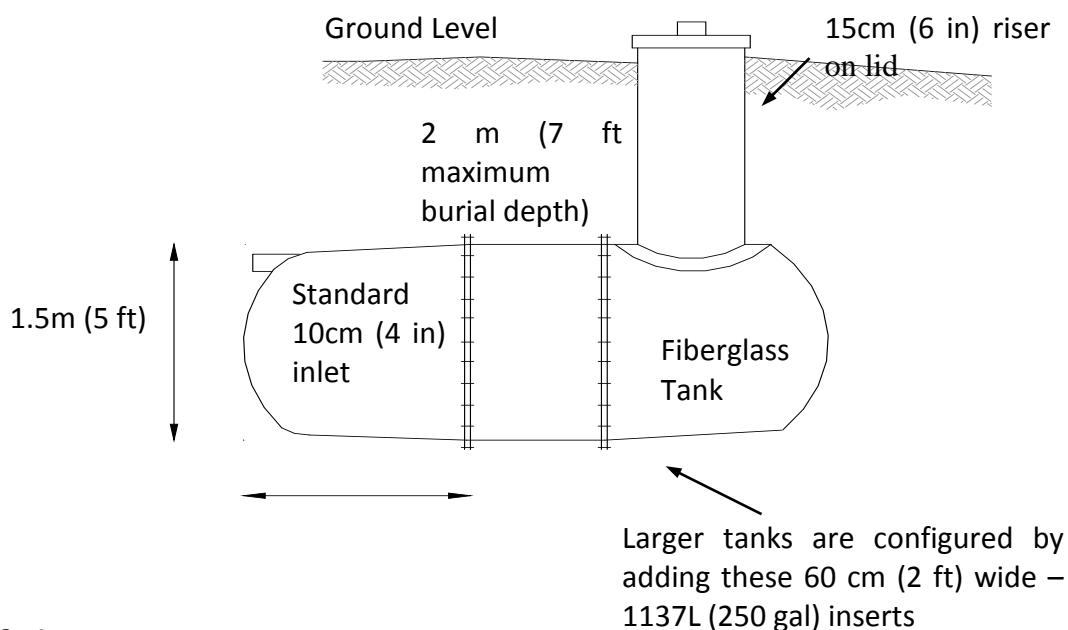
Capacity is one of the most important considerations in holding tank design. Liberal tank capacity is important from an economic perspective. Large holding tanks minimize the frequency of tank pumping.

As a rule, single family dwellings should have a holding tank that is about 1800 L (400 gals) times the number of bedrooms. For other establishments, the capacity should be based on measured flow rates or estimated flow rates. The tank capacity should be at least five times the average daily flow rate.

Prefabricated sewage holding tanks must be certified to the most current CSA standard for prefabricated septic tanks and holding tanks, except that an inlet baffle must not be an elbow fitting.

Holding tanks must be watertight and constructed of sound and durable materials that are not subjected to excessive corrosion, frost damage, cracking or buckling due to settlement or back filling.

Figure 11-2 - Typical Fibreglass Holding Tank



11.2 INSTALLATION

11.2.1 Site Selection

- 1) Holding tanks should be located where they cannot cause contamination of any well, spring or other water supply.
- 2) It is not a good installation practice to bury tanks in areas where a high water table exists as this increases the stress load on the tank (the deeper the burial in water and or saturated soil, the more stress). However, it is recognized that, in some situations, burial in the water table is necessary.
- 3) In such cases, the contractor should:
 - a) advise the cottage/homeowner of the stress/pressure implications;
 - b) ensure that the water table does not rise above any openings to the tank; and
 - c) anchor the tank per manufacturer's instructions to prevent floatation and/or shifting.
- 4) Holding tanks should not be installed in flood plains, drainage ways or depressions unless flood protection is provided.

11.2.2 Excavations for Holding Tanks

"Excavations for Septic Tanks" should be considered when installing a holding tank.

Where a building has no basement walls, a holding tank may be installed beneath the floor of such a building provided that access to the tank for inspection and pumping purposes is from the exterior of the building and no unsealed access port is present in the building or beneath the building.

Recommendation: In areas where insufficient soil depth is present to install a tank (e.g. bedrock near the ground surface in Northern Saskatchewan, above ground holding tanks with adequate frost protection should be considered.

11.3 CARE AND MAINTENANCE

The holding tank typically requires little operator intervention. Regular inspections and sewage pumping are the only operation and maintenance requirements. To assure that this work can be performed efficiently, the system must be designed, installed, and maintained in a way which promotes ease of access for pumping and cleanup.

11.4 REQUIREMENTS

11.4.1 General

- 1) The design, installation and operation of holding tanks must ensure that ground or surface waters are not contaminated, the public is not exposed to untreated sewage or source of nuisance odors is not created.

11.4.2 Sizing

- 1) For single family residences, holding tanks shall have a minimum capacity of:
 - a) at least 4546 L (1000 gals);
 - b) 1800 L (400 gal) per bedroom; or
 - c) five times the average daily flow rate, whichever is greater.
- 2) For non-single family residences, holding tanks shall have a minimum capacity of:
 - a) at least 4546 L (1000 gals); or
 - b) five times the average daily flow rate whichever is greater.

11.4.3 Design

- 1) Prefabricated and non-prefabricated sewage holding tanks must be certified to the most current CSA B-66 standard for prefabricated septic tanks and holding tanks, except that an inlet baffle must not be an elbow fitting.
- 2) All holding tanks must be water-tight.
 - a) All access openings, manhole extensions, and piping connections shall prevent infiltration and exfiltration of wastewater and groundwater.
 - b) Tongue and groove joints and cleaning access extensions in concrete tanks should be joined using a waterproof mastic compound.
- 3) An access opening shall be provided that is:
 - a) above the final grade; and
 - b) is secured to unauthorized access by a cover weighing at least 30 kg (65 lbs) or other equivalent method (i.e. mechanical lock for plastic/fiberglass covers).

Recommendation: Safety screens should be installed in all holding tank risers.

- 4) Large tanks greater than 9,000 L (2,000 gals) should have multiple access points (pumping access ports) to allow for efficient pumping of all contents.

11.4.4 Installation

- 1) Holding tanks shall be installed
 - a) no deeper than the maximum burial depth specified by the manufacturer;
 - b) on a uniform base to support the tank in a level position;
 - c) According to manufacturer's instructions; and
 - d) in an area easily accessible for sewage removal.
- 2) Where holding tanks are installed in areas of high groundwater conditions at the location and elevation of the tank, the system shall:
 - a) include anti-floatation measures;
 - b) ensure the tank can withstand the structural stresses caused by hydrostatic pressure;
 - c) maintain the elevation of the piping connections above the projected water table or include other specific additional measures to ensure that infiltration does not occur through piping connections or manhole risers.
- 3) A holding tank shall have adequate earth cover or other means to protect it from freezing while in operation and during periods of non-use.
 - a) A tank with less than 1.2 m (4 ft) of earth cover shall be insulated with the equivalent of R-8 insulation value over the top and sides of the tank to a minimum depth of 1.2 m (4 ft) below grade or insulated in some fashion to produce an equivalent of 1.2 m (4 ft) of insitu soil.

Recommendation: For holding tanks installed under a building, the tank shall be properly vented to ensure fumes do not enter the building.

- 4) A basement wall shall not be used as a wall of a holding tank.
- 5) Roof drains, surface water runoff, and other clear water sources shall not be routed to the holding tank.
- 6) When locating a holding tank the minimum setback distance shall be:

| | |
|----------------------|---------------|
| a) Basement | 1 m (3 ft) |
| b) Large tree | 3 m (10 ft) |
| c) Property Boundary | 3 m (10 ft) |
| d) Walk/Driveway | 1.5 m (5 ft) |
| e) Cut or embankment | 3 m (10 ft) |
| f) Well | 9 m (30 ft) |
| g) Water Course | 9 m (30 ft) |

12 SEPTIC TANKS

A septic tank is a two-compartment tank of which the first compartment is a settling tank and the second compartment is a storage compartment for the effluent from the first compartment.

12.1 FUNCTION

Everything that goes down any of the drains in the house (toilets, showers, sinks, laundry machines, etc.) travels first to the septic tank. It is a watertight receptacle designed, constructed and installed to receive sewage and wastewater. The septic tank provides a complex interaction of physical and biological processes. The essential functions of the septic tanks are to provide:

- removal of solids;
- biological treatment; and
- sludge and scum storage.

The turbidity of the effluent is significantly reduced so that it may be more readily percolated into the subsoil of the ground. Thus, the most important function of a septic tank is to provide protection for absorption ability of the subsoil.

12.1.1 Removal of Solids

Organic and inorganic solids are removed by the physical process of sedimentation and floatation. As sewage from a building sewer enters a septic tank, its rate of flow is reduced. The reduction in flow allows material that is denser than water to settle out and material less dense than water to float to the surface. This will allow for approximately 40 to 80 percent of suspended solids to be removed from the waste stream and 30-50% Biochemical Oxygen Demand (BOD) reduction.

There are several factors that will affect this process of settling rate. Water is denser at lower temperatures; therefore, the required settling time increases. As the temperature of the water increases, the required settling time decreases. Often the effluent temperature varies between 8°C and 28°C (46°F and 82°F).

Another factor that is critical is the equal distribution of the flow throughout the tank. A greater velocity in one area will result in less actual detention time. Solids not having sufficient time to settle out will be discharged in the effluent. If discharged into a soil-based secondary treatment system, these solids can drastically reduce the life of the field.

12.1.2 Biological Treatment

Solids and liquid in the tanks are subjected to decomposition by bacterial and natural processes. The bacteria present are a variety known as anaerobic which thrive in the absence of free oxygen. The decomposition or treatment of sewage under anaerobic conditions is termed “septic”, hence the name of the tanks.

The solids retained in the tank undergo anaerobic decomposition resulting in the formation of gas. The gases entrained in the solids cause them to rise through the wastewater to the surface and lie as a scum layer until the gas has escaped, after which the solids settle again. This biological process is able to considerably reduce the volume of sludge. This allows the septic tank to operate for periods of one to four years or more, depending on site circumstances, before it needs to be cleaned.

12.1.3 Sludge and Scum Storage

Sludge is an accumulation of solids at the bottom of the tank, while scum is a partially submerged mat of floating solids that may form at the surface of the fluid in the tank. Sludge, and scum to a lesser degree, will be digested and compacted into a smaller volume. However, no matter how efficient the process is, the residual or inert solid material will remain. Space must be provided in the tank to store this residue

during the interval between cleanings; otherwise, sludge and scum will eventually be scoured from the tank and may clog the disposal field.

12.2 DESIGN

As with sewage holding tanks, all septic tanks must be certified to the CSA B66 standard. The design of the septic tank should promote and facilitate the separation and digestion of the sewage solids and provide the periodic inspection and occasional physical removal of accumulated sludge and scum.

12.2.1 Capacity

Capacity is one of the most important considerations in septic tank design. Liberal tank capacity is not only important from a functional standpoint, but is also good economy. It is important that the capacity be ample to permit reasonably long periods of trouble-free service and to prevent frequent and progressive damage to the infiltrative soil surface due to discharge of suspended solids. References to septic tank sizing in this guide refer to “working capacity”. This is the working (first) compartment of the septic tank in which the liquid volume of sewage that will remain in the septic chamber, but does not include the air space, siphon chamber, pumping chamber or effluent chamber. Caution must be exercised when sizing a septic tank as the manufacturer’s model number does not necessarily indicate the “Working Capacity” of their product.

12.2.2 Tank Construction

Septic tanks must be watertight and constructed of sound and durable materials that are not subjected to excessive corrosion, frost damage, cracking or buckling due to settlement or backfilling. Common materials include concrete, fiberglass, and plastic.

Figure 12-1 - Septic Tank

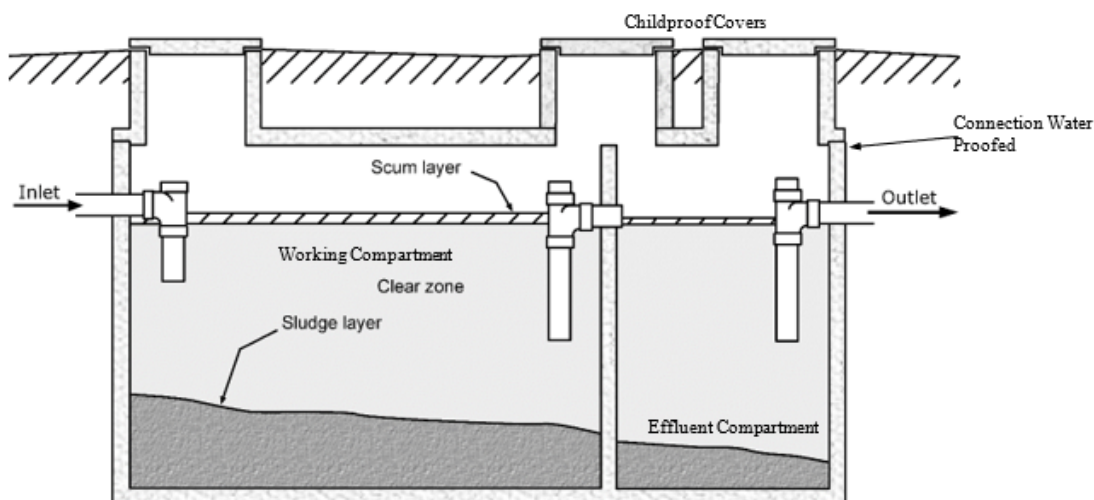
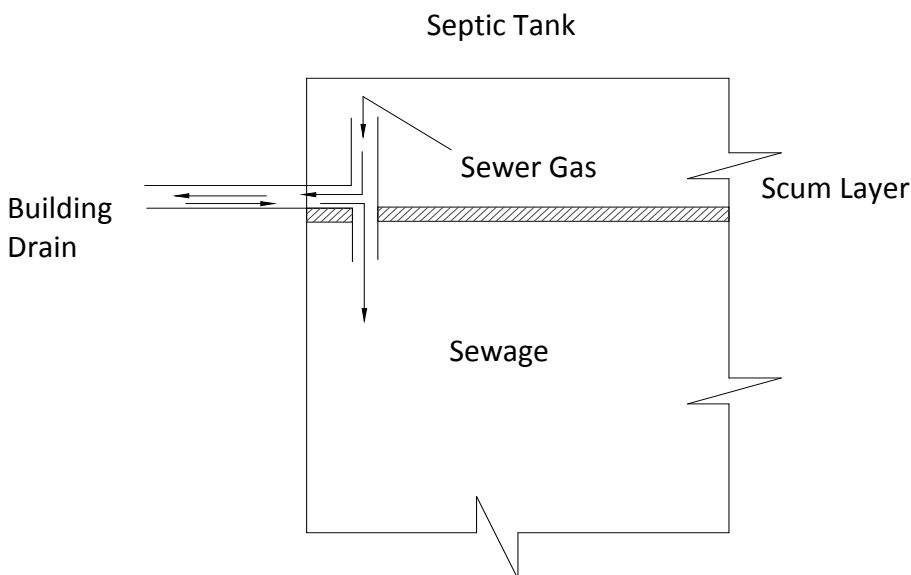


Image credit: Onsiteconsortium.org (note: image shows all possible access risers on a single tanks. Tanks do not require multiple access risers.)

12.2.3 Inlets and Outlets

The inlet baffle is designed to dissipate the energy of the effluent flow and deflect it downward into the tank. The TY inlet fitting extends above the scum line into the air space to allow sewer gas in the tank to vent through building drain.

Figure 12-2 - Venting of Sewer Gas from the Working Chamber



The outlet baffle, between the working compartment and the effluent compartment, is designed to draw wastewater from the clear zone between the sludge and scum layers. It allows the wastewater to overflow into the effluent compartment or pump chamber.

12.3 SPECIAL CONSIDERATIONS

Special considerations should be made when designing a septic tank for other than a private residence.

Restaurants – Restaurant waste typically contains large amounts of cooking fats and greases, many of which have been removed from the cooking utensils by the use of degreasers. For the grease to again coagulate and separate from the liquid, both dilution and cooling must take place. Restaurants and other types of foodservice that utilize a private sewage works must have a grease interceptor installed upstream of the septic system.

High temperature dishwashers, which have internal heaters, may discharge wastewater with temperatures as high as 60°C (140°F). Tanks that are in series, and thus contact with more soil, provide better cooling.

Laundromats – Laundromats have the problem of excessive washing products (detergent) use, along with the lint that is typically discharged with the wash water. In some cases, lint traps have been used effectively to reduce the amount discharged into the septic tank system. Very little sludge accumulates in the septic tanks of a laundromat system. However, large volumes of wastewater 1800 L (400 gals) per day per machine can be expected.

Slaughterhouses – Because blood has an extremely high biochemical oxygen demand, it is very difficult to break down in a septic system. When slaughterhouses have their own private sewage works, no blood should be allowed to enter the septic tank. There may be small amounts of blood entering with the cleanup water but the major amounts should be collected and disposed of separately from the sewage system.

Milk House Waste – Experience has shown that milk solids do not break down under anaerobic digestion present in a septic tank. Consequently, subsurface disposal fields should not be used with milk wastes.

12.4 INSTALLATION

Important construction considerations include tank location, bedding and back filling, water tightness and floatation prevention, especially with non-concrete tanks. Attention to these considerations will help to ensure that the tank performs as intended.

Proper pipe and tank bedding is very important to ensure that shearing of the pipe at the tank inlet, outlet or at the foundation does not occur.

12.4.1 Site Selection

Septic tanks should be located where they cannot cause contamination of any well, spring or other source of water supply. Underground contamination may travel in any direction and for considerable distances under saturated conditions. It is therefore necessary to rely on horizontal as well as vertical distances for protection.

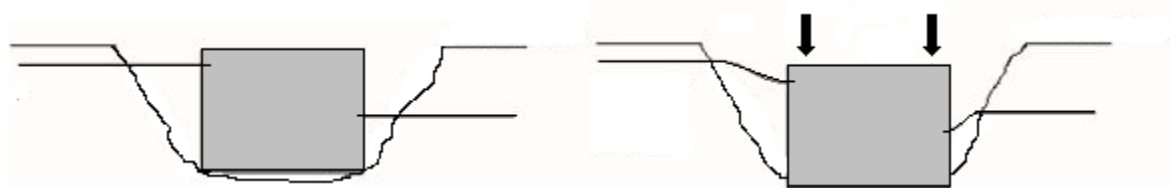
Septic tanks should not be installed in flood plains, drainage ways or depressions unless flood protection is provided. Also, it is important to consider the proximity to the largest possible area available for the disposal field.

It is not a good installation practice to bury tanks in areas where a high water table exists as this increases the stress load on the tank (the deeper the burial in water and or saturated soil, the more stress). However, it is recognized that, in some situations, this may be necessary. If the tank is set where the soil can be saturated, tank flotation may occur, particularly when the tank is empty (e.g., recently pumped dose tanks or septic tank after septage removal). Tank manufacturers should be consulted for appropriate anti-flotation devices. In such cases, the contractor should advise the cottage/homeowner of the stress/pressure implications.

12.4.2 Excavations for Septic Tanks

It is important that excavations for septic tanks (and holding tanks) are completed properly. The diagram on the left of the figure below demonstrates an improperly supported tank. The right side of the figure shows the resulting condition. An improperly supported septic tank will settle and may cause breakage or disconnection of the inlet and outlet piping from the tank.

Figure 12-3 - Poor Septic Tank Installation



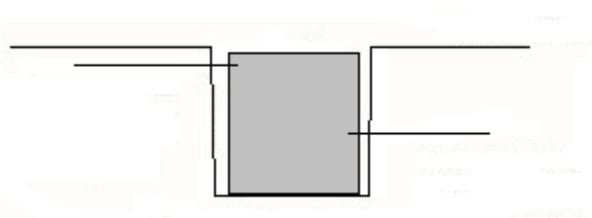
The figure below shows the result of an excessive excavation. In this situation, the long sloping ends of an excavation do not provide support for the inlet and outlet piping connected to the septic tank. The weight of the soil above the unsupported piping may cause the breakage of the piping.

Figure 12-4 - Excessive Tank Excavation



The figure below shows a proper excavation for a septic tank. There will be steep vertical ends to provide proper support for the inlet and outlet piping as close to the tank as possible and will have a flat undisturbed or compacted base.

Figure 12-5 - Proper Excavation for a Septic Tank



All septic tanks need to be installed as per the manufacturer's specifications. Bedding material in the excavation will typically need to be compacted and leveled. The installer should take care that the tank remains undamaged and that the manufacturer's instructions for back filling, which may include the use of pea gravel, are followed.

12.5 CARE AND MAINTENANCE

The septic tank typically requires little operator intervention. Regular inspections and septage (sludge) pumping are the only operation and maintenance requirements.

Please see Annex 14 – Operational Tips for Septic Systems (Informative) for more information on the care and maintenance of septic tanks.

12.6 REQUIREMENTS

12.6.1 General

- 1) The design, installation and operation of septic tanks must ensure that ground or surface waters are not contaminated, the public is not exposed to untreated sewage or source of nuisance odors is not created.

12.6.2 Sizing

- 1) Septic tanks shall be sized so that:
 - a) the working compartment is:
 - i) at least one times the peak daily flow plus
 - ii) an allowance for sludge and scum.
 - b) the working compartment of the septic tank conforms with the minimum sizes shown in the table below, whichever is greater.

Table 12-1 - Septic Tank Minimum Working Capacity

| Number of Bedrooms | Minimum Working Compartment Size |
|--------------------|----------------------------------|
| 2 | 3000 L (660 gals) |
| 3 | 3360 L (740 gals) |
| 4 | 4260 L (940 gals) |
| 5 | 5220 L (1150 gals) |
| 6 | 6130 L (1350 gals) |

- 2) For larger systems, where the required working capacity is greater than septic tank sizes supplied by industry, it is necessary to connect several tanks in series.
- 3) Sludge and scum shall be:
 - a) calculated based on maximum occupancy,
 - b) for residential occupancies, 400 L (88 imperial gallons) per person except that where a garburator is present, sludge and scum volume shall be increased by a factor of 1.5, and
 - c) for other occupancies, an amount equivalent to a three-year accumulation of sludge, and scum at ninety-fifth percentile except that where a garburator is present, sludge and scum volume shall be increased by a factor of 1.5.

12.6.3 Design

- 1) In all shoreland development areas, urban centres and subdivisions, prefabricated septic tanks must conform to the most current CSA B66 standard for prefabricated septic tanks and holding tanks, except that an inlet baffle must not be an elbow fitting.
- 2) The following are requirements intended to act as a guide for constructing a “*poured in place*” septic tank in locations where *The Private Sewage Works Regulations* permit their use. The requirements are not intended to supersede any design criteria that is specified in the most current CSA B66 standard for prefabricated septic tanks and holding tanks:
 - a) All poured in place tanks must be assessed by an engineer for conformance to the CSA B66 standard.
 - b) The working (first) compartment should have a liquid depth, measured at the deepest point of not less than 1.2 m (4 ft). This distance may be altered to accommodate tanks of special design such as those installations being placed in high water table areas.
 - c) There should be a minimum of 300 mm (12 in) air space between the maximum sewage level and the highest point of the ceiling of the septic tank body. The volume of the air space provided should not be less than 10 percent of the working capacity of the septic tank.
 - d) The inlet to the septic chamber should be provided with a flow diversion (a baffle or TY) device extending not less than 75 mm (3 in) into the sewage.
 - e) The outlet of the septic chamber should also have a TY fitting or baffle extending 450 – 650 mm (18-25 in) into the sewage. The top of such a fitting or baffle should not be more than 50 mm (2 in) below the ceiling of the tank body.
 - f) Outlets should be protected by a device which deflects gas and particles away from the outlet. The invert of the outlets should not be less than 50 mm (2 in) below the invert of the inlet.
 - g) The distance between the inlet and the outlet of the working (first) compartment should not be less than 1.2 m (4 ft) measured horizontally. This distance is measured from the vertical centre

line of the inlet and outlet fittings or if baffles are provided, from a point midway between the baffle and adjacent tank wall.

- h) Extensions for access openings should be constructed of sound durable material of a standard not less than that required for the septic tank construction and should have a minimum diameter of 600 mm (24 in). The connection between the septic tank and extension should be waterproofed and the extension extended to grade. Extension covers should be childproof.
 - i) Septic tanks should not be buried deeper than the depth of burial recommended by the manufacturer. The excavation necessary for a septic tank may be reduced if advantage is taken of natural ground surface grade.
 - j) Septic tank inside dimensions should not be less than 1.7 m (5.5 ft) long, 0.9 m (3 ft) wide and have a minimum liquid depth of 1.2 m (4 ft) unless otherwise approved.
 - k) For those systems which do not rely on gravity to discharge the liquid effluent, the installation of an effluent pump will be necessary. These pumps are normally activated by a liquid level control in the effluent (second) compartment of the septic tank. Common control types are: electrodes, floats and pneumatic. These controls require 2-3 annual service checks to ensure their successful operation.
- 3) Compartmentalized tanks must have:
- a) A baffled connection between compartments;
 - b) adequate access to each compartment; and
 - c) no more than four tanks installed in a series.
- 4) The rising inlet of the tee shall:
- a) extend at least 150 mm (6 in) above the liquid level to prevent the scum layer from plugging the inlet;
 - b) be open at the top to allow venting of the tank through the building sewer and out the plumbing stack vent; and
 - c) have the descending leg extend well into the clear space between the sludge and scum layers, but not more than 30 to 40 percent of liquid depth.
- 5) Septic tanks shall have at least one access opening that is at least 24 inches in diameter and
- a) extends above the final finished grade;
 - b) is secured to prevent unauthorized or accidental access with a cover of 30kg (65lbs) or equivalent (i.e. mechanical lock for plastic/fiberglass covers).

Recommendation: Safety screens should be installed in all septic tank risers.

12.6.4 Installation

- 1) A septic tank shall have adequate earth cover or other means to protect it from freezing while in operation and during periods of non-use
 - a) A tank with less than 1.2 m (4 ft) of earth cover shall be insulated with the equivalent of R-8 insulation value over the top and sides of the tank to a minimum depth of 1.2 m (4 ft) below grade or insulated in some fashion to produce an equivalent to 1.2 m (4 ft) of soil.
- 2) A septic tank shall be watertight.
 - a) Concrete tanks shall use tongue and groove joints and cleaning access extensions should be joined using a waterproof mastic compound.

- b) Septic tanks should be located where they cannot cause contamination of any well, spring, or other source of water supply.
- 3) Where a septic tank is installed in areas of high groundwater conditions at the location and elevation of the tank, the system shall:
 - a) ensure that the water table does not arise above any openings to the tank;
 - b) anchor the tank per manufacturer's instructions to prevent floatation and/or shifting; and
 - c) Maintain the elevation of the piping connections above the projected water table or include other specific additional measures to ensure that infiltration does not occur through piping connects or manhole risers.
- 4) Roof drains, surface water runoff, and other clear water sources must not be routed to the septic tank.
- 5) Manufacturers' instructions should be followed for the installation of septic tanks.
- 6) The connection between the pipe and the tank should be accomplished with a watertight, resilient and preferably, flexible connector, such as a boot.
- 7) Unless otherwise permitted by *The Private Sewage Works Regulations*, all septic tanks conforming to CSA standards should be:
 - a) accessed easily for sewage removal;
 - b) installed in accordance with instructions provided by the manufacturer;
 - c) installed in a bed that is free of sharp rocks or large earth blocks that could damage the tank; and
 - d) installed in a fashion that will ensure that the septic tank, building sewer connection and access openings are watertight.
- 8) The excavation beneath a septic tank should be flat native material.
 - a) Backfilling should be completed with a suitable fill that is free of sharp rocks or large earth blocks.
- 9) When locating a septic tank, the minimum setback distance shall be:

| | |
|----------------------|---------------|
| a) Basement | 1 m (3 ft) |
| b) Cistern | 3 m (10 ft) |
| c) Large tree | 3 m (10 ft) |
| d) Property Boundary | 3 m (10 ft) |
| e) Walk/Driveway | 1.5 m (5 ft) |
| f) Cut or embankment | 3 m (10 ft) |
| g) Well | 9 m (30 ft) |
| h) Water Course | 9 m (30 ft) |
- 10) The tank, if installed under a building, shall be properly vented to ensure fumes do not enter the building.
- 11) Where a building has no basement walls, a septic tank may be installed beneath the floor of such a building provided that access to the tank for inspection and pumping purposes is from the exterior of the building and no unsealed access port is present in the building or beneath the building.
- 12) The tank shall be properly vented to ensure fumes do not enter the building. A basement wall shall not be used as a wall of a septic tank.

13 SOIL TREATMENT FIELD

13.1 DESCRIPTION

A soil treatment field is a system for the treatment and dispersal of effluent within soil utilizing a means for the distribution of the effluent onto an infiltrative surface in such a way as to maximize treatment.

The soil treatment field is a key risk management approach and the primary method of achieving the specific objectives in Goal 1.

Soil based treatment includes:

- Absorption fields;
- Type I and II Treatment mounds; and
- LFH at-grade systems.

13.2 FUNCTION

The soil treatment field serves two functions. First, it provides significant additional treatment to the primary effluent. Secondly, the treated effluent is assimilated back into the water cycle and environment in such a way that public health and the environment are not compromised.

In a typical soil treatment field, primary effluent leaving the septic tank is discharged below the ground surface into a soil treatment field. Here the effluent receives additional treatment by natural processes in the soil. Biological, physical and chemical processes occur as the primary effluent moves through the infiltrative surface, the unsaturated vadose zone and the saturated zone (groundwater).

An unsaturated aerobic zone beneath the infiltrative surface is critical to proper sewage treatment. Poor treatment occurs under saturated conditions. The designer and installer must ensure there will be unsaturated water movement through the soil when designing a system. Unsaturated flow allows the contaminants to be held and treated in the soil.

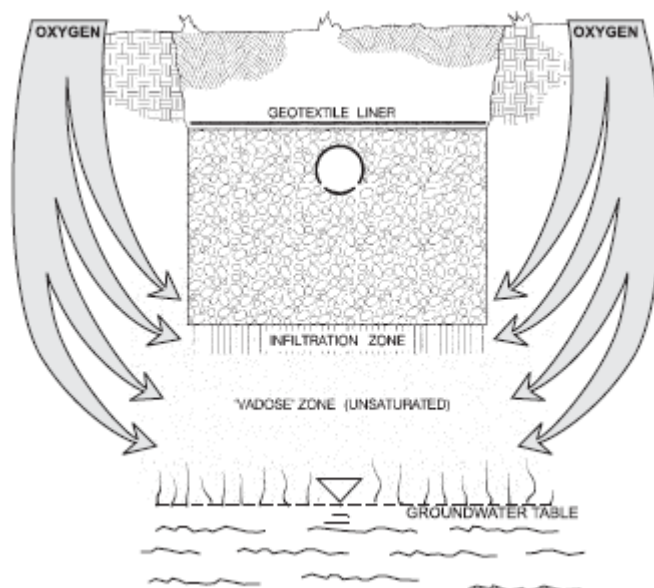
Soil treatment fields are assumed to be receiving primary or secondary treated effluent from a domestic source. The requirements for soil treatment fields are based on this. A soil treatment field can be designed for other wastewater qualities; however, the designer must consider whether the requirements of the Guide apply.

13.3 DESIGN

The design of the soil treatment field of a private sewage works should consider the following principles:

- Aerobic conditions are present beneath the infiltrative surface.
- Unsaturated flow is maintained beneath the infiltrative surface.
- Bypass flows and short-circuiting through the soil treatment field is not allowed.
- A sufficient vertical separation between a restrictive layer and the infiltrative surface is maintained to avoid saturated flow paths and ensure proper sewage treatment. A retention time of 7 days is recommended.
- Uniform distribution of the effluent over the soil infiltration surface is required.
- Dose frequency is maximized.

Figure 13-1 - Pathway of Re-Aeration



Many inter-related factors affect the performance of soil treatment field including the following:

- hydraulic loading rate (HLR);
- linear loading rate (LLR);
- organic loading rate (OLR);
- dosing frequency and volume;
- vertical separation (VS);
- type of distribution and uniformity of distribution; and
- infiltrative surface characteristics.

If the designer does not adequately consider the design principles and factors affecting performance, a soil treatment field will fail. Failure of the soil treatment field can occur in one of two ways. First, the field can fail to treat the sewage adequately in which case, pathogenic organisms and other potentially harmful compounds can reach the ground water and move long distances contaminating wells and surface waters. Secondly, the field can become hydraulically overloaded in which case wastewater will rise to the surface and people and animals can be directly exposed to pathogens.

13.3.1 Special Conditions

Designers should be aware of several special conditions that may require additional consideration beyond what is specified in this Guide. These conditions include:

- highly permeable soils,
- very low permeability soils,
- special soil conditions, and
- steep slopes.

13.3.1.1 Highly Permeable Soils

Very permeable soils, such as gravel or gravelly sand and soils with high coarse fragment content, are too permeable for effective soil-based treatment without special strategies. Sewage passing through these soils are not retained for a sufficient time to allow sufficient treatment of the wastewater to occur. Some strategies are included in the Guide however, designers should also consider:

- Increasing the vertical separation.
- Increasing the dose frequency and decreasing the dose volume.
- Creating uniform distribution of effluent in each dose.
- Reducing the HLR (resulting in larger treatment areas).
- Using soil treatment components that include a soil layer of reduced hydraulic capacity such as Type II mounds or sand lined trenches.

13.3.1.2 Very Low Permeability

Very low permeability soils have a reduced ability to absorb effluent and are poorly aerated. This results in a higher probability that saturated conditions and surface breakout may result. Very low permeability soils include clay loams and clay textured soils, and soils with unfavorable structure and consistence.

Some strategies are included in the Guide however, designers should consider:

- Reducing the HLR (resulting in larger treatment areas).
- Creating uniform distribution of effluent in each dose.
- Increasing the dose frequency and decreasing the dose volume.
- Improving the quality of effluent applied to the very low permeability soils with package treatment plants or Type II mounds.
- Using non-soil-based treatment such as lagoons.
- Decreasing the linear loading rate.

13.3.1.3 Special Soils

Prismatic, columnar or platy soil structures are a concern as they are undesirable soil conditions.

Prismatic or columnar soil structure *may* indicate the presence of highly expandable clay content, low permeability, or high sodium content. For soils with significant amounts of expandable clay minerals, there is a risk of soil permeability becoming very low.

Platy soils are difficult as hydraulic properties can vary widely. Designers relying on percolation tests should be aware that they are unreliable in these types of soils.

Some methods have been incorporated in the Guide; however, for these soils, the only means to minimize risks is to fully understand the soils on the site by increasing the number of test pits and completing additional soil testing such as SAR, COLE, and soil electrical conductivity.

Figure 13-2 - Soil Structures and Associated Infiltration Rates

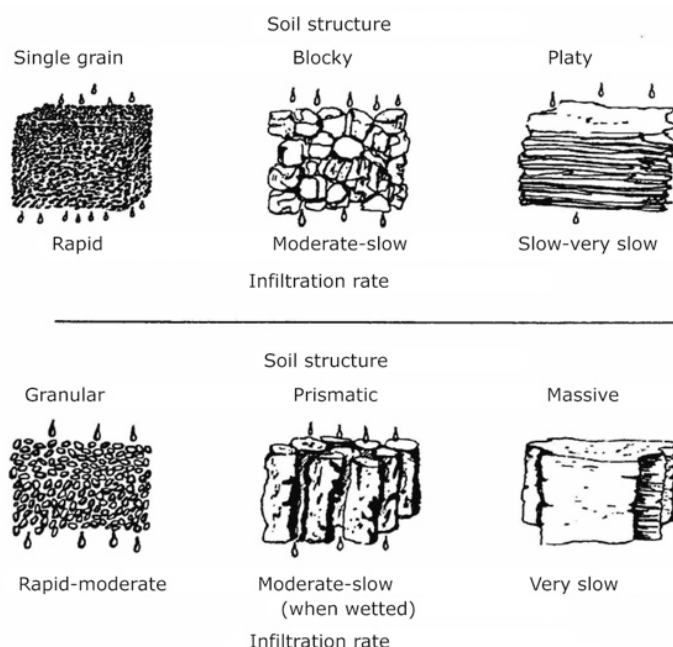


Image Credit: <http://www.onsiteconsortium.org>

13.3.1.4 Steep Slope

Steep slopes are a significant site constraint for soil treatment fields due to the following issues:

- Poor distribution of effluent when using gravity distribution systems.
- Break out of sewage due to a limiting or restrictive layer intersecting the ground surface (i.e. daylighting).
- Insufficient treatment due to a decreased vertical separation under parts of the soil treatment.

Designers and installers are responsible for ensuring that the soil treatment field operates properly on slopes.

13.3.2 Determining the Hydraulic Loading Rate

The size of the system depends upon the design sewage volume, organic loading, and the hydraulic loading rate. The design sewage volume and organic loading rate are covered in this Guide. The hydraulic loading rate can be determined two ways: a percolation test or a soils analysis.

Note: Designers and installers should determine what method of determining the hydraulic loading rate is required by the local authority.

13.3.2.1 Calculating Hydraulic Loading Rate Using Soil Percolation Test

Annex 2 - How to Conduct a Percolation Test (normative) provides the procedure for performing a percolation test. The percolation test estimates saturated hydraulic conductivity by filling a borehole with water and measuring how quickly the water level falls.

Although this method is allowed, designers should be aware of the known issues with the outcome of the test. Specifically, percolation test results can be highly variable. In completing the test, there are several limitations including:

- Difficulty determining if saturated conditions have been achieved, particularly in dry soil conditions.
- Time consuming.
- Large volumes of water may be needed.
- Results affected by the proximity of water table.
- Results affected by the proximity of highly permeable characteristics such as gravel layers and tunnels from roots and rodents.
- Difficulty getting consistent results.

The designer is responsible to ensure that the percolation test is completed properly and is representative of the soil conditions present on the site.

When a soil percolation test is conducted, the percolation rate can be converted to a loading rate in liters per square meter or imperial gallons per square foot using the tables found in the requirements section. Even where percolation tests are used to size a soil treatment field, a proper site investigation must occur.

13.3.2.2 Calculating Hydraulic Loading Rate Using Soil Texture Classification Method

The soil texture and structure (shape and grade) is the preferred method to be used to determine the width and area of a soil treatment field. The "Effluent Soil Loading Rates" and "Linear Loading Rates" table in the technical requirements is used in combination with a soil investigation to determine a hydraulic loading rate.

13.3.3 Linear Loading Rate

Linear loading rates are an important design aspect when soil treatment fields are sited where there is a soil layer with very limited permeability or where there is a shallow ground water table. The linear loading rate considers how much water can move through soil horizontally between the infiltration surface and the restrictive layer. The linear loading rate depends on the depth to restricting layer, the soil texture of the limiting soil layer, the type and grade of structure in the limiting soil layer, and the slope of the restrictive soil layer. Limiting the width of the system and extending the length across the slope can control loading of each linear foot of soil.

The linear loading is used to determine the total width of soil treatment fields across a slope to prevent the surfacing of effluent and saturation of the vadose zone. This is particularly important when a bed type system such as a Type II mound is used. In this case, the sand layer width will be determined by the linear loading rate used in the design. The linear loading rate represents the maximum amount of effluent that should be applied per unit length of a soil treatment field. This is not per unit length of trench or bed (e.g. trench width); it is for the whole system along the contour. For trench systems, individual trenches will be narrower than required using a linear loading rate, but when a number of trenches are placed side by side, the linear loading rate should be used to determine the total trench width allowed across the slope.

For design, there is no need to calculate areas. First, the linear loading rate is selected from the appropriate table. Then, divide the wastewater volume by the hydraulic linear loading rate to determine the length of the soil treatment field. The total width of all trenches or the width of a Type II mound's sand layer is the linear loading rate divided by the hydraulic loading rate.

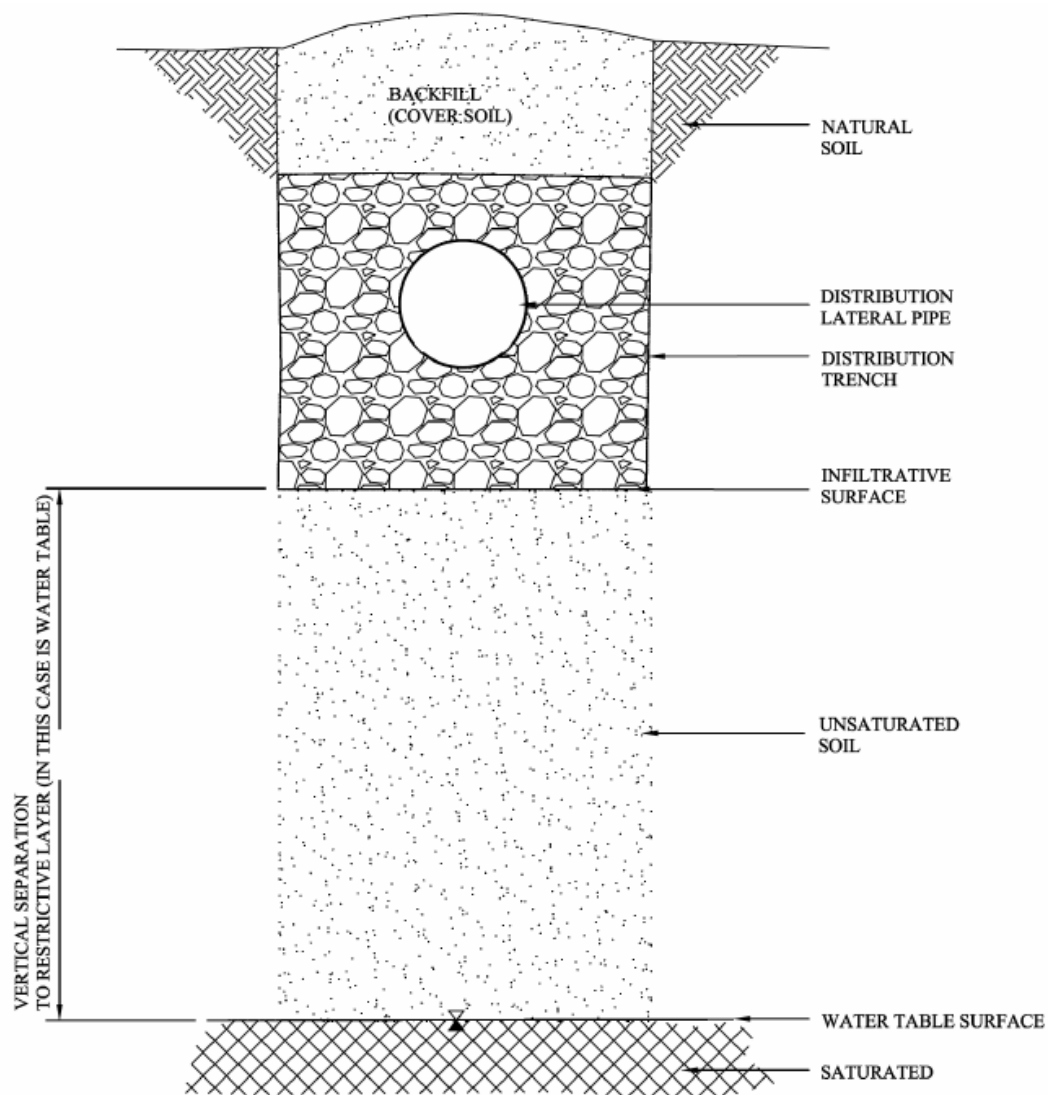
13.3.4 Vertical Separation

Vertical separation is the depth of permeable, unsaturated soil that exists between the infiltration surface and a restrictive layer such as a water table, bedrock, hardpan, unacceptable fine textured soils (clay), or excessively permeable material (gravelly sand). The limiting layer will be found within the

vertical separation depth. The vertical separation shall be designed to maintain unsaturated aerobic conditions to assure removal of organics and pathogenic organisms.

The required vertical separation varies from 0.9 m (3 ft) to 1.5 m (5 ft) depending on many factors. However, the designer should also be aware that it is critical to apply the effluent to the soil infiltration surface in a manner that will maintain the proper conditions for removal.

Figure 13-3 - Vertical Separation



13.3.5 Surface and Groundwater Diversion

In some cases, it may be necessary to divert surface water or groundwater from a soil treatment field. Surface water which would run onto or pond on the field should be diverted. Fields should slope to their edges however; diversion swales may be necessary. A swale is a shallow depression installed at the upslope of a soil treatment field and shaped to divert surface water away. In granular soils, a swale may be lined with low permeability soil or a liner.

Interception drains are used to divert groundwater and can lower the water table around a soil treatment field. A typical interception drain consists of a trench with a drainage pipe surrounded by gravel or rock. An impermeable membrane may be installed on the downslope wall of the trench to provide a subsurface dam and to reduce the risk of seepage from the soil treatment field to the drain.

Swales and drains should be sized to handle the peak flows and designed using good engineering practice. In cases where large flows are expected, design of the swale or drain by a qualified professional is strongly recommended.

Drains should be sized and specified using good field drainage practice.

A recommended design manual is the National Engineering Handbook Part 650 Section 14 “Water Management (Drainage)” published by the US National Resources Conservation Service and available online at: <https://directives.sc.egov.usda.gov/17551.wba>

If a drainage system is being relied on to lower the water table to achieve vertical separation standards, it is best to pre-install the drainage system to confirm that the drain can lower the water table to an adequate depth. This would involve measuring the depth of the water table in the proposed dispersal area during the wet season, using observation standpipes

Drains should be installed using good field drainage practice.

13.3.6 Gravelless Systems

Gravelless systems, including artificial aggregate systems, are alternatives to pipe and gravel distribution systems. They may consist of chambers, pipe, or pipe bundles with artificial aggregate. Where approved by the local authority, these types of systems may be used. Commonly, manufacturers or suppliers of such equipment seek a Province Wide Approval to facilitate approvals by local authorities.

13.3.7 Supply and Distribution of effluent

All soil treatment fields require a dose tank and a means to supply the distribution system with effluent. In many cases, the second chamber of a traditional septic tank may suffice as a dose tank. However, for pressure distribution systems, dose tanks are usually equal to the peak daily flow or double the average daily flow, whichever is greater. Properly sized dose tanks allow for the proper distribution of effluent and the equalization of flow. Dosing can occur with a pumping system or via gravity and a siphon. The dosing process must be done in a way that incorporates soil treatment design principles.

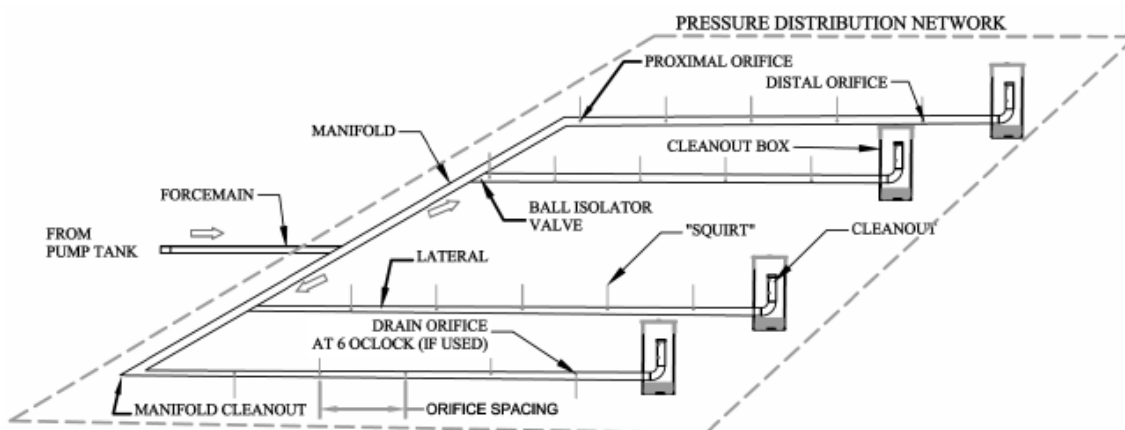
Before being applied to a soil treatment field, the effluent must be filtered. The filter may be at the tank outlet, in the baffle wall, in a separate filter chamber, as a screened vault for the pump or siphon or after a pump in the discharge line. After the effluent is supplied to a soil treatment field, it is either distributed across the infiltration surface by gravity or by a piped pressure system. The type of distribution will depend on the soil present, slopes, and other environmental conditions.

Gravity distribution relies on biomat formation to encourage the effluent to spread across the infiltration surface. This is only suitable where a significant vertical separation is present; where the soils will retain the effluent for long enough for the biomat to form; where the soils will not encourage ponding and saturation resulting in poor aeration; and where the applied effluent contains sufficient organics that a significant biomat will develop. Serial distribution of effluent is not permitted in Saskatchewan as this type of distribution encourages saturation underneath flooded trenches and will

only use the entire infiltration surface after significant biomat development. A pressure manifold or a dosed distribution box can be used to distribute effluent to gravity systems.

Pressure distribution in a soil treatment field is a controlled way to ensure even distribution of effluent. The development of a biomat is not necessary to ensure unsaturated flow conditions throughout the field system. Pressure distribution may be sufficient in some cases to overcome site or soil limitations and should be considered where a marginal site is present.

Figure 13-4 - Pressure Distribution System

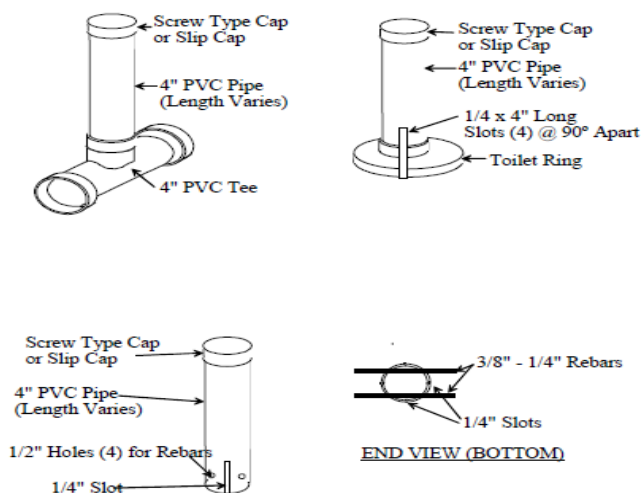


Where pressure distribution is used, a series of smaller diameter pipes called laterals are placed throughout the soil treatment field. Orifices are drilled into the pipes that squirts effluent into the soil treatment field. Orifices should be staggered on adjacent laterals. Improved distribution of effluent can be achieved by increasing the pressure in the laterals. The increased pressure will also reduce pressurization time, assist in clearing orifices and help to scour laterals.

The pressurization time of the system is measured from the first evidence of effluent flow from an orifice to full squirt height from all orifices. The dose time is measured from the first evidence of effluent flow from an orifice to the end of the pump cycle (i.e. when the pump shuts off). Pressurization time should be as small as possible to ensure that even distribution of effluent occurs. Distribution laterals should be fully pressurized for 67% of the dose time.

Monitoring ports are required on every soil treatment field. Below are examples of inspection ports.

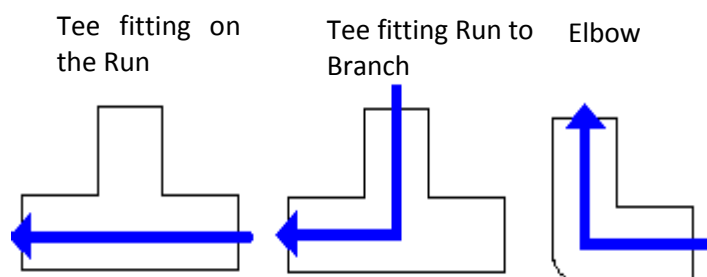
Figure 13-5 - Monitoring Ports



13.3.8 Hydraulic calculations for pressure distribution systems

When calculating the friction losses using the equivalent length method or other equivalent method, the designer must understand different types of flow through fittings. Specifically, different flow through fittings as described below.

Figure 13-6 - Fitting Descriptions



All the head loss calculations in the tables are based on the Hazen-Williams formula with a coefficient of 150 for PVC and 147 for polyethylene.

13.4 REQUIREMENTS

13.4.1 General

- 1) A soil treatment field shall be designed and installed to
 - a) be capable of treating the volume and strength of wastewater generated by the development and as treated by any upstream components; and
 - b) be suitable for the site, soil and climatic conditions that the soil treatment field shall reasonably be expected to experience during its design life.
- 2) All soil treatment fields shall be designed in conformance to section 13 - Soil Treatment Field.
- 3) The soil treatment field and surrounding landscaping shall be designed and installed to minimize the impact of surface storm runoff on the performance and operation of the system.

- 4) All soil treatment fields shall be designed to consider organic loading, the ability of the soil to transmit oxygen, and the need for frost protection.
- 5) Components of a soil treatment field that require regular maintenance shall be readily accessible such that servicing or required maintenance can be performed from the ground surface.
- 6) Effluent shall not bypass the soil treatment field.
- 7) All soil treatment fields that result in a raised area above the natural ground elevation shall be sloped to ensure positive drainage of precipitation.

13.4.2 Hydraulic Loading Rate

- 1) The design of a soil treatment field shall be based on peak daily flow volumes and the effluent loading rates set out for primary and secondary treated effluent except that an infrequently loaded soil treatment field can be dosed over days where no usage is expected.
- 2) The effluent hydraulic loading rate on the soil infiltrative surface shall be based on:
 - a) the soil texture and structure as set out in:
 - i) Table 13-2 - Hydraulic Loading Rates (Metric) or
 - ii) Table 13-3 - Hydraulic Loading Rates (Imperial), when the required vertical separation distance below the infiltrative surface is available, or
 - iii) the median (middle value) of the percolation tests taken on the site as set out in Table 13-1 - Percolation Rate to HLR and completed in accordance with Annex 2 - How to Conduct a Percolation Test (normative).

Table 13-1 - Percolation Rate to HLR

| Percolation Rate (Min/inch) | Maximum Hydraulic Loading Rate | |
|--------------------------------|-----------------------------------|--------------------------|
| | L/m ² | imp. gal/ft ² |
| <0.5 | 15 | 0.31 |
| 0.5–1.0 | 15 | 0.31 |
| 1–2 | 15 | 0.31 |
| 2–4 | 15 | 0.31 |
| 4–7.5 | 20 | 0.41 |
| 7.5–15 | 20 | 0.41 |
| 15–30 | 22 | 0.45 |
| 30–60 | 14.7 | 0.30 |
| 60–120 | 6.9 | 0.14 |
| >120 | NA | |

Table 13-2 - Hydraulic Loading Rates (Metric)

| Soil characteristics | | | Maximum Hydraulic loading rate (L/day/m ²) | |
|----------------------|-----------|-------|--|----------|
| Texture | Structure | | Effluent Quality (BOD) | |
| | Shape | Grade | >30 to 150 mg/L | <30 mg/L |
| COS, MS, LCOS, LMS | -- | OSG | 29.3 | 58.6 |
| FS, VFS, LFS, LVFS | -- | OSG | 27.4 | 46.4 |
| COSL, MSL | -- | OM | 19.5 | 36.6 |
| | PL | 1 | 9.8 | 24.5 |
| | | 2,3 | 0.0 | 9.8 |
| | PR/BK/GR | 1 | 19.6 | 29.4 |
| | | 2,3 | 29.4 | 29.4 |
| FSL, VFSL | -- | OM | 8.8 | 17.6 |
| | PL | 1 | 8.8 | 17.6 |
| | | 2,3 | 0.0 | 7.3 |
| | PR/BK/GR | 1 | 8.8 | 22.0 |
| | | 2,3 | 15.7 | 30.8 |
| L | -- | OM | 8.8 | 22.0 |
| | PL | 1 | 14.7 | 22.0 |
| | | 2,3 | 0.0 | 7.3 |
| | PR/BK/GR | 1 | 14.7 | 22.0 |
| | | 2,3 | 22.0 | 30.8 |
| SIL | -- | OM | 0.0 | 8.8 |
| | PL | 1 | 0.0 | 7.3 |
| | | 2,3 | 0.0 | 0.0 |
| | PR/BK/GR | 1 | 14.7 | 22.0 |
| | | 2,3 | 22.0 | 30.8 |
| SCL, CL, SICL, SI | -- | OM | 0.0 | 0.0 |
| | PL | 1 | 0.0 | 7.3 |
| | | 2,3 | 0.0 | 0.0 |
| | PR/BK/GR | 1 | 8.8 | 13.2 |
| | | 2,3 | 13.2 | 22.0 |
| SC, C, SIC | -- | OM | 0.0 | 0.0 |
| | PL | 1,2,3 | 0.0 | 0.0 |
| | PR/BK/GR | 1 | 0.0 | 0.0 |
| | | 2,3 | 6.9 | 9.8 |
| HC | -- | OM | 0.0 | 0.0 |
| | PL | 1,2,3 | 0.0 | 0.0 |
| | PR/BK/GR | 1 | 0.0 | 0.0 |
| | | 2,3 | 4.4 | 7.8 |

Table 13-3 - Hydraulic Loading Rates (Imperial)

| Soil characteristics | | | Maximum Hydraulic loading rate (Imp. gal/day/ft ²) | |
|----------------------|-----------|-------|---|----------|
| Texture | Structure | | Effluent Quality (BOD) | |
| | Shape | Grade | >30 to 150 mg/L | <30 mg/L |
| COS, MS, LCOS, LMS | -- | OSG | 0.6 | 1.2 |
| FS, VFS, LFS, LVFS | -- | OSG | 0.56 | 0.95 |
| COSL, MSL | -- | OM | 0.4 | 0.75 |
| | PL | 1 | 0.20 | 0.50 |
| | | 2,3 | 0.00 | 0.20 |
| | PR/BK/GR | 1 | 0.40 | 0.60 |
| | | 2,3 | 0.60 | 0.60 |
| FSL, VFSL | -- | OM | 0.18 | 0.36 |
| | PL | 1 | 0.18 | 0.36 |
| | | 2,3 | 0.00 | 0.15 |
| | PR/BK/GR | 1 | 0.18 | 0.45 |
| | | 2,3 | 0.32 | 0.63 |
| L | -- | OM | 0.18 | 0.45 |
| | PL | 1 | 0.30 | 0.45 |
| | | 2,3 | 0.00 | 0.15 |
| | PR/BK/GR | 1 | 0.30 | 0.45 |
| | | 2,3 | 0.45 | 0.63 |
| SIL | -- | OM | 0.00 | 0.18 |
| | PL | 1 | 0.00 | 0.15 |
| | | 2,3 | 0.00 | 0.00 |
| | PR/BK/GR | 1 | 0.30 | 0.45 |
| | | 2,3 | 0.45 | 0.63 |
| SCL, CL, SICL, SI | -- | OM | 0.00 | 0.00 |
| | PL | 1 | 0.00 | 0.15 |
| | | 2,3 | 0.00 | 0.00 |
| | PR/BK/GR | 1 | 0.18 | 0.27 |
| | | 2,3 | 0.27 | 0.45 |
| SC, C, SIC | -- | OM | 0.00 | 0.00 |
| | PL | 1,2,3 | 0.00 | 0.00 |
| | | 1 | 0.00 | 0.00 |
| | PR/BK/GR | 2,3 | 0.14 | 0.20 |
| HC | -- | OM | 0.00 | 0.00 |
| | PL | 1,2,3 | 0.00 | 0.00 |
| | | 1 | 0.00 | 0.00 |
| | PR/BK/GR | 2,3 | 0.09 | 0.16 |

- 3) The effluent hydraulic loading rate calculated using soil texture and structure can be increased by the factors indicated below:
 - a) Primary effluent and pressure lateral distribution system: 1.2 except that the resulting loading rate shall not exceed the loading rate for secondary effluent or as limited elsewhere in the standard;
 - b) Primary effluent, gravity lateral distribution system and chamber system: 1.1;
 - c) Primary effluent, pressure lateral distribution system and chamber system: 1.3;
 - d) Secondary effluent and pressure lateral distribution system and chamber system: 1.1;
 - e) Secondary effluent and pressure lateral distribution system and chamber system and timed dosing: 1.2; or,
 - f) Other increase approved by the Local Authority.
- 4) With respect to the adjustments allowed to hydraulic loading rates outlined in [13.4.2.3](#), the hydraulic loading rate to a native soil infiltration surface shall be no greater than:
 - a) 58.6 L/m²/day (1.2 imp. gal/ft²/day) per day on coarse sand, medium sand, loamy coarse sand, or loamy medium sand native in situ soils;
 - b) 46.4 L/m²/day (0.95 imp. gal/ft²/day) per day on fine sand, very fine sand, loamy fine sand or loamy very fine sand soils native in situ soils;
 - c) 40.7 L/m²/day (0.83 imp. gal/ft²/day) per day on coarse sandy loam or medium sandy loam soils native in situ soils; and
 - d) 40.7 L/m²/day (0.83 imp. gal/ft²/day) per day on all other soils.
- 5) The effluent hydraulic loading rate on soils that have a soil texture classification of coarse sand, medium sand, loamy coarse sand or loamy medium sand, that also have a coarse fragment content by volume that exceeds:
 - a) 35% but is less than or equal to 60% shall be reduced to 9.8 L/m²/day (0.2 imp. gal/ft²/day) or less for both primary treated effluent and secondary treated effluent.
 - b) 60% but is less than or equal to 75% shall be reduced to 7.4 L/m²/day (0.15 imp. gal/ft²/day) or less for both primary treated effluent and secondary treated effluent.
 - c) 75% shall be reduced to 0 L/m²/day (0.0 imp. gal/ft²/day) or less for both primary treated effluent and secondary treated effluent.
- 6) The top of a columnar structure soil horizon shall be considered a restrictive layer with an effluent loading rate of 0 L/m²/day (0.0 imp. gal/ft²/day).
- 7) Where the consistence of the peds in a horizon are very firm or harder (moist consistence) or hard or harder (dry consistence), the horizon shall be considered a restrictive layer with an effluent loading rate of 0 L/m²/day (0.0 imp. gal/ft²/day).
- 8) Prismatic soil structure shall be considered a restrictive layer with an effluent loading rate of 0 L/m²/day (0.0 imp. gal/ft²/day) if the soil consistence is very firm or harder (moist consistence) or hard or harder (dry consistence).

Recommendation:

When prismatic soil structures are encountered, to confirm that a prismatic soil structure will have a hydraulic loading rate of 0 L/m²/day (0.0 imp. gal/ft²/day), the following laboratory analysis should be conducted:

- Measure soil electrical conductivity is greater than 4;
- Sodium absorption ratio (SAR) is greater than 8;
- Soil coefficient of lineal extensibility (COLE) is greater than 3%; or
- Soil dispersion test shows more than slight dispersion of the soil.

13.4.3 Organic Loading Rate

- 1) Where the effluent strength exceeds primary treated effluent or secondary treated effluent, as required for the design, the effluent hydraulic loading rate shall be reduced to achieve an organic loading rate that does not exceed the organic loading rate on the soil infiltration surface that would result from primary treated effluent or secondary treated effluent, as required for the design.
- 2) The organic loading rate shall not exceed 6 g/m²/day (1.23 lb BOD₅/1000 ft²/day).

13.4.4 Linear Loading Rate

- 1) The design of the soil treatment field geometry shall consider the linear loading rate to allow the horizontal movement of effluent away from the soil treatment field without effluent surfacing.
- 2) Where soil texture and structure of the in situ soils beneath a soil treatment field are used to size the soil treatment field, the linear loading rate provided in Table 13-4 - Linear Loading Rates (Metric) or Table 13-5 - Linear Loading Rates (Imperial) shall be used.
- 3) Where percolation tests are used to select the hydraulic loading rate, the linear loading rate provided in Tables 13-6 and 13-7 shall be used.
- 4) All soil treatment fields shall be aligned perpendicular to the assumed ground water flow when the available vertical separation is less than 1200 mm (4 ft).
- 5) The soil treatment field design shall consider the linear loading rate for the cumulative loading from all trenches and beds when the available vertical separation is less than 1200 mm (4 ft).

Table 13-4 - Linear Loading Rates (Metric)

| | | | Maximum Linear Loading Rate, L/da/m | | | | | |
|----------------------|-----------|-------|-------------------------------------|----------|---------------------------|----------|---------------------------|----------|
| | | | Slope of land | | | | | |
| Soil characteristics | | | 0-4% | | >4-9% | | >9% | |
| Texture | Structure | | Infiltration distance, m. | | Infiltration distance, m. | | Infiltration distance, m. | |
| | Shape | Grade | 0.3-<0.6 | 0.6-<1.2 | 0.3-<0.6 | 0.6-<1.2 | 0.3-<0.6 | 0.6-<1.2 |
| COS, MS, LCOS, LMS | -- | OSG | 62.3 | 74.8 | 74.8 | 87.2 | 87.2 | 99.7 |
| FS, VFS, LFS, LVFS | -- | OSG | 56.1 | 68.5 | 62.3 | 74.8 | 74.8 | 87.2 |
| COSL, MSL | -- | OM | 43.6 | 49.9 | 51.1 | 57.3 | 74.8 | 87.2 |
| | PL | 1 | 52.2 | 59.7 | 61.2 | 68.6 | 74.6 | 89.5 |
| | | 2,3 | 37.3 | 44.7 | 40.3 | 47.7 | 43.3 | 50.7 |
| | PR/BK /GR | 1 | 67.1 | 82.0 | 74.6 | 89.5 | 89.5 | 104.4 |
| | | 2,3 | 67.1 | 82.0 | 74.6 | 89.5 | 89.5 | 104.4 |

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| | | | | | | | | |
|-------------------|-----------|-------|------|------|------|------|------|------|
| FSL, VFSL | -- | OM | 34.3 | 38.8 | 40.3 | 44.7 | 47.7 | 55.2 |
| | PL | 1 | 34.3 | 38.8 | 40.3 | 44.7 | 47.7 | 55.2 |
| | | 2,3 | 37.3 | 44.7 | 40.3 | 47.7 | 43.3 | 50.7 |
| | PR/BK /GR | 1 | 52.2 | 59.7 | 56.7 | 64.1 | 61.2 | 68.6 |
| | | 2,3 | 56.7 | 64.1 | 61.2 | 68.6 | 65.6 | 73.1 |
| L | -- | OM | 34.3 | 38.8 | 40.3 | 44.7 | 47.7 | 55.2 |
| | PL | 1 | 52.2 | 59.7 | 56.7 | 64.1 | 61.2 | 68.6 |
| | | 2,3 | 37.3 | 44.7 | 40.3 | 47.7 | 43.3 | 50.7 |
| | PR/BK /GR | 1 | 52.2 | 59.7 | 56.7 | 64.1 | 61.2 | 68.6 |
| | | 2,3 | 56.7 | 64.1 | 61.2 | 68.6 | 65.6 | 73.1 |
| SIL | -- | OM | 37.3 | 44.7 | 40.3 | 47.7 | 43.3 | 50.7 |
| | PL | 1 | 37.3 | 44.7 | 40.3 | 47.7 | 43.3 | 50.7 |
| | | 2,3 | | | | | | |
| | PR/BK /GR | 1 | 40.3 | 44.7 | 44.7 | 49.2 | 52.2 | 59.7 |
| | | 2,3 | 44.7 | 49.2 | 52.2 | 59.7 | 56.7 | 64.1 |
| SCL, CL, SICL, SI | -- | OM | | | | | | |
| | PL | 1 | 25.4 | 32.8 | 28.3 | 35.8 | 31.3 | 38.8 |
| | | 2,3 | | | | | | |
| | PR/BK /GR | 1 | 37.3 | 44.7 | 40.3 | 47.7 | 43.3 | 50.7 |
| | | 2,3 | 43.3 | 50.7 | 44.7 | 49.2 | 52.2 | 59.7 |
| SC, C, SIC | -- | OM | | | | | | |
| | PL | 1,2,3 | | | | | | |
| | PR/BK /GR | 1 | | | | | | |
| | | 2,3 | 37.3 | 44.7 | 40.3 | 47.7 | 43.3 | 50.7 |
| HC | -- | OM | | | | | | |
| | PL | 1,2,3 | | | | | | |
| | PR/BK /GR | 1 | | | | | | |
| | | 2,3 | 31.3 | 38.8 | 34.3 | 41.8 | 37.3 | 44.7 |

Table 13-5 - Linear Loading Rates (Imperial)

| | | | Maximum Linear Loading Rate, Imp. gal/da/ft | | | | | |
|----------------------|-----------|-------|---|--------|----------------------------|--------|----------------------------|--------|
| | | | Slope of land | | | | | |
| Soil characteristics | | | 0-4% | | >4-9% | | >9% | |
| Texture | Structure | | Infiltration distance, in. | | Infiltration distance, in. | | Infiltration distance, in. | |
| | Shape | Grade | 12-<24 | 24-<48 | 12-<24 | 24-<48 | 12-<24 | 24-<48 |
| COS, MS, LCOS, LMS | -- | OSG | 4.2 | 5.0 | 5.0 | 5.8 | 5.8 | 6.7 |
| FS, VFS, LFS, LVFS | -- | OSG | 3.8 | 4.6 | 4.2 | 5.0 | 5.0 | 5.8 |

| | | | | | | | | |
|----------------------|--------------|-------|-----|-----|-----|-----|-----|-----|
| COSL, MSL | -- | 0M | 2.9 | 3.3 | 3.4 | 3.8 | 5.0 | 5.8 |
| | PL | 1 | 3.5 | 4.0 | 4.1 | 4.6 | 5.0 | 6.0 |
| | | 2,3 | 2.5 | 3.0 | 2.7 | 3.2 | 2.9 | 3.4 |
| | PR/BK /GR | 1 | 4.5 | 5.5 | 5.0 | 6.0 | 6.0 | 7.0 |
| | | 2,3 | 4.5 | 5.5 | 5.0 | 6.0 | 6.0 | 7.0 |
| FSL, VFSL | -- | 0M | 2.3 | 2.6 | 2.7 | 3.0 | 3.2 | 3.7 |
| | PL | 1 | 2.3 | 2.6 | 2.7 | 3.0 | 3.2 | 3.7 |
| | | 2,3 | 2.5 | 3.0 | 2.7 | 3.2 | 2.9 | 3.4 |
| | PR/BK /GR | 1 | 3.5 | 4.0 | 3.8 | 4.3 | 4.1 | 4.6 |
| | | 2,3 | 3.8 | 4.3 | 4.1 | 4.6 | 4.4 | 4.9 |
| L | -- | 0M | 2.3 | 2.6 | 2.7 | 3.0 | 3.2 | 3.7 |
| | PL | 1 | 3.5 | 4.0 | 3.8 | 4.3 | 4.1 | 4.6 |
| | | 2,3 | 2.5 | 3.0 | 2.7 | 3.2 | 2.9 | 3.4 |
| | PR/BK /GR | 1 | 3.5 | 4.0 | 3.8 | 4.3 | 4.1 | 4.6 |
| | | 2,3 | 3.8 | 4.3 | 4.1 | 4.6 | 4.4 | 4.9 |
| SIL | -- | 0M | 2.5 | 3.0 | 2.7 | 3.2 | 2.9 | 3.4 |
| | PL | 1 | 2.5 | 3.0 | 2.7 | 3.2 | 2.9 | 3.4 |
| | | 2,3 | - | - | - | - | - | - |
| | PR/BK /GR | 1 | 2.7 | 3.0 | 3.0 | 3.3 | 3.5 | 4.0 |
| | | 2,3 | 3.2 | 3.7 | 3.5 | 4.0 | 3.8 | 4.3 |
| SCL, CL, SICL, SI | -- | 0M | - | - | - | - | - | - |
| | PL | 1 | 1.7 | 2.2 | 1.9 | 2.4 | 2.1 | 2.6 |
| | | 2,3 | - | - | - | - | - | - |
| | PR/BK /GR | 1 | 2.5 | 3.0 | 2.7 | 3.2 | 2.9 | 3.4 |
| | | 2,3 | 2.9 | 3.4 | 3.2 | 3.7 | 3.5 | 4.0 |
| SC, C, SIC | -- | 0M | -- | -- | -- | -- | -- | -- |
| | PL | 1,2,3 | -- | -- | -- | -- | -- | -- |
| | | 1 | -- | -- | -- | -- | -- | -- |
| | PR/BK /GR | 2,3 | 2.5 | 3.0 | 2.7 | 3.2 | 2.9 | 3.4 |
| HC | -- | 0M | -- | -- | -- | -- | -- | -- |
| | PL | 1,2,3 | -- | -- | -- | -- | -- | -- |
| | | 1 | -- | -- | -- | -- | -- | -- |
| | PR/BK /GR | 2,3 | 2.1 | 2.6 | 2.3 | 2.8 | 2.5 | 3.0 |

Table 13-6 - Percolation Linear Loading Rates (Metric)

| Percolation Rate (Min/inch) | Maximum Linear Loading Rate (L/day/m) | | | | | |
|-----------------------------------|---------------------------------------|----------|---------------------------------|----------|---------------------------------|----------|
| | Slope 0 to 4% | | Slope >4 to 9% | | Slope >9% | |
| | Soil Depth Below Surface (m) | | Soil Depth Below Surface (m) | | Soil Depth Below Surface (m) | |
| | 0.3-<0.6 | 0.6-<1.2 | 0.3-<0.6 | 0.6-<1.2 | 0.3-<0.6 | 0.6-<1.2 |
| <0.5 | 62.3 | 74.8 | 74.8 | 87.2 | 87.2 | 99.7 |
| 0.5–1.0 | 62.3 | 74.8 | 74.8 | 87.2 | 87.2 | 99.7 |
| 1–2 | 62.3 | 74.8 | 74.8 | 87.2 | 87.2 | 99.7 |
| 2–4 | 62.3 | 74.8 | 74.8 | 87.2 | 87.2 | 99.7 |
| 4–7.5 | 56.1 | 68.5 | 62.3 | 74.8 | 74.8 | 87.2 |
| 7.5–15 | 52.2 | 59.7 | 61.2 | 68.6 | 74.6 | 89.5 |
| 15–30 | 37.3 | 44.7 | 40.3 | 47.7 | 43.3 | 50.7 |

| | | | | | | |
|--------|------|------|------|------|------|------|
| 30–60 | 25.4 | 32.8 | 28.3 | 35.8 | 31.3 | 38.8 |
| 60–120 | 25.4 | 32.8 | 28.3 | 35.8 | 31.3 | 38.8 |
| >120 | NA | | | | | |

Table 13-7 - Percolation Linear Loading Rates (Imperial)

| Percolation Rate (Min/inch) | Maximum Linear Loading Rate (imp. gal/day/ft) | | | | | |
|--------------------------------|---|--------|-------------------------------|--------|-------------------------------|--------|
| | Slope 0 to 4% | | Slope >4 to 9% | | Slope >9% | |
| | Soil Depth Below Surface (in) | | Soil Depth Below Surface (in) | | Soil Depth Below Surface (in) | |
| | 12-<24 | 24-<48 | 12-<24 | 24-<48 | 12-<24 | 24-<48 |
| <0.5 | 4.2 | 5.0 | 5.0 | 5.8 | 5.8 | 6.7 |
| 0.5–1.0 | 4.2 | 5.0 | 5.0 | 5.8 | 5.8 | 6.7 |
| 1–2 | 4.2 | 5.0 | 5.0 | 5.8 | 5.8 | 6.7 |
| 2–4 | 4.2 | 5.0 | 5.0 | 5.8 | 5.8 | 6.7 |
| 4–7.5 | 3.8 | 4.6 | 4.2 | 5.0 | 5.0 | 5.8 |
| 7.5–15 | 3.5 | 4.0 | 4.1 | 4.6 | 5.0 | 6.0 |
| 15–30 | 2.5 | 3.0 | 2.7 | 3.2 | 2.9 | 3.4 |
| 30–60 | 1.7 | 2.2 | 1.9 | 2.4 | 2.1 | 2.6 |
| 60–120 | 1.7 | 2.2 | 1.9 | 2.4 | 2.1 | 2.6 |
| >120 | NA | | | | | |

13.4.5 Vertical Separation

- 1) Except as noted in in [Article 3](#) below, soil treatment fields shall maintain a vertical separation between the soil infiltration surface and a restrictive layer of not less than:
 - a) 1500 mm (5ft) when receiving primary treated effluent,
 - b) 900 mm (3ft) when receiving secondary treated effluent through a pressurized lateral distribution system, or
 - c) The depth of soil required to achieve a 7-day effluent travel time to 2.4 m (8 ft) below the soil infiltration surface or a restrictive layer, whichever is less.
- 2) Fill material meeting the requirements of treatment system sand may be used to achieve the required vertical separation between soil infiltration surface and a restrictive layer except that there shall be at least 300 mm (1 ft) of suitable in situ native soil with an assigned hydraulic loading rate below the fill material and above the restrictive layer.
- 3) A soil treatment field may have a vertical separation distance between the soil infiltration surface and a restrictive layer of 600 mm (2ft) where:
 - d) effluent applied will meet the quality set out for secondary treated effluent with disinfection;
 - e) the system is not located over a shallow domestic use aquifer;
 - f) seven days of effluent travel time is achieved prior to a restrictive layer; and
 - g) the package treatment plant supplying the effluent is managed in a manner that the ongoing operation and maintenance is ensured.
- 4) A soil treatment field that uses tire chip media shall have a vertical separation between the tire chip infiltration surface and a restrictive layer of not less than 1500 mm (5ft).

13.4.6 Groundwater Mounding Considerations Required

- 1) The potential for groundwater mounding below a soil treatment field shall be assessed for all systems where the available separation distance to a restrictive layer is less than 300 mm more than the required vertical separation except where the system is designed in accordance to Table 13-4 - Linear Loading Rates (Metric) or Table 13-5 - Linear Loading Rates (Imperial).

13.4.7 Surface drainage

- 1) A swale or interceptor trench is required when the elevation of the ground surface adjacent to the soil treatment field site is higher and may be expected to drain water onto the soil absorption field site.

13.4.8 Interceptor Trench

- 1) An interceptor trench must be dug into an impermeable layer when used to divert perched groundwater over a layer of impermeable soil upslope of a system.
- 2) An interceptor trench must meet all of the following:
 - a) it must be at least 300 mm (12 in) in width and filled with aggregate;
 - b) it must be long enough to divert the water to a point where it will not enter the system and it will freely discharge to the surface.
- 3) An interceptor trench must be located a minimum of 5 m (16.4 ft) upslope of the distribution trench and pass no closer than within 5 m (16.4 ft) of the end of the soil treatment field.
- 4) Despite [Article 3](#), if an interceptor trench cannot meet the required 5 m (16.4 ft) separation distances, an impervious geomembrane or fill, such as compacted clay or bentonite, must be used to line the interceptor trench.
- 5) An impervious geomembrane referred to above must be not be placed on the upslope side of the trench, and must meet all of the following requirements:
 - a) it must be installed along the bottom of the interceptor trench;
 - b) it must be installed up the entire vertical face of the downslope side of the trench.
- 6) An interceptor trench that is also used to intercept surface drainage must either have aggregate installed to within 50 mm (2 in) of the surface with no final cover material, or have a swale included at the surface of the interceptor trench.
- 7) An interceptor trench shall have a minimum slope of 0.2% towards the trench outlet.
- 8) An interceptor trench may also be used to lower ground water, where the lowered ground water level can be confirmed by sampling prior to system construction.

13.4.9 Surface Water Diversion Swales

- 1) A swale must be at least 300 mm (12 in) deep and 600 mm (24 in) wide, and must be stabilized with gravel, sod or other material to prevent erosion.
- 2) The edge of a swale must be at least 3 m (9 ft) from the edge of a soil treatment field.
- 3) A swale shall have a minimum slope of 0.2% towards the swale outlet.

13.4.10 Distribution of Effluent

- 1) A soil treatment field shall receive a volume dose that achieves effective distribution of the effluent and minimizes the risk of freezing.
- 2) All distribution system components that may reasonably require maintenance are required to be accessible.
- 3) The system shall be designed so that the trench used for the piping from the tank to the soil treatment field does not provide a path for unintended effluent flow.

- 4) Lateral piping shall be centered in the trench or where more than one lateral is in a trench they shall be spaced evenly.
- 5) In a soil treatment field, each independent native in-situ soil infiltrative surface shall have at least two 100 mm (4 in.) monitoring ports located within 4.5 m (14.75 ft) of each end.
- 6) Each monitoring port shall be:
 - a) fitted with a mechanical fastened top;
 - b) fitted with a collar or other mechanical means to prevent easy removal;
 - c) extend from the finished grade to the native in-situ soil infiltration surface; and
 - d) be fitted with perforations that:
 - i) allow the entry of ponded effluent while excluding material surrounding the access port; and
 - ii) are located within the vertical section that they are intended to monitor.

13.4.11 Dose tank

- 1) All soil treatment fields shall be dosed using a dedicated dose tank which may be the pumping chamber of a septic tank (i.e. not the working chamber).
- 2) The required volume a dose tank is not included in the volume of the working capacity of the septic tank.
- 3) The dose tank shall be of a sufficient size to ensure adequate dosing of the soil treatment field.

13.4.12 Gravity distribution

- 1) The gravity effluent distribution system shall be designed to provide approximately equal effluent distribution to each weeping lateral trench.
- 2) All laterals shall be an equal length (within 10%) except laterals fed from a pressure manifold system.
- 3) All laterals and trenches shall be to a maximum of 15 m (50 ft) in length.
- 4) All lateral pipes shall be a minimum 75 mm (3 in) nominal diameter.
- 5) Except where gravity lateral pipes meet CSAB182.1-M92 or CGSB 41-GP-31, they shall:
 - a) Have perforations that are a minimum of 12.5 mm (1/2 in) and a maximum of 25 mm (1 in) diameter.
 - b) Have perforations that are separated by a minimum of 125 mm (5 in) and a maximum of 250 mm (10 in).
 - c) Have two rows of perforations, facing at 4 and 8 o'clock (60 degree separation).
- 6) Gravity lateral pipes shall be terminated by capping or installing a cleanout or looped to an adjacent lateral if level.
- 7) Pipes from a flow splitter to the soil treatment field shall be piped using solid walled pipe installed with a minimum 1% slope.
- 8) Where gravity laterals connect to a gravity distribution header or field header, all piping in the soil treatment field shall be installed at the same elevation.
- 9) Where gravity lateral pipes in the field are at different elevations, distribute effluent evenly to each gravity lateral pipe by either supplying each lateral via a pressure supply or use a distribution box.
- 10) Where used, a distribution box shall have an internal dimension not exceeding 300 mm (12 in); provide relatively equal distribution to all outlets; be readily accessible for inspection and service; and be protected from frost.
- 11) A drop box or a bi-level cross shall not be used in a soil treatment field.

- 12) Lateral pipes shall be installed level, or with a positive slope in the direction of flow not exceeding 5 cm in 30 m (0.2%).
- 13) Gravity lateral pipes shall be laid nominally level at a maximum depth of 600 mm (2 ft) below the finished ground surface as measured from top of pipe.
- 14) A gravity lateral distribution system shall be dosed to encourage effluent spreading over the entire soil infiltration system.
- 15) Dosing to a gravity distribution system shall be completed by using a flow splitter that is either a distribution box, T-splitter, gravity distribution header, or pressure manifold
- 16) A gravity lateral distribution system shall be dosed within a range of 3.4 and 12 L/m² (0.07 to 0.25 imp. gal./ft²) of soil infiltration surface area per dose.
- 17) All gravity lateral pipes shall be dosed at least once per day at the design flow of the system.
- 18) Maintenance access shall be provided for all flow splitters, including pressure manifold orifices.

Recommendation:

Each dose of effluent should be more than 66% of the draining volume of all lateral and distribution piping.

13.4.13 Pressure distribution

- 1) The design of a pressure distribution lateral pipe system shall:
 - a) be based on pressure head and flow rate to ensure appropriate distribution of effluent;
 - b) allow for flushing and cleaning of individual laterals at the most downstream end of the lateral without requiring excavation;
 - c) allow for checking of residual pressure head at both the supply end and most downstream end of the lateral without requiring excavation;
 - d) allow for the regular maintenance and servicing of filters, pumps, and valves without requiring physical entry into a tank;
 - e) include a drain back orifice within the effluent tank that allows for effluent to drain back to the tank and prevents siphoning of effluent; and
 - f) calculate head loss resulting from piping at the calculated design flows using the Hazen Williams equation with the coefficient specific to the type of pipe used in the system. Tables 13-8 and 13-9 can be used for simple system designs.

Table 13-8 - Flow versus Friction Loss (Metric)

| Flow in Litres per Minute | Friction Loss in mm Pressure Head per 30.5 Metres in Schedule 40 PVC Pipe (C=150) | | | | | | Friction Loss in mm Pressure Head per 30.5 Metres in Polyethylene Pipe, Carlon = 147 | | | | | |
|------------------------------------|--|--------|--------|--------|-------|-------|---|--------|--------|--------|-------|-------|
| | Nominal Pipe Diameter (mm) | | | | | | Nominal Pipe Diameter (mm) | | | | | |
| | 20 | 25 | 32 | 40 | 50 | 80 | 20 | 25 | 32 | 40 | 50 | 80 |
| 5 | 128 | 40 | 10 | 5 | 1 | 0 | 133 | 41 | 11 | 5 | 2 | 0 |
| 10 | 461 | 142 | 38 | 18 | 5 | 1 | 479 | 148 | 39 | 18 | 5 | 1 |
| 15 | 977 | 302 | 79 | 38 | 11 | 2 | 1014 | 313 | 82 | 39 | 12 | 2 |
| 20 | 1,663 | 514 | 135 | 64 | 19 | 3 | 1,726 | 533 | 140 | 66 | 20 | 3 |
| 25 | 2,512 | 776 | 204 | 97 | 29 | 4 | 2,608 | 806 | 212 | 100 | 30 | 4 |
| 30 | 3,520 | 1,088 | 286 | 135 | 40 | 6 | 3,654 | 1,129 | 297 | 140 | 42 | 6 |
| 35 | 4,682 | 1,446 | 381 | 180 | 53 | 8 | 4,860 | 1,502 | 395 | 187 | 55 | 8 |
| 40 | 5,994 | 1,852 | 488 | 230 | 68 | 10 | 6,222 | 1,922 | 506 | 239 | 71 | 11 |
| 45 | 7,453 | 2,303 | 606 | 286 | 85 | 13 | 7,737 | 2,390 | 629 | 297 | 88 | 13 |
| 50 | 9,058 | 2,798 | 737 | 348 | 103 | 15 | 9,402 | 2,905 | 765 | 361 | 107 | 16 |
| 55 | 10,804 | 3,338 | 879 | 415 | 123 | 18 | 11,215 | 3,465 | 912 | 431 | 128 | 19 |
| 60 | 12,691 | 3,921 | 1,032 | 488 | 145 | 21 | 13,174 | 4,070 | 1,072 | 506 | 150 | 22 |
| 65 | 14,717 | 4,546 | 1,197 | 566 | 168 | 25 | 15,277 | 4,720 | 1,243 | 587 | 174 | 26 |
| 70 | - | 5,214 | 1,373 | 649 | 192 | 29 | - | 5,413 | 1,425 | 673 | 200 | 30 |
| 75 | - | 5,924 | 1,560 | 737 | 218 | 32 | - | 6,150 | 1,619 | 765 | 227 | 34 |
| 80 | - | 6,676 | 1,758 | 830 | 246 | 37 | - | 6,930 | 1,825 | 862 | 256 | 38 |
| 85 | - | 7,468 | 1,967 | 929 | 275 | 41 | - | 7,752 | 2,041 | 964 | 286 | 42 |
| 90 | - | 8,301 | 2,186 | 1,033 | 306 | 45 | - | 8,617 | 2,269 | 1,072 | 318 | 47 |
| 95 | - | 9,174 | 2,416 | 1,141 | 338 | 50 | - | 9,524 | 2,508 | 1,185 | 351 | 52 |
| 100 | - | 10,087 | 2,656 | 1,255 | 372 | 55 | - | 10,471 | 2,757 | 1,303 | 386 | 57 |
| 120 | - | 14,134 | 3,722 | 1,758 | 521 | 77 | - | 14,672 | 3,864 | 1,825 | 541 | 80 |
| 140 | - | - | 4,950 | 2,338 | 693 | 103 | - | - | 5,139 | 2,427 | 720 | 107 |
| 160 | - | - | 6,337 | 2,993 | 888 | 132 | - | - | 6,579 | 3,107 | 921 | 137 |
| 180 | - | - | 7,880 | 3,722 | 1,104 | 164 | - | - | 8,180 | 3,864 | 1,146 | 170 |
| 200 | - | - | 9,576 | 4,523 | 1,341 | 199 | - | - | 9,941 | 4,696 | 1,392 | 207 |
| 220 | - | - | 11,422 | 5,395 | 1,600 | 238 | - | - | 11,857 | 5,601 | 1,661 | 247 |
| 240 | - | - | - | 6,338 | 1,879 | 279 | - | - | - | 6,579 | 1,951 | 290 |
| 260 | - | - | - | 7,349 | 2,179 | 324 | - | - | - | 7,629 | 2,262 | 336 |
| 280 | - | - | - | 8,429 | 2,499 | 371 | - | - | - | 8,750 | 2,594 | 385 |
| 300 | - | - | - | 9,577 | 2,840 | 422 | - | - | - | 9,942 | 2,948 | 438 |
| 320 | - | - | - | 10,791 | 3,200 | 475 | - | - | - | 11,202 | 3,321 | 493 |
| 340 | - | - | - | - | 3,579 | 532 | - | - | - | - | 3,716 | 552 |
| 360 | - | - | - | - | 3,979 | 591 | - | - | - | - | 4,130 | 613 |
| 380 | - | - | - | - | 4,397 | 653 | - | - | - | - | 4,565 | 678 |
| 400 | - | - | - | - | 4,835 | 718 | - | - | - | - | 5,019 | 745 |
| 450 | - | - | - | - | 6,012 | 893 | - | - | - | - | 6,241 | 927 |
| 500 | - | - | - | - | 7,306 | 1,085 | - | - | - | - | 7,584 | 1,126 |
| 550 | - | - | - | - | 8,714 | 1,294 | - | - | - | - | 9,046 | 1,343 |
| 600 | - | - | - | - | - | 1,520 | - | - | - | - | - | 1,578 |
| 700 | - | - | - | - | - | 2,022 | - | - | - | - | - | 2,099 |
| 800 | - | - | - | - | - | 2,588 | - | - | - | - | - | 2,687 |
| 900 | - | - | - | - | - | 3,218 | - | - | - | - | - | 3,341 |

Shaded values represent combinations where the flow velocity is in the preferred 0.6 to 1.5 m/sec range.

Table 13-9 - Flow versus Friction Loss (Imperial)

| Flow in Imperial Gallons per Minute | Friction Loss in Feet Pressure Head per 100 Feet in Schedule 40 PVC Pipe (C=150) | | | | | | Friction Loss in Feet Pressure Head per 100 Feet in Polyethylene Pipe "Carlton" (C=147) | | | | | |
|-------------------------------------|--|-------|-------|-------|-------|-------|---|-------|-------|-------|-------|-------|
| | Nominal Pipe Diameter (in.) | | | | | | Nominal Pipe Diameter (in.) | | | | | |
| | 0.75 | 1 | 1 1/4 | 1 1/2 | 2 | 3 | 0.75 | 1 | 1 1/4 | 1 1/2 | 2 | 3 |
| 1 | 0.35 | 0.11 | 0.03 | 0.01 | - | - | 0.37 | 0.11 | 0.03 | 0.01 | - | - |
| 2 | 1.27 | 0.39 | 0.10 | 0.05 | 0.01 | - | 1.32 | 0.41 | 0.11 | 0.05 | 0.02 | - |
| 3 | 2.69 | 0.83 | 0.22 | 0.10 | 0.03 | - | 2.80 | 0.86 | 0.23 | 0.11 | 0.03 | - |
| 4 | 4.59 | 1.42 | 0.37 | 0.18 | 0.05 | 0.01 | 4.76 | 1.47 | 0.39 | 0.18 | 0.05 | 0.01 |
| 5 | 6.93 | 2.14 | 0.56 | 0.27 | 0.08 | 0.01 | 7.19 | 2.22 | 0.59 | 0.28 | 0.08 | 0.01 |
| 6 | 9.71 | 3.00 | 0.79 | 0.37 | 0.11 | 0.02 | 10.08 | 3.11 | 0.82 | 0.39 | 0.11 | 0.02 |
| 7 | 12.92 | 3.99 | 1.05 | 0.50 | 0.15 | 0.02 | 13.41 | 4.14 | 1.09 | 0.52 | 0.15 | 0.02 |
| 8 | 16.54 | 5.11 | 1.35 | 0.64 | 0.19 | 0.03 | 17.17 | 5.30 | 1.40 | 0.66 | 0.20 | 0.03 |
| 9 | 20.56 | 6.35 | 1.67 | 0.79 | 0.23 | 0.03 | 21.34 | 6.59 | 1.74 | 0.82 | 0.24 | 0.04 |
| 10 | 24.99 | 7.72 | 2.03 | 0.96 | 0.28 | 0.04 | 25.94 | 8.01 | 2.11 | 1.00 | 0.30 | 0.04 |
| 11 | 29.80 | 9.21 | 2.42 | 1.15 | 0.34 | 0.05 | 30.94 | 9.56 | 2.52 | 1.19 | 0.35 | 0.05 |
| 12 | 35.01 | 10.82 | 2.85 | 1.35 | 0.40 | 0.06 | 36.34 | 11.23 | 2.96 | 1.40 | 0.41 | 0.06 |
| 13 | 40.60 | 12.54 | 3.30 | 1.56 | 0.46 | 0.07 | 42.14 | 13.02 | 3.43 | 1.62 | 0.48 | 0.07 |
| 14 | - | 14.38 | 3.79 | 1.79 | 0.53 | 0.08 | - | 14.93 | 3.93 | 1.86 | 0.55 | 0.08 |
| 15 | - | 16.34 | 4.30 | 2.03 | 0.60 | 0.09 | - | 16.97 | 4.47 | 2.11 | 0.63 | 0.09 |
| 16 | - | 18.42 | 4.85 | 2.29 | 0.68 | 0.10 | - | 19.12 | 5.03 | 2.38 | 0.71 | 0.10 |
| 17 | - | 20.60 | 5.42 | 2.56 | 0.76 | 0.11 | - | 21.39 | 5.63 | 2.66 | 0.79 | 0.12 |
| 18 | - | 22.90 | 6.03 | 2.85 | 0.84 | 0.13 | - | 23.77 | 6.26 | 2.96 | 0.88 | 0.13 |
| 19 | - | 25.31 | 6.66 | 3.15 | 0.93 | 0.14 | - | 26.27 | 6.92 | 3.27 | 0.97 | 0.14 |
| 20 | - | 27.83 | 7.33 | 3.46 | 1.03 | 0.15 | - | 28.89 | 7.61 | 3.59 | 1.07 | 0.16 |
| 25 | - | 42.05 | 11.07 | 5.23 | 1.55 | 0.23 | - | 43.65 | 11.49 | 5.43 | 1.61 | 0.24 |
| 30 | - | - | 15.51 | 7.33 | 2.17 | 0.32 | - | - | 16.11 | 7.61 | 2.26 | 0.33 |
| 35 | - | - | 20.63 | 9.75 | 2.89 | 0.43 | - | - | 21.42 | 10.12 | 3.00 | 0.45 |
| 40 | - | - | 26.42 | 12.48 | 3.70 | 0.55 | - | - | 27.42 | 12.95 | 3.84 | 0.57 |
| 45 | - | - | 32.85 | 15.52 | 4.60 | 0.68 | - | - | 34.10 | 16.11 | 4.78 | 0.71 |
| 50 | - | - | 39.92 | 18.85 | 5.59 | 0.83 | - | - | 41.44 | 19.57 | 5.80 | 0.86 |
| 55 | - | - | - | 22.49 | 6.67 | 0.99 | - | - | - | 23.35 | 6.92 | 1.03 |
| 60 | - | - | - | 26.42 | 7.83 | 1.16 | - | - | - | 27.42 | 8.13 | 1.21 |
| 65 | - | - | - | 30.64 | 9.08 | 1.35 | - | - | - | 31.80 | 9.43 | 1.40 |
| 70 | - | - | - | 35.14 | 10.42 | 1.55 | - | - | - | 36.47 | 10.81 | 1.61 |
| 75 | -- | - | - | 39.92 | 11.84 | 1.76 | -- | - | - | 41.44 | 12.29 | 1.82 |
| 80 | - | - | - | - | 13.34 | 1.98 | - | - | - | - | 13.85 | 2.06 |
| 85 | - | - | - | - | 14.92 | 2.22 | - | - | - | - | 15.49 | 2.30 |
| 90 | - | - | - | - | 16.58 | 2.46 | - | - | - | - | 17.22 | 2.46 |
| 95 | - | - | - | - | 18.33 | 2.72 | - | - | - | - | 19.03 | 2.83 |
| 100 | - | - | - | - | 20.15 | 2.99 | - | - | - | - | 20.92 | 3.11 |
| 125 | - | - | - | - | 30.45 | 4.54 | - | - | - | - | 31.61 | 4.69 |
| 150 | - | - | - | - | 42.67 | 6.34 | - | - | - | - | 44.29 | 6.58 |
| 175 | - | - | - | - | - | 8.43 | - | - | - | - | - | 8.75 |
| 200 | - | - | - | - | - | 10.79 | - | - | - | - | - | 11.20 |
| 250 | - | - | - | - | - | 16.30 | - | - | - | - | - | 16.92 |
| 300 | - | - | - | - | - | 22.84 | - | - | - | - | - | 23.71 |

Shaded values represent combinations where the flow velocity is in the preferred 2 to 5 ft/sec range.

Table 13-10 – Equivalent Length for Polyethylene Fittings

| Equivalent Lengths for Polyethylene Piping Insert Fittings | | | | | | |
|--|--------------------|--------|---------------------------------------|--------|---------------------------------------|--------|
| Expressed in Approximate Length of Straight Pipe | | | | | | |
| Pipe Size (in.) | Iron Pipe Adapters | | Couplings and Tee Fittings on the Run | | Elbows and Tee Fittings Run to Branch | |
| | Feet | Metres | Feet | Metres | Feet | Metres |
| 1/2 | 1 | 0.30 | 0.50 | 0.15 | 3.00 | 0.91 |
| 3/4 | 1.5 | 0.46 | 0.75 | 0.23 | 4.3 | 1.31 |
| 1 | 2 | 0.61 | 1 | 0.30 | 6 | 1.83 |
| 1 1/4 | 2.7 | 0.82 | 1.3 | 0.40 | 8.6 | 2.62 |
| 1 1/2 | 3.4 | 1.04 | 1.6 | 0.49 | 10.5 | 3.20 |
| 2 | 4.4 | 1.34 | 2 | 0.61 | 13.2 | 4.02 |
| 3 | 6.2 | 1.89 | 2.9 | 0.88 | 17 | 5.18 |

Table 13-11 - Equivalent Length for PVC Fittings

| Equivalent Lengths for PVC Schedule 40 Piping Insert Fittings | | | | | | | | |
|---|----------------------------|-----|-----|-----|-----|-----|-----|-----|
| Expressed in Approximate Length of Straight Pipe (ft) | | | | | | | | |
| Fitting | Nominal Pipe Size (inches) | | | | | | | |
| | ½ | ¾ | 1 | 1 ¼ | 1 ½ | 2 | 2 ½ | 3 |
| 90 Elbow | 1.5 | 2 | 2.5 | 3.8 | 4 | 5.7 | 6.9 | 7.9 |
| 45 Elbow | 0.8 | 1.1 | 1.4 | 1.8 | 2.1 | 2.6 | 3.1 | 4 |
| Gate Valve | 0.3 | 0.4 | 0.6 | 0.8 | 1 | 1.5 | 2 | 3 |
| Tee Flow on Run | 1 | 1.4 | 1.7 | 2.3 | 2.7 | 4.3 | 5.1 | 6.2 |
| Tee Flow on Branch | 4 | 5 | 6 | 7 | 8 | 12 | 15 | 16 |
| Male/Female Threaded Adapter | 1 | 1.5 | 2 | 2.8 | 3.5 | 4.5 | 5.5 | 6.5 |

- 2) Orifices shall be designed based on the following requirements.
- The volume of effluent discharged through any orifice in a distribution lateral pipe system as measured over the duration of a single dose cycle shall not vary by more than:
 - 10% along the length of a single distribution lateral pipe; and,
 - 15% between all orifices in the system, unless specifically designed for in the system to accommodate variations in soil conditions.
 - Distribution lateral piping shall be installed so that each orifice opening is an adequate distance above the soil infiltration surface to prevent drain back into the system should intermittent ponding occur.
 - The minimum diameter of an orifice is 3.2 mm (1/8 in).
 - Orifices shall point upwards and not form an angle greater than 45° with the vertical except when required for pipe drainage or the orifice is on a lateral encased in drain media.
 - Provide orifice shields on all orifices, except for upward-facing orifices inside of infiltration chambers or inside other gravelless systems that act as orifice shields.
 - Where a pressure effluent distribution lateral pipe supplies effluent to a Treatment System Sand layer, orifices shall be spaced evenly with no more than one orifice for every 0.5 square metre (5.5 ft²) of Treatment System Sand Layer; and,
 - Orifices shall be spaced no more than
 - 1.5 m (5 ft) apart when applying primary treated effluent,

- ii) 0.9 m (3 ft) when applying secondary treated effluent or when the limiting layer is medium sandy loam, coarse sandy loam or any coarser-textured soil
- h) The number of orifices shall not exceed the maximum number specified for the lateral pipe size as per Table 13-12 Orifice Size and Number versus Distribution Lateral Size or
- i) Table 13-13 - Orifice Size and Number versus Distribution Lateral Size (Continued)

Table 13-12 - Orifice Size and Number versus Distribution Lateral Size

| | | Orifice Diameter | | 3.2mm (1/8") | | | | | 4mm (5/32") | | | | | 4.8mm (3/16") | | | | |
|---------------|---------------|--|--------|-------------------------|----|------|-----|-----|-------------------------|----|------|-----|-----|----------------------------|----|------|-----|-----|
| | | NPS Pipe Size of Distribution Lateral Pipe | inch | 0.7 5 | 1 | 1.25 | 1.5 | 2.0 | 0.7 5 | 1 | 1.25 | 1.5 | 2.0 | 0.7 5 | 1 | 1.25 | 1.5 | 2.0 |
| | | | mm | 20 | 25 | 32 | 40 | 50 | 20 | 25 | 32 | 40 | 50 | 20 | 25 | 32 | 40 | 50 |
| Squirt Height | | Distribution Lateral Pipe Length | | Max. Number of Orifices | | | | | Max. Number of Orifices | | | | | Maximum Number of Orifices | | | | |
| 2 to 4 ft | 0.6 to 1.2 m | 10 ft | 3 m | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| | | 15 ft | 4.6 m | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| | | 20 ft | 6.1 m | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| | | 25 ft | 7.6 m | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| | | 30 ft | 9.1 m | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| | | 35 ft | 10.7 m | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| | | 40 ft | 12.2 m | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| | | 45 ft | 13.7 m | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| | | 50 ft | 15.2 m | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| | | 55 ft | 16.8 m | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| | | 60 ft | 18.3 m | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| | | 65 ft | 19.8 m | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| >4 to 9 ft | >1.2 to 2.7 m | 10 ft | 3 m | 20 | 20 | 20 | 20 | 20 | 20 | 20 | 20 | 20 | 20 | 14 | 20 | 20 | 20 | 20 |
| | | 15 ft | 4.6 m | 26 | 30 | 30 | 30 | 30 | 17 | 30 | 30 | 30 | 30 | 12 | 22 | 30 | 30 | 30 |
| | | 20 ft | 6.1 m | 22 | 40 | 40 | 40 | 40 | 14 | 27 | 40 | 40 | 40 | 10 | 19 | 38 | 40 | 40 |
| | | 25 ft | 7.6 m | 20 | 37 | 50 | 50 | 50 | 13 | 24 | 48 | 50 | 50 | 9 | 16 | 34 | 50 | 50 |
| | | 30 ft | 9.1 m | 18 | 33 | 60 | 60 | 60 | 11 | 21 | 44 | 60 | 60 | 8 | 15 | 30 | 46 | 60 |
| | | 35 ft | 10.7 m | 16 | 31 | 70 | 70 | 70 | 10 | 20 | 40 | 60 | 70 | 7 | 14 | 28 | 42 | 70 |
| | | 40 ft | 12.2 m | 15 | 29 | 58 | 80 | 80 | 9 | 18 | 37 | 56 | 80 | - | 13 | 26 | 39 | 75 |
| | | 45 ft | 13.7 | 14 | 27 | 55 | 82 | 90 | - | 17 | 35 | 53 | 90 | - | 12 | 25 | 37 | 71 |

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| | | | | | | | | | | | | | | | | | | |
|-------------|---------------|-------|--------|----|----|----|----|-----|----|----|----|----|----|----|----|----|----|----|
| | | | m | | | | | | | | | | | | | | | |
| | | 50 ft | 15.2 m | 14 | 25 | 52 | 78 | 100 | - | 16 | 33 | 50 | 96 | - | 11 | 23 | 35 | 67 |
| | | 55 ft | 16.8 m | 13 | 24 | 49 | 74 | 110 | - | 15 | 32 | 47 | 91 | - | 11 | 22 | 33 | 63 |
| | | 60 ft | 18.3 m | 12 | 23 | 47 | 70 | 120 | - | 15 | 30 | 45 | 87 | - | 10 | 21 | 31 | 60 |
| | | 65 ft | 19.8 m | 12 | 22 | 45 | 67 | 130 | - | 14 | 29 | 43 | 83 | - | 10 | 20 | 30 | 58 |
| >9 to 15 ft | >2.7 to 4.5 m | 10 ft | 3 m | 20 | 20 | 20 | 20 | 20 | 20 | 20 | 20 | 20 | 20 | 15 | 20 | 20 | 20 | 20 |
| | | 15 ft | 4.6 m | 26 | 30 | 30 | 30 | 30 | 17 | 30 | 30 | 30 | 30 | 12 | 22 | 30 | 30 | 30 |
| | | 20 ft | 6.1 m | 23 | 40 | 40 | 40 | 40 | 15 | 27 | 40 | 40 | 40 | 10 | 19 | 39 | 40 | 40 |
| | | 25 ft | 7.6 m | 20 | 38 | 50 | 50 | 50 | 13 | 24 | 50 | 50 | 50 | 9 | 17 | 35 | 50 | 50 |
| | | 30 ft | 9.1 m | 18 | 34 | 60 | 60 | 60 | 12 | 22 | 45 | 60 | 60 | 8 | 15 | 31 | 47 | 60 |
| | | 35 ft | 10.7 m | 17 | 32 | 65 | 70 | 70 | 11 | 20 | 41 | 62 | 70 | 8 | 14 | 29 | 43 | 70 |
| | | 40 ft | 12.2 m | 16 | 29 | 60 | 80 | 80 | 10 | 19 | 39 | 58 | 80 | - | 13 | 27 | 40 | 77 |
| | | 45 ft | 13.7 m | 15 | 28 | 56 | 85 | 90 | 10 | 18 | 36 | 54 | 90 | - | 12 | 25 | 38 | 73 |
| | | 50 ft | 15.2 m | 14 | 26 | 53 | 80 | 100 | - | 17 | 34 | 51 | 99 | - | 12 | 24 | 36 | 69 |
| | | 55 ft | 16.8 m | 13 | 25 | 51 | 76 | 110 | - | 16 | 33 | 49 | 94 | - | 11 | 23 | 34 | 65 |
| | | 60 ft | 18.3 m | 13 | 24 | 48 | 72 | 120 | - | 15 | 31 | 46 | 89 | - | - | 22 | 32 | 62 |
| | | 65 ft | 19.8 m | - | 23 | 46 | 69 | 130 | - | 15 | 30 | 44 | 86 | - | - | 21 | 31 | 60 |

Table 13-13 - Orifice Size and Number versus Distribution Lateral Size (Continued)

| | | Orifice Diameter | | 5.6mm (7/32") | | | | | 6.4mm (1/4") | | | | | 7.1mm (9/32") | | | | |
|------------------|--------------|--|-----------|-------------------------------|----|----------|-----|-----|----------------------------|----|------|-----|-----|-------------------------------|----|------|-----|-----|
| | | NPS Pipe Size of Distri- bution Lateral Pipe | inch | 0.75 | 1 | 1.2 5 | 1.5 | 2.0 | 0.75 | 1 | 1.25 | 1.5 | 2.0 | 0.75 | 1 | 1.25 | 1.5 | 2.0 |
| | | | mm | 20 | 25 | 32 | 40 | 50 | 20 | 25 | 32 | 40 | 50 | 20 | 25 | 32 | 40 | 50 |
| Squirt Height | | Distribution Lateral Pipe Length | | Maximum Number of Orifices | | | | | Maximum Number of Orifices | | | | | Maximum Number of Orifices | | | | |
| 2 to 4 ft | 0.6 to 1.2 m | 10 ft | 3 m | 10 | 19 | 20 | 20 | 20 | 8 | 15 | 20 | 20 | 20 | 6 | 12 | 20 | 20 | 20 |
| | | 15 ft | 4.6 m | 8 | 15 | 30 | 30 | 30 | 6 | 12 | 24 | 30 | 30 | 5 | 9 | 19 | 28 | 30 |
| | | 20 ft | 6.1 m | 7 | 13 | 27 | 40 | 40 | 6 | 10 | 21 | 31 | 40 | 4 | 8 | 16 | 24 | 40 |
| | | 25 ft | 7.6 m | 6 | 12 | 24 | 36 | 50 | 5 | 9 | 18 | 27 | 50 | - | 7 | 15 | 22 | 42 |
| | | 30 ft | 9.1 m | 6 | 11 | 22 | 32 | 60 | - | 8 | 17 | 25 | 48 | - | 7 | 13 | 20 | 38 |
| | | 35 ft | 10.7 m | - | 10 | 20 | 30 | 57 | - | 8 | 15 | 23 | 44 | - | - | 12 | 18 | 35 |

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| | | | | | | | | | | | | | | | | | | |
|-------------|---------------|-------|--------|----|----|----|----|----|---|----|-----|----|----|---|----|----|----|----|
| | | 40 ft | 12.2 m | - | 9 | 19 | 28 | 53 | - | - | 14 | 21 | 41 | - | - | 11 | 17 | 32 |
| | | 45 ft | 13.7 m | - | 9 | 17 | 26 | 50 | - | - | 13 | 20 | 38 | - | - | 11 | 16 | 30 |
| | | 50 ft | 15.2 m | - | - | 16 | 25 | 47 | - | - | 13 | 19 | 36 | - | - | 10 | 15 | 29 |
| | | 55 ft | 16.8 m | - | - | 16 | 23 | 45 | - | - | 12 | 18 | 34 | - | - | - | 14 | 27 |
| | | 60 ft | 18.3 m | - | - | 15 | 22 | 43 | - | - | 12 | 17 | 33 | - | - | - | 14 | 26 |
| | | 65 ft | 19.8 m | - | - | 14 | 21 | 41 | - | - | - | 16 | 31 | - | - | - | 13 | 25 |
| >4 to 9 ft | >1.2 to 2.7 m | 10 ft | 3 m | 11 | 20 | 20 | 20 | 20 | 8 | 15 | 20 | 20 | 20 | 7 | 12 | 20 | 20 | 20 |
| | | 15 ft | 4.6 m | 9 | 16 | 30 | 30 | 30 | 7 | 12 | 25 | 30 | 30 | 5 | 10 | 20 | 30 | 30 |
| | | 20 ft | 6.1 m | 7 | 14 | 28 | 40 | 40 | 6 | 11 | 21 | 32 | 40 | 5 | 8 | 17 | 25 | 40 |
| | | 25 ft | 7.6 m | 7 | 12 | 25 | 37 | 50 | 5 | 9 | 19 | 28 | 50 | - | 7 | 15 | 22 | 43 |
| | | 30 ft | 9.1 m | 6 | 11 | 22 | 34 | 60 | - | 9 | 17 | 26 | 49 | - | 7 | 14 | 20 | 39 |
| | | 35 ft | 10.7 m | - | 10 | 21 | 31 | 59 | - | 8 | 16 | 24 | 46 | - | - | 13 | 19 | 36 |
| | | 40 ft | 12.2 m | - | 10 | 19 | 29 | 55 | - | - | 15 | 22 | 42 | - | - | 12 | 18 | 34 |
| | | 45 ft | 13.7 m | - | 9 | 18 | 27 | 52 | - | - | 14 | 21 | 40 | - | - | 11 | 16 | 32 |
| | | 50 ft | 15.2 m | - | - | 17 | 26 | 49 | - | - | 13 | 20 | 38 | - | - | 10 | 16 | 30 |
| | | 55 ft | 16.8 m | - | - | 16 | 24 | 47 | - | - | 136 | 19 | 36 | - | - | - | 15 | 28 |
| | | 60 ft | 18.3 m | - | - | 16 | 23 | 44 | - | - | 12 | 18 | 34 | - | - | - | 14 | 27 |
| | | 65 ft | 19.8 m | - | - | 15 | 22 | 43 | - | - | - | 17 | 33 | - | - | - | 14 | 26 |
| | | 10 ft | 3 m | 11 | 20 | 20 | 20 | 20 | 8 | 16 | 20 | 20 | 20 | 7 | 12 | 20 | 20 | 20 |
| | | 15 ft | 4.6 m | 9 | 16 | 30 | 30 | 30 | 7 | 13 | 26 | 30 | 30 | 5 | 10 | 20 | 30 | 30 |
| | | 20 ft | 6.1 m | 8 | 14 | 29 | 40 | 40 | 6 | 11 | 22 | 33 | 40 | 5 | 9 | 17 | 26 | 40 |
| | | 25 ft | 7.6 m | 7 | 13 | 25 | 38 | 50 | 5 | 10 | 20 | 29 | 50 | - | 8 | 16 | 23 | 44 |
| | | 30 ft | 9.1 m | 6 | 11 | 23 | 35 | 60 | - | 9 | 18 | 26 | 51 | - | 7 | 14 | 21 | 40 |
| | | 35 ft | 10.7 m | - | 10 | 21 | 32 | 61 | - | 8 | 16 | 24 | 47 | - | - | 13 | 19 | 37 |
| | | 40 ft | 12.2 m | - | 10 | 20 | 30 | 57 | - | 8 | 15 | 23 | 44 | - | - | 12 | 18 | 35 |
| >9 to 15 ft | >2.7 to 4.5 m | 45 ft | 13.7 m | - | 9 | 19 | 28 | 53 | - | - | 14 | 21 | 41 | - | - | 11 | 17 | 32 |
| | | 50 ft | 15.2 m | - | 9 | 18 | 26 | 50 | - | - | 14 | 20 | 39 | - | - | 11 | 16 | 31 |
| | | 55 ft | 16.8 m | - | - | 17 | 25 | 48 | - | - | 13 | 19 | 37 | - | - | - | 15 | 29 |
| | | 60 ft | 18.3 m | - | - | 16 | 24 | 46 | - | - | 12 | 18 | 35 | - | - | - | 15 | 28 |
| | | 65 ft | 19.8 | - | - | 15 | 23 | 44 | - | - | - | 18 | 34 | - | - | - | 14 | 27 |

[illegible]

The discharge rate from each orifice in the laterals and from the drain back orifice will be calculated based on $q=16.37CD^2H^{\frac{1}{2}}$ with C equal to 0.6 as given in the following tables.

Table 13-14 - Orifice Discharges in Litres per Minute

| Pressure Head (mm) | Orifice Diameter in mm | | | | | | | | |
|-----------------------|------------------------|--------|--------|--------|--------|--------|--------|--------|--------|
| | 3.2 mm | 4.0 mm | 4.8 mm | 5.6 mm | 6.4 mm | 7.1 mm | 7.9 mm | 8.7 mm | 9.5 mm |
| 600 mm | 0.99 | 1.55 | 2.24 | 3.04 | 3.97 | 4.89 | 6.05 | 7.34 | 8.76 |
| 750 mm | 1.11 | 1.74 | 2.50 | 3.40 | 4.44 | 5.47 | 6.77 | 8.21 | 9.79 |
| 900 mm | 1.22 | 1.9 | 2.74 | 3.73 | 4.87 | 5.99 | 7.42 | 8.99 | 10.72 |
| 1050 mm | 1.31 | 2.05 | 2.96 | 4.02 | 5.26 | 6.47 | 8.01 | 9.71 | 11.58 |
| 1200 mm | 1.40 | 2.20 | 3.16 | 4.30 | 5.62 | 6.92 | 8.56 | 10.58 | 12.38 |
| 1350 mm | 1.49 | 2.33 | 3.35 | 4.56 | 5.95 | 7.34 | 9.08 | 11.01 | 13.13 |
| 1500 mm | 1.57 | 2.45 | 3.53 | 4.81 | 6.28 | 7.73 | 9.57 | 11.61 | 13.84 |
| 1800 mm | 1.72 | 2.69 | 3.87 | 5.27 | 6.88 | 8.17 | 10.47 | 12.72 | 15.16 |

Table 13-15 - Orifice Discharges in Imperial Gallons per Minute

| Pressure Head Feet (ft) | Orifice Diameter in Inches | | | | | | | | |
|-------------------------|----------------------------|------|------|------|------|------|------|-------|------|
| | 1/8 | 5/32 | 3/16 | 7/32 | 1/4 | 9/32 | 5/16 | 11/32 | 3/8 |
| 2.0 ft | 0.22 | 0.34 | 0.49 | 0.66 | 0.87 | 1.09 | 1.35 | 1.64 | 1.95 |
| 2.5 ft | 0.24 | 0.38 | 0.55 | 0.75 | 0.98 | 1.23 | 1.52 | 1.84 | 2.19 |
| 3.0 ft | 0.27 | 0.42 | 0.6 | 0.82 | 1.07 | 1.35 | 1.67 | 2.02 | 2.4 |
| 3.5 ft | 0.29 | 0.45 | 0.65 | 0.88 | 1.15 | 1.45 | 1.8 | 2.17 | 2.59 |
| 4.0 ft | 0.31 | 0.48 | 0.69 | 0.94 | 1.23 | 1.55 | 1.91 | 2.32 | 2.76 |
| 4.5 ft | 0.33 | 0.51 | 0.73 | 1 | 1.3 | 1.64 | 2.03 | 2.46 | 2.93 |
| 5.0 ft | 0.34 | 0.54 | 0.77 | 1.05 | 1.38 | 1.74 | 2.15 | 2.6 | 3.09 |
| 6.0 ft | 0.37 | 0.59 | 0.85 | 1.16 | 1.52 | 1.91 | 2.37 | 2.86 | 3.4 |

- 3) Laterals shall be designed based on the following requirements.
 - a) A distribution lateral pipe shall not be smaller than 19 mm (3/4 in.) in diameter.
 - b) Distribution lateral pipe size shall be determined by Table 13-12 - Orifice Size and Number versus Distribution Lateral Size; or
 - c) Table 13-13 - Orifice Size and Number versus Distribution Lateral Size (Continued) or by using good engineering practice.
 - d) An individual distribution lateral pipe shall not be longer than 20 m (65ft) from the distribution header to the last orifice.
 - e) An individual distribution lateral pipe is required for each chamber assembly where chambers are used.
 - f) The flow velocity shall be maintained above a minimum flow velocity in the piping of 0.6 m/s (2 ft/s) except in a lateral pipe where the minimum velocity is only required at the supply end.
 - g) The flow velocity shall be maintained below a maximum flow velocity of 1.5 m/s (5 ft/s) where the system includes any quick-closing valves.

- h) The pressure head shall be not less than 1.5 m (5 ft) at orifices that are 4.8 mm (3/16 in) in diameter or smaller, and 600 mm (2ft) at orifices that are larger than 4.8 mm (3/16 in) in diameter.
 - i) Distribution lateral piping that is not encased in trench media shall be supported at intervals of 1.2 m (4 ft) or less, unless otherwise specified by the pipe manufacturer.
 - j) Distribution lateral piping that is not encased in Trench Media shall be supported at least 100 mm (4 in) above the sand layer or trench media.
 - k) Access shall be provided for testing and maintenance using cleanouts constructed with 45 degree elbows or sweeps at the far end of each lateral.
 - l) On sloping sites, laterals shall be laid out in such a way to avoid draining effluent down to lower laterals.
- 4) An individual dose is greater than 5 times the volume of the distribution lateral piping as calculated using the Table 13-16.
- 5) The design of the system shall be based on a minimum number of doses per day of
- a) for primary effluent, 4 for demand dosing and 8 for timed dosing, or
 - b) for secondary effluent, 6 for demand dosing and 12 for timed dosing.

Table 13-16 - Piping Liquid Volume

| LIQUID VOLUME OF VARIOUS SIZES OF PLASTIC PIPES | | | | |
|---|--------------------|--------|----------------------------------|-------------|
| Nominal Pipe Diameter | Inside Diameter | | Volume (per 100 feet of pipe) | |
| | mm | inches | liters | Imp Gallons |
| 3/4 | 20.93 | 0.824 | 11 | 2.41 |
| 1 | 26.65 | 1.049 | 17 | 3.74 |
| 1 1/4 | 35.10 | 1.380 | 30 | 6.48 |
| 1 1/2 | 40.89 | 1.61 | 40 | 8.82 |
| 2 | 52.5 | 2.067 | 66 | 14.66 |
| 3 | 77.93 | 3.068 | 145 | 30.0 |
| 4 | 102.26 | 4.026 | 250 | 55.1 |

- 6) All systems shall include an effluent filter suitable for use in a private sewage system.
- 7) Where the system includes a pressure distribution system, the effluent filter shall remove particles 3.2 mm (1/8 in.) in diameter and larger from the effluent prior to downstream treatment or disposal options.
- 8) All effluent filters shall be sized for the required flow rate of the system design and to provide a service interval frequency desired for the system.
- 9) All effluent filters shall be located and installed so they are readily accessible from the ground surface for servicing.
- 10) Any pump used shall be:
- a) suitable for wastewater applications; and
 - b) capable of supplying the pressure head and flow rate required by the system.

13.4.14 Commissioning

- 1) The following activities shall be carried out during commissioning:
- a) Set float switches or transducers, and test the system operation, including alarms.

- b) Set the pump control panel (timers, data loggers and programmable controls) and test operation.
- c) Check the force mains, including the pressure effluent collection mains, for leaks.
- d) Flush all lines in the treatment and pumping systems, transport lines and dispersal system.
- e) Test back-flow preventers (i.e. check valves).
- f) For a gravity distribution system, test and adjust flow splitters to provide even division of the flow.
- g) For a pressure distribution system, test the pressure distribution residual pressures. This may include the final pressure distribution system, and treatment system distribution piping (i.e. sand and textile media filters). Adjust valves, as required, to equalize pressure. Record distal pressures (squirt heights).
- h) For a pressure distribution system, check the time to fully pressurize the system (and either check that at least 66% of the dose is delivered at full pressurization or check distribution uniformity by another method). Adjust dose volume or dose time (for timed dose systems) if needed.
- i) Test and record pump discharge flow rate or draw down.
- j) Record the initial control panel settings, system operating parameters, and the start-up data logs. Note any changes to the design or operational settings.
- k) Complete a general review of the system operation to verify that it is operating as intended, and in accordance with the manufacturer's specifications.
- l) Perform baseline monitoring if applicable,
- m) Put the sewerage system into service. Ensure that the breakers, switches and valves are in operating position, the tank lids are secure and that the site has been left in a safe and tidy condition.

13.4.15 Prohibitions

- 1) A Soil Treatment Field shall not be located under:
 - a) A roadway or driveway;
 - b) A paved area;
 - c) A vehicle parking area;
 - d) Any structure;
 - e) A vegetable garden; or
 - f) An area where shrubs and trees can or will impact the treatment field area.
- 2) A Soil Treatment Field using gravity distribution shall not use serial distribution as a method to distribute effluent to weeping or gravity lateral trenches.
- 3) Gravity distribution shall not be used where:
 - a) the limiting layer is very or extremely gravelly, coarse sand, medium sand, loamy coarse sand, loamy medium sand, fine sand, very fine sand, loamy medium sand, loamy fine sand, loamy very fine sand, coarse sandy loam, medium sandy loam;
 - b) the percolation rate is faster than 5 minutes per inch;
 - c) the coarse fragment content of the soil is more than 60% (soil particles larger than 2 mm);
 - d) there is treatment system sand below the infiltrative surface;
 - e) secondary treated effluent or better is applied to the infiltration surface;
 - f) the soil treatment field is a Type II mound or raised field; or,
 - g) the land slope is over 15% in the dispersal area unless a pressure manifold is used.

13.4.16 Materials

- 1) Trench media shall be:
 - a) Granular Lateral Trench Distribution Media
 - i) Granular Lateral Trench Media shall be clean washed crushed rock; and
 - ii) Granular Lateral Trench Media shall have a particle-size distribution conforming to:
 - (1) 100% passing the 50 mm (2in) sieve
 - (2) 0 to 25% passing the 12.5 mm (1/2 in) sieve
 - (3) 0 to 10% passing the 9.51 mm (3/8 in) sieve
 - (4) 0 to 2 % passing the 1.18 mm (3/64 in) sieve
 - (5) 0 to 1 % passing the 0.15 mm (0.0059 in) sieve, or
 - b) Tire Chip Media
 - i) Tire Chip Media shall be:
 - (1) free (95% or better by weight) of balls of wire and fine rubber particles less than 2 mm.
 - (2) clean and free (95% or better by weight) of any soil particles (fines) either adhering to the chips or floating loose within the chips.
 - (3) nominally 5 cm (2 in) in size and may range from 1.25 cm (½ in) to a maximum of 10 cm (4 in) in any one direction (95% or better by weight).
 - (4) Free of wire protruding more than 2.5 cm (1 in) from the sides of the chips (85% or better by weight).
 - ii) Tire-derived aggregate that meets type A TDA of the ASTM Standard D6270 “Standard Practice for Use of Scrap Tires in Civil Engineering Applications” may be used as a replacement for Tire Chip Media.
 - iii) Contractors seeking approval to use tire chip coarse aggregate in a soil absorption system shall, upon request by a local authority, provide documentation of the tire chip aggregate size and quality.
- 2) Treatment System Sand is a treatment media and shall
 - a) Meet one of the following specifications:
 - i) The concrete sand specification provided in CAN/CSA-A23.1, “Concrete Materials and Methods of Concrete Construction”
 - ii) The concrete sand specification provided in ASTM-C33, “Standard Specification for Concrete Aggregates,” or
 - iii) A particle-size distribution of:
 - (1) 100 % passing the 9.51 mm (3/8 in) sieve,
 - (2) 95 to 100 % passing the 4.76 mm (0.187 in) sieve,
 - (3) 80 to 100 % passing the 2.36 mm (0.0937 in) sieve,
 - (4) 45 to 85 % passing the 1.18 mm (0.0469 in) sieve,
 - (5) 15 to 60 % passing the 0.6 mm (0.0234 in) sieve,
 - (6) 3 to 10 % passing the 0.3 mm (0.0117 in) sieve,
 - (7) 0 to 1 % passing the 0.15 mm (0.0059 in) sieve,
 - b) have no more than 1 percent of a particle size passing through a 0.15 mm (0.0059 in) sieve;
 - c) have less than 1% fines by weight;
 - d) have an effective particle size (D10) of not less than 0.3 mm (0.0117 in);
 - e) have a uniformity coefficient of between 4 and 6; and

f) be well washed.

13.4.17 Setbacks

- 1) Setbacks are measured from the infiltrative surface edge to the outside edge of the features identified below.

Table 13-17 - Soil Treatment Field Setbacks

| Type of Soil Treatment Fields | | | | |
|-------------------------------|------------------|-------------|-------------|-------------|
| Set Back Requirements | Absorption Field | Mound I | Mound II | LFH |
| Basement/Building | 9m (30ft) | 9m (30ft) | 9m (30ft) | 9m (30ft) |
| Cistern | ---- | ---- | ---- | ---- |
| City, Town, Village | ---- | ---- | ---- | ---- |
| Cut/ Embankment | 3m (10ft) | 3m (10ft) | 3m (10ft) | 3m (10ft) |
| Ground Water Table | 1.5 m (5ft) | 1.5 m (5ft) | 1.5 m (5ft) | 1.5 m (5ft) |
| Large Tree | ---- | ---- | ---- | ---- |
| Property Boundary | 3m (10ft) | 3m (10ft) | 3m (10ft) | 3m (10ft) |
| Rec. Area | 60m (200ft) | 60m (200ft) | 60m (200ft) | 60m (200ft) |
| Walk/ Driveway | 1.5 m (5ft) | 1.5 m (5ft) | 1.5 m (5ft) | 1.5 m (5ft) |
| Water Course | 15m (50ft) | 15m (50ft) | 15m (50ft) | 15m (50ft) |
| Water Source | 15m (50ft) | 15m (50ft) | 15m (50ft) | 15m (50ft) |

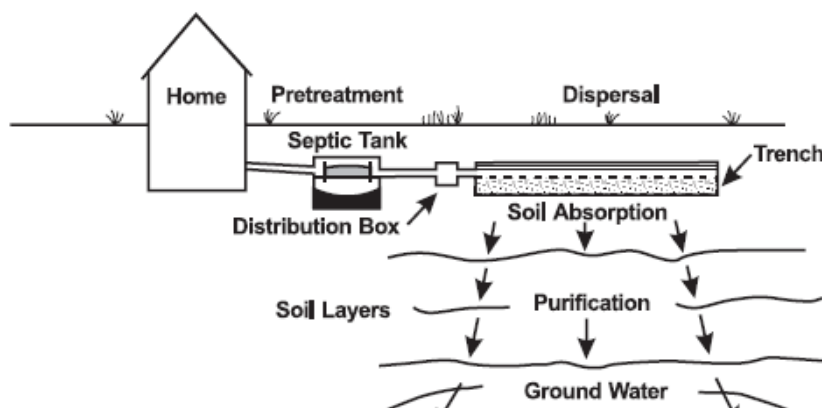
- 2) Unless otherwise approved by a Public Health Inspector, (through consultation with Water Security Agency officials), the setback distance from a well that is used as a water source for a municipal waterworks - should be at least 75 m (250 ft) in the case of a small municipality (population less than 1,000) and at least 225 m (750 ft) in the case of a large municipality (population 1,000 or more).

14 ABSORPTION FIELDS

14.1 DEFINITION

An absorption field system is a series of perforated pipes laid in trenches, which spread effluent from a septic tank through a void space before it enters the surrounding soil. It is a type of soil treatment system (Figure 14-1).

Figure 14-1 - Absorption Field



14.2 FUNCTION

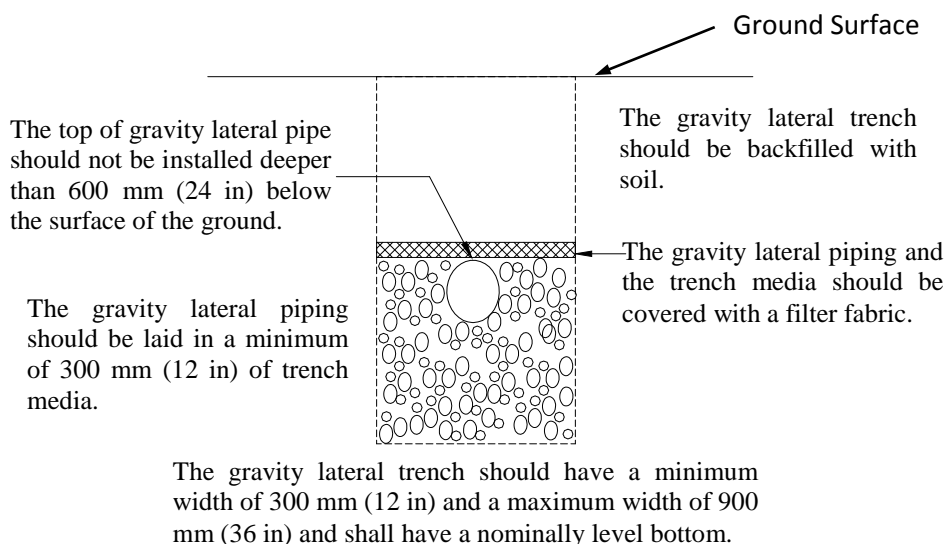
The partially treated wastewater (primary effluent) leaving the septic tank is discharged below the ground surface into a drainage field. Here the water receives secondary treatment by natural processes in the soil as described in soil treatment fields

14.3 DESIGN

An absorption field system can be designed with gravity distribution or pressure distribution in the soil treatment field.

Dosing an absorption field can be accomplished by a siphon in the effluent chamber or by pump. The type of dosing can be gravity, demand dosing or timed dosing (see Soil Treatment Fields).

Figure 14-2 – Gravity (Weeping) Lateral Trench



14.3.1 Gravity Effluent Distribution Systems

In gravity distribution, primary effluent is either pumped from the working chamber of the septic tank or transferred using a siphon. A well-maintained gravity distribution system can last for many years. Effluent spreads through the trench using hydrostatic head as the driving force. The development of a biomat is critical and aids in the distribution of effluent. Gravity effluent distribution system should be designed to provide approximately equal distribution of effluent to each gravity lateral trench.

14.3.2 Pressure Effluent Distribution Systems

In pressurized distribution systems, primary effluent is pumped from the working chamber of the septic tank and provides for even distribution of effluent through the entire system. This allows for a dosing-resting cycle so that re-oxygenation and rejuvenation of the absorption field can occur. In other words, such systems are pressurized and designed to "dose" the absorption field, wetting the entire leaching area at one time. The field should then have time to dry out and aerate before the next dose is applied. For this reason, it is important to maintain the dosing volume specified in the system design.

14.4 INSTALLATION

14.4.1 Site Selection

Like all soil treatment fields, it is important to maintain the horizontal separation distances from water supply wells, surface waters, springs, cuts, the boundary of the property, and the building foundation. Systems should not be constructed in flood plains, drainage ways, or depressions unless flood protection is provided.

14.4.2 Soil Depth

Absorption fields should be located so as not to impact on the water table.

Absorption field design begins by establishing the presence of a restrictive layer and a limiting layer. This is accomplished by excavating test pits. By determining the depth to any impermeable layer or saturated soil, the viability of an absorption field can be established.

14.5 CARE AND MAINTENANCE

Care should be taken never to drive over the absorption field before, during, or after construction. To do so may compact soil and crack and/or tilt the pipes, which will seriously limit the effectiveness of the system.

In order to prevent freezing during the winter months, lateral trenches should be covered during the winter months with:

- at least 0.5 m (1.75 ft) of snow; or
- the use of straw bales when snow cover is inadequate.

Grass cover should be established over the entire site.

14.6 REQUIREMENTS

14.6.1 General

- 1) A soil absorption field shall meet all the requirements for a soil treatment field except where noted in this section.
- 2) The geometry of an absorption field shall be arranged to have the longest axis perpendicular to the slope direction except where there is documentation that the direction of groundwater movement or slope of the restrictive layer is different from the slope of the land in which case the long axis shall be perpendicular to ground water flow or restrictive layer slope.

14.6.2 Trench Design

- 1) A trench used in a soil treatment field shall:
 - a) Be not more than 900 mm (3ft) deep.
 - b) Be between 300 mm (1 ft) and 900 mm (3 ft) wide.
 - c) Have a nominally level bottom.
 - d) Have a void space created by:
 - i) A chamber;
 - ii) For gravity distribution:
 - (1) Trench Media to at least 150 mm (6 in) depth below the distribution pipe and at least 50 mm (2 in) above the pipe; or
 - (2) Treatment System Sand 100 mm (4 in) covered by 50 mm (2in) of Trench Media below the distribution pipe and at least 5 cm (2 in) above the pipe.
 - iii) For pressure distribution:
 - (1) Trench Media to at least 225 mm (9 in) depth below the distribution pipe and at least 5 cm (2 in) above the pipe; or
 - (2) Treatment System Sand 150 mm (6 in) covered by 75 mm (3in) of Trench Media below the distribution pipe and at least 50 mm (2 in) above the pipe.
- 2) The void space shall be covered with a separation material that will prevent the migration of soil particles into the void space and allow movement of air into the system.
- 3) At least 450 mm (18 in) of cover shall be above the separation material to the natural surface of the ground.
- 4) If providing soil cover deeper than 300 mm (1ft), use clean coarse sand or treatment system sand to add depth prior to placing the cover soil
- 5) Adjacent trenches shall have at least 900 mm (3ft) of earth between their closest sidewalls.

14.6.3 Raised treatment field

- 1) Where the bottom of the trench forming the soil infiltration surface is within the surface vegetation thatch zone or above the elevation of the in-situ soil,
 - a) the soil interface at the in-situ surface directly below the trench bottom shall be broken up, or the thatch removed to develop strong contact between the fill material of the trench and the in-situ soil,
 - b) the fill material that is directly under the trench bottom, from the in-situ surface to the finished elevation of the soil infiltration surface area shall meet the requirements of sand specified in treatment system sand, and
 - c) effluent shall be distributed through the laterals using pressure distribution.
- 2) A raised treatment field shall only be used where there is at least 600 mm (2ft) of in situ soil with an effluent loading rate that is not equal to 0.
- 3) Coarse sand, medium sand, fine sand, loamy medium sand, or loamy coarse sand backfill material shall be used to cover the area of the raised treatment field and placed over the gravel layer of the trenches or chambers to a depth of 300mm (1 ft) to 600mm (2 ft).
- 4) The first 300 mm (1ft) of fill material, if used, is intended to improve the quality of effluent.
- 5) 75 mm (3 in) of soil having a texture not finer than sandy loam and not coarser than loamy fine sand shall be placed over the fill material to cover the entire area of the raised treatment field in order to support grass cover.
- 6) A grass cover shall be established on the entire area of the raised treatment field.

- 7) The side slopes of the raised treatment field shall not be steeper than 3:1 (H:1).

14.6.4 Gravelless Systems

- 1) Follow manufacturer's instructions for installation.
- 2) For single and multiple pipe gravelless systems, the effective trench width is taken to be the outside diameter of the pipe (including any attached artificial aggregate), pipe and aggregate bundle, or pipe bundle. The maximum effective trench width is 900 mm (3 ft).
- 3) For chamber systems:
 - a) the effective trench width is taken to be, at a maximum, the outside dimensional width of the chamber in contact with the bottom of the trench or bed;
 - b) the maximum effective width of a chamber system is 900 mm (3 ft);
 - c) they shall be certified to the American Association of State Highway and Transportation Officials H-10 or H-20 ratings; and
 - d) where an effluent piping running the total length of the trench is not present, a means to dissipate the hydraulic energy of the effluent delivered to the trench by using geotextile fabric or 50 mm (2 in) of gravel shall be in all areas of the trench within 1.5 m (5 ft) of the location receiving effluent.
- 4) For geo-composite systems:
 - a) the effective trench width is taken to be the outside dimension(s) of the bundle(s) in contact with the trench or bed base (or sand layer, where used). The maximum effective trench width is 900 mm (3 ft).
- 5) For tire chip media,
 - a) they shall be firmly compacted prior to covering with a filter fabric;
 - b) the tire chip aggregate shall be covered with a layer of non-woven filter fabric extending across the top of the tire chip aggregate before backfilling;
 - c) all tire chips not used in the soil absorption system shall be removed from the site by the installer or contractor of the system and the site shall be cleaned-up to ensure that no chipped tires or related material remain after completion of the system;
 - d) any tire chips placed on top of the filter fabric after system inspection shall be covered adequately to prevent persons or pets from being punctured by the wires; and,
 - e) contractors are responsible to ensure that an appropriate level of cover (which may include a straw layer above the filter fabric) to prevent an undue risk of freezing.

14.6.5 Installation

- 1) The trench media and, where used, treatment system sand shall be put in place using methods that minimize compaction of the soil and prevent smearing or glazing of soil in the trench.
- 2) Scarify the trench base.
- 3) Scarify any smeared sidewalls.
- 4) Crown and grade the cover soil to shed water.
- 5) Once the trench is constructed, the berm shall immediately have a suitable grass seed applied in order to establish a sod layer as soon as possible.

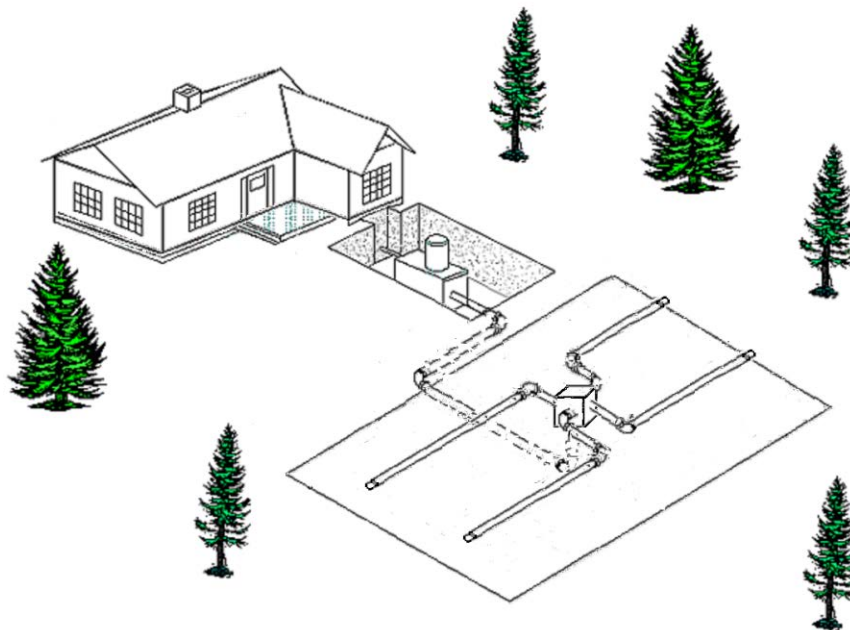
15 TYPE I MOUNDS

15.1 DEFINITION

A Type I Mound is preferred over open discharge. However, a Type I Mound does not meet all the design principles of a soil treatment field. These systems may be installed in areas where a jet is not permitted due to the lot size or surrounding density. However, given the increased number of surrounding residents, it is important that the system be designed properly.

A Type I Mound is a sewage disposal system consisting of a series of perforated laterals on a graded stone bed above the natural soil surface. These perforated laterals receive wastewater effluent from a septic tank through a distribution box. The effluent is transmitted into the graded stone bed and natural soil for final treatment and disposal.

Figure 15-1 - Type I Mound



15.2 FUNCTION

Type I mounds have two key functions: to dispose of effluent from the septic tanks and to distribute this effluent in a manner that prevents animals and people from being able to come into contact with the partially treated effluent.

Sewage effluent is pumped from the septic tank to the distribution box and then allowed to flow by gravity out to the distribution laterals within the covered area onto the prepared stone. Effluent is spread over the graded stone and allowed to percolate through this layer.

15.3 DESIGN

The following concepts should be included in the design and construction process of the mound to ensure proper performance:

- Plow topsoil before placement of the sand or stone fill material.
- On sites where a nominally level in situ surface cannot be constructed, a layer of treatment sand shall be used to level the infiltrative surface.
- Uniformly distribute the effluent over the seepage area.

Type I mounds can only be used in locations where gravity distribution is permitted.

15.3.1 Sizing the System

The infiltration area of the mound is that area of soil covered by the mound and that receives effluent. The berms located at the ends of the mound are necessary for mound construction but the soil under these berms is not considered part of the total infiltrative area. Only the area beneath the graded stone is considered part of the infiltrative area. To prevent seepage at the toe of the berm, the area of the soil receiving the effluent must be sized to absorb the expected loads.

A Type I Mound is sized according to the type of underlying natural soil.

Figure 15-2 - Type I Mound Plan View

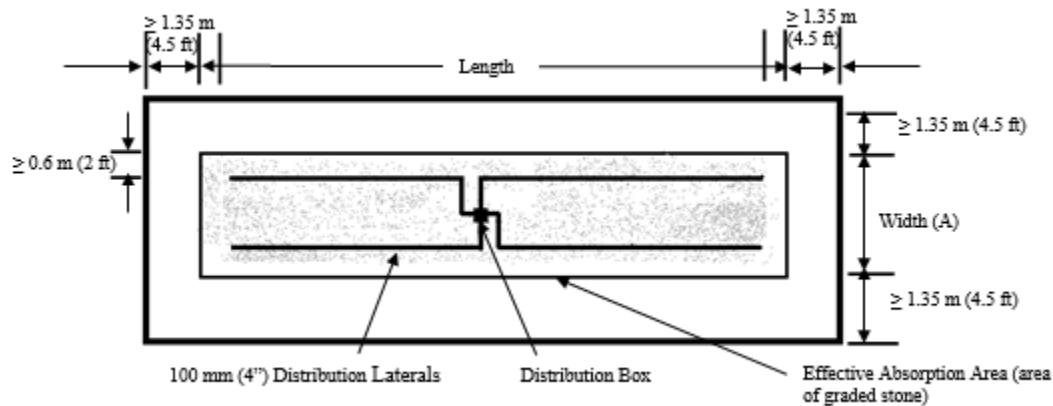
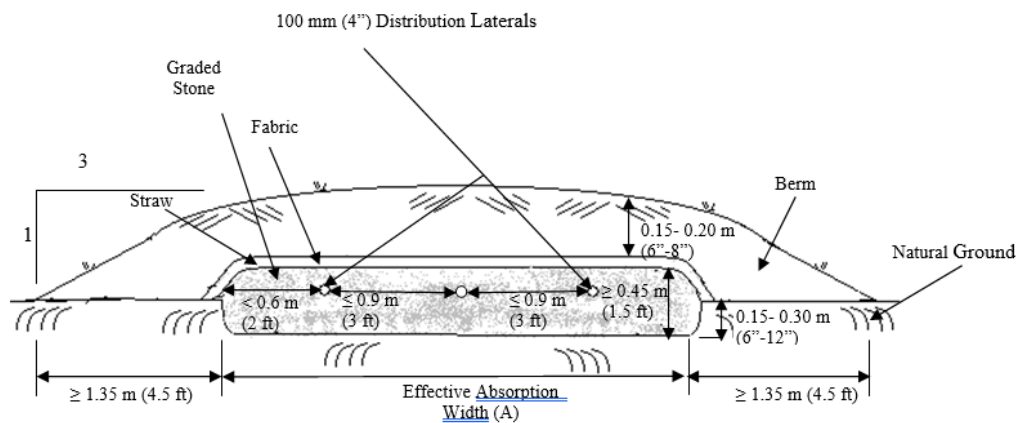


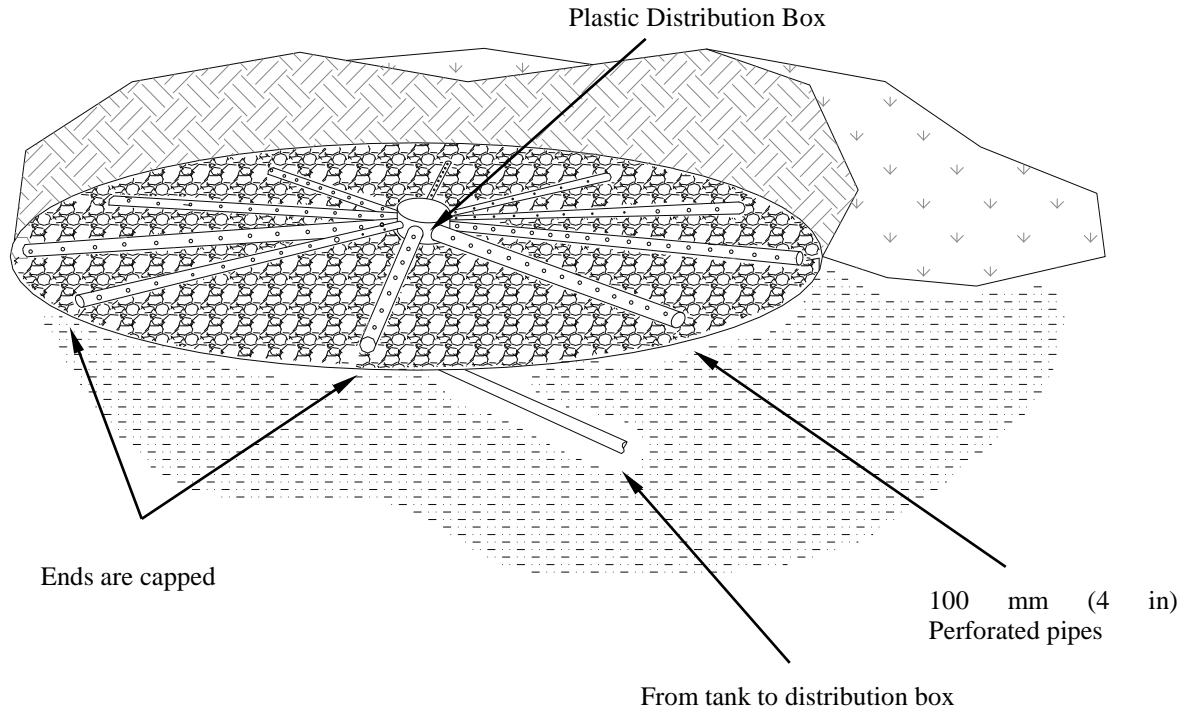
Figure 15-3 - Type I Mound Cross-Section



15.3.2 Alternative Type I Mound

An alternative form of the Type I mound is available for typical residential installations. Where the installer believes that this alternative Type I mound will perform adequately and where approved by the local authority, the following design criteria can be used to make a circular Type I mound.

Figure 15-4 - Alternative Type I Mound

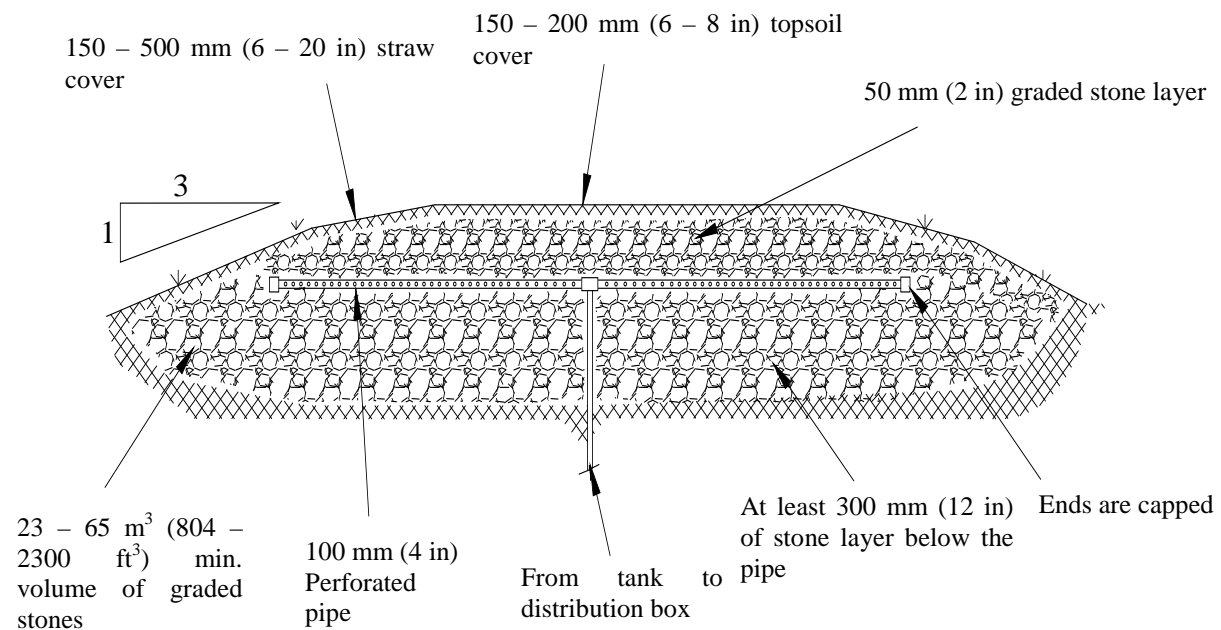


For a three bedroom house, the dimensions of an Alternative Type I Mound may be:

- Where native soil is loamy sand:
 - Area: 50 m² (534ft²);
 - Total Diameter: 8.0 m (26 ft);
 - Length of each of the 10 laterals: 2.75 m (9 ft);
 - Minimum volume of graded stone: 23 m³ (800 ft³).
- Where native soil is sandy loam:
 - Area: 69.7 m² (750 ft²);
 - Total Diameter: 9.4 m (30.9 ft);
 - Length of each of the 10 laterals: 3.5 m (11.45 ft);
 - Minimum volume of graded stone: 31.9 m³ (1125 ft³).
- Where native soil is loam:
 - Area: 89.6 m² (964 ft²);
 - Total Diameter: 10.7 m (35 ft);
 - Length of each of the 10 laterals: 4.1 m (13.5 ft);
 - Minimum volume of graded stone: 41 m³ (1446 ft³).
- Where native soil is silt loam or sandy clay loam:
 - Area: 112 m² (1205 ft²);
 - Total Diameter: 12 m (39.2 ft);
 - Length of each of the 10 laterals: 4.75 m (15.6 ft);
 - Minimum volume of graded stone: 51.2 m³ (1808 ft³).

- Where native soil is silt:
 - Area: 125.4 m² (1350 ft²);
 - Total Diameter: 12.6 m (41.5 ft);
 - Length of each of the 10 laterals: 5.1 m (16.7 ft);
 - Minimum volume of graded stone: 57.3 m³ (2025 ft³).
- Where native soil is clay loam:
 - Area: 142.5 m² (1534 ft²);
 - Total Diameter: 13.5 m (44.2 ft);
 - Length of each of the 10 laterals: 5.5 m (18.1 ft);
 - Minimum volume of graded stone: 65 m³ (2300 ft³).

Figure 15-5 - Alternative Type I Mound Cross Section



15.4 INSTALLATION

15.4.1 Site Selection

If considering a Type I Mound, it is important to maintain the horizontal separation distances from water supply wells, surface waters, springs, cuts, the boundary of the property, and the building foundation. A Type I Mound should not be constructed in flood plains, drainage ways, or depressions unless flood protection is provided.

15.4.2 Soil Depth

A Type I Mound should be located so as not to impact on the water table.

15.5 CARE AND MAINTENANCE

Like other systems, poor maintenance could lead to early system failure. If Type I mounds are improperly designed or constructed, the following problems can occur:

- Clogging of part or all of the distribution system.
- Seepage out of the system.
- Spongy areas on the side or top of the system.
- Ponding of effluent in the system, resulting in system overload and failure.

To minimize the risk of system failure:

- Divert all surface runoff away from the system.
- Timed dosing regularly throughout the day.
- Install water-saving devices on fixtures to prevent system overload.
- Keep all traffic off the system.
- Keep shrubs and trees off the system.
- Plant grass on the system surface to prevent erosion.

In order to protect from freezing the system is kept covered during the winter months with:

- at least 0.5 m (1.7 ft) of snow; or
- when there is inadequate snow cover, the use of straw bales.
- Rigid insulation inserted into inspection ports will also help to reduce freezing concerns.

15.6 Requirements

15.6.1 General

- 1) A Type I Mound shall meet all the requirements for a Soil Treatment Field except where noted in this section.
- 2) The geometry of the sand layer and the Type I mound shall have its longest axis perpendicular to the slope direction except where there is documentation that the direction of groundwater movement or slope of the restrictive layer is different from the slope of the land in which case the Type I mound's long axis shall be perpendicular to ground water flow or restrictive layer slope.
- 3) A Type I mound shall not be constructed on a slope greater than 15%.
- 4) An Alternative Type I mound may only be installed where:
 - a) there are four bedrooms or less and there are no extra flows;
 - b) there is more than 1200 mm (48 in) of vertical separation between the proposed native soil infiltration surface and the restrictive layer; and,
 - c) the slope is less than 10%.

15.6.2 Sand Layer

- 1) A leveling sand layer is required where:

- a) the slope is greater than 10%; or
 - b) the in situ soil infiltration surface is not nominally level.
- 2) Where used, the leveling sand layer shall:
- a) meet the requirements of treatment system sand;
 - b) be hydraulically loaded based on the native in situ soils;
 - c) be nominally level along its top surface; and
 - d) be constructed on or above the existing native soil.

15.6.3 Stone Layer

- 1) The layer of stone or crushed rock shall be constructed of trench media.
- 2) The stone layer shall be a minimum of 450 mm (18 in) in depth.
- 3) The stone layer shall have a width as measured along the top of the sand layer based on the linear loading rate where the infiltration distance is the in situ soil portion of the vertical separation, except where an Alternative Type I mound is used.

15.6.4 Infiltration Surface

- 1) The infiltration surface for a Type I mound is defined as being the upper surface of the native in situ soil after installation.
- 2) For an alternative Type I mound, the native in situ soil should be removed to a maximum depth of 300 mm (12 in).
- 3) For a Type I mound, the native soil shall be:
 - a) removed to create a shallow bed; and,
 - b) in no area be more than 300 mm (12 in) below the original native soil surface.
- 4) The native soil infiltration surface hydraulic loading rate shall:
 - a) be determined based on primary treated effluent; and,
 - b) include the area of contact with the in situ soil that is underneath the rock layer forming the mound, excluding the end slopes.
- 5) The width of the native soil infiltration surface shall be no wider than 3 m (10 ft), except where an alternative Type I mound is used.
- 6) Where an alternative Type I mound is used, the native soil infiltration surface shall be nominally level.

15.6.5 Berm

- 1) The soil forming the berm covering the native soil infiltration surface area shall
 - a) have a texture classification of coarse sand, medium sand, fine sand, loamy fine sand, loamy medium sand, sandy loam, or loamy coarse sand;
 - b) be at a minimum of 150 mm (6 in) deep;
 - c) be sloped to ensure the drainage of surface water from the mound; and,
 - d) extend a minimum of 600 mm (2 ft) beyond the sides of the infiltrative surface.
- 2) The berm shall be covered with 75 mm (3 in) of soil suitable for supporting grass cover.
- 3) The slopes of the finished mound berm surface shall not be steeper than 3:1 (3H to 1V).

15.6.6 Effluent Distribution

- 1) The distribution of effluent onto the leveling sand layer or native soil shall:
 - a) be done using gravity distribution pipes that are located in a void space created by:
 - i) a chamber covering more than 80% of the infiltration surface, or

- ii) trench media to at least 300 mm (12 in.) depth below the distribution pipe and at least 50 mm (2 in.) above the pipe.
- 2) The void space shall be covered with a separation material that will prevent the migration of soil particles into the void space and allow movement of air into the system.
- 3) Gravelless systems shall not be used in alternative Type I mounds.
- 4) Each gravity lateral end shall be no closer than 0.5 m (1.5 ft) to the edge of the infiltration surface.
- 5) Gravity laterals shall be no more than 600 mm (2 ft) from the edge of the infiltration surface.
- 6) Gravity laterals shall be spaced at no more than 900 mm (3 ft) on center, except where an alternative Type I mound is used.
- 7) Gravity laterals shall be evenly spaced across the infiltration surface.

15.6.7 Monitoring Ports

- 1) The monitoring ports required for soil treatment fields shall be located within 4.5 m (14.75 ft) of each end of the leveling sand layer and, where the slope is less than 1%, along the centerline of the length of the mound or, in other cases, on the downstream edge of the leveling sand layer.
- 2) The monitoring ports shall be located 100-150mm (4-6in) from the outermost lateral pipes.

Recommendation: Rigid insulation installed within the monitoring port piping can provide additional frost protection.

15.6.8 Location

- 1) A minimum parcel size of 465 m² (5000 ft²) is required for a Type I mound.
- 2) When Type I Mounds are located on slopes, a diversion shall be constructed immediately up slope to intercept and direct run-off water away from the discharge point.

15.6.9 Installation

- 1) Scarify the infiltration surface in a manner that does not destroy the soil structure.
- 2) Scarify any smeared sidewalls.
- 3) The native soil infiltrative surface shall be nominally level or, where an alternative Type I mound is not used, a leveling layer of treatment sand shall be used.
- 4) The void space shall be covered with a separation material that will prevent the migration of soil particles into the void space and allow movement of air into the system.
- 5) The graded stone and filter fabric may be covered with straw to a depth of 150 mm to 500 mm (6 in to 20 in) where the designer believes there is an increased risk of freezing.
- 6) Once the mound is constructed, the berm shall immediately have a suitable grass seed applied in order to establish a sod layer as soon as possible.

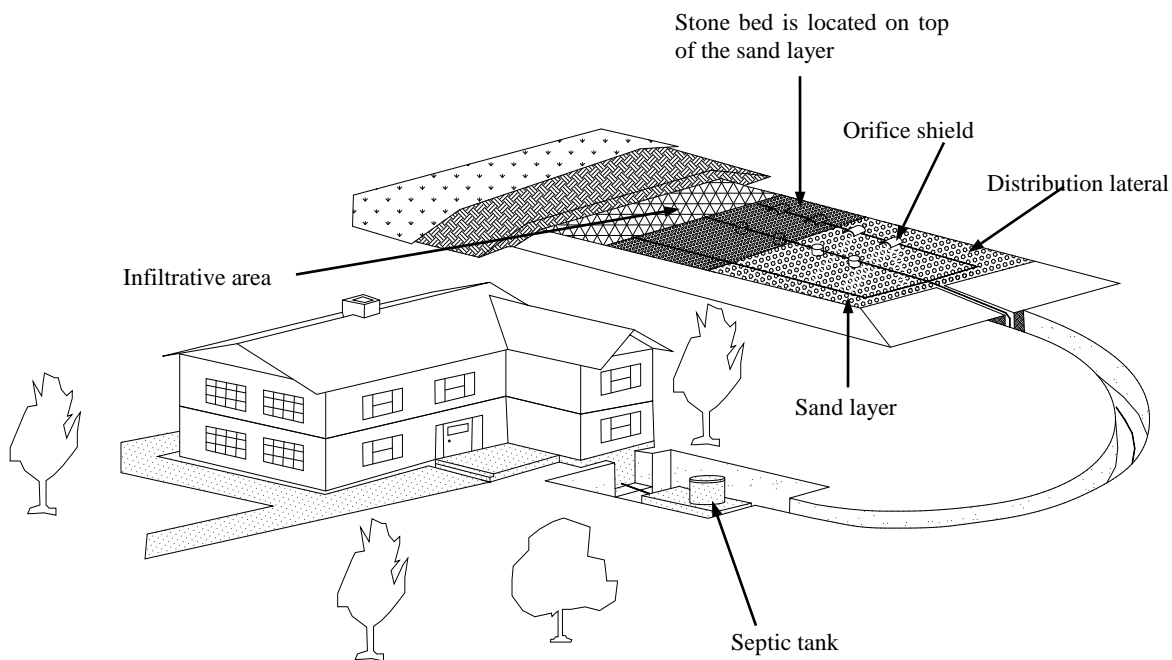
16 TYPE II MOUNDS

16.1 DEFINITION

Mounds are an excellent treatment and disposal choice; however, it cannot be overemphasized that careful planning and design, filter media selection, construction and maintenance of the mound is critical. Mound systems require an environment for microbial activity so care in the material selection and construction steps must be taken to provide such an environment.

This mound is a wastewater treatment system that is raised above the natural soil surface in a specific graded, clean sand media. Perforated laterals under pressure receive wastewater effluent from a septic tank. Laterals distribute the effluent over a gravel bed and sand media. The sand layer is overlain with a gravel or chambers to assist in the distribution of the effluent over the entire surface of the sand layer and provide brief storage for the effluent as it is pumped onto the mound. The covering soil, loamy sand, must be porous to provide good aerobic conditions in the sand layer. Using a clay soil for covering material would limit air movement into the mound causing anaerobic conditions and greatly reduce the effectiveness of the sand layer.

Figure 16-1 - Type II Mound



16.2 FUNCTION

Sewage mounds have two key functions: to dispose of effluent from the septic tanks and to distribute this effluent in a manner allowing adequate natural wastewater treatment in the sand bed and natural soil before the effluent reaches the underlying groundwater.

Sewage effluent is pumped from the septic tank to the distribution laterals under pressure. Effluent in the laterals is spread over the gravel and sand and allowed to percolate through this layer removing the organic load in the effluent. The effluent undergoes biological treatment as it passes through the different layers of gravel, sand and soil to the natural environment. The mound treatment produces an effluent that is equivalent or better than other conventional onsite disposal systems.

Type II mounds offer a possible solution to difficult soil conditions or other site restrictions such as a high water table. If the soil percolation rate is either too fast or too slow or a seasonally saturated soil

or water table exists closer than 900 mm (3 ft) from the surface, construction of a Type II mound may be an option.

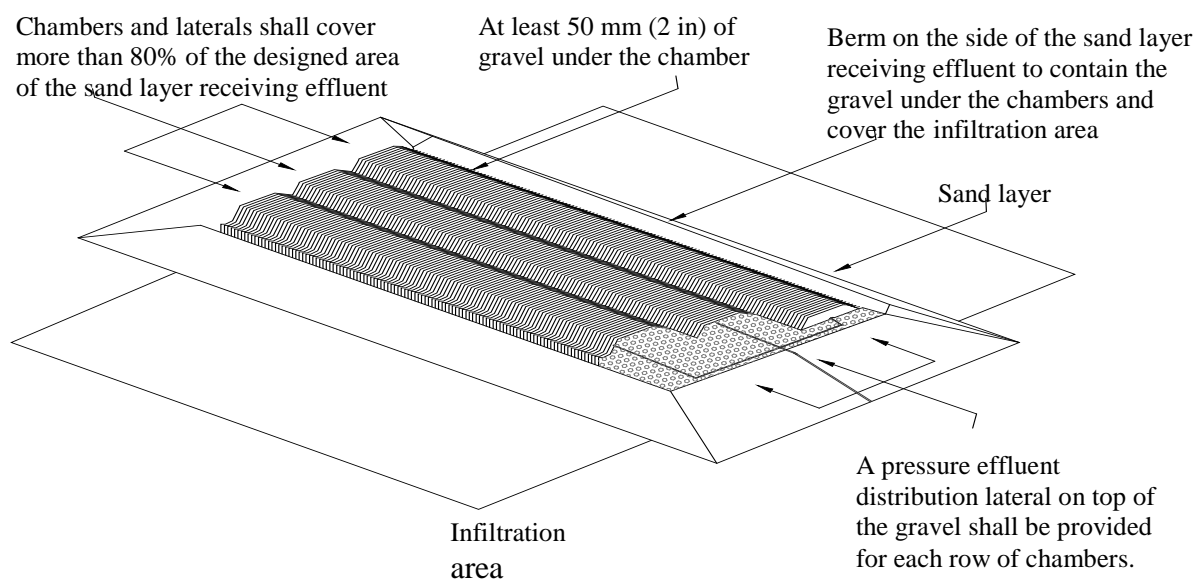
16.3 DESIGN

To ensure proper performance of the mound system, the following concepts must be included in the design and construction process:

- Quality of clean sand fill
- Size and shape (infiltrative area)
- Soil surface preparation
- Construction procedures (leaving the topsoil in place but tilling it before placement of the sand fill)
- Distribution of effluent
- Dosing quantity
- Location

The area of the mound within the berm, excluding the end slopes, providing the infiltration area into the

Figure 16-2 - Type II Mound Details



original soil should be constructed of a loamy sand or sandy loam fill material.

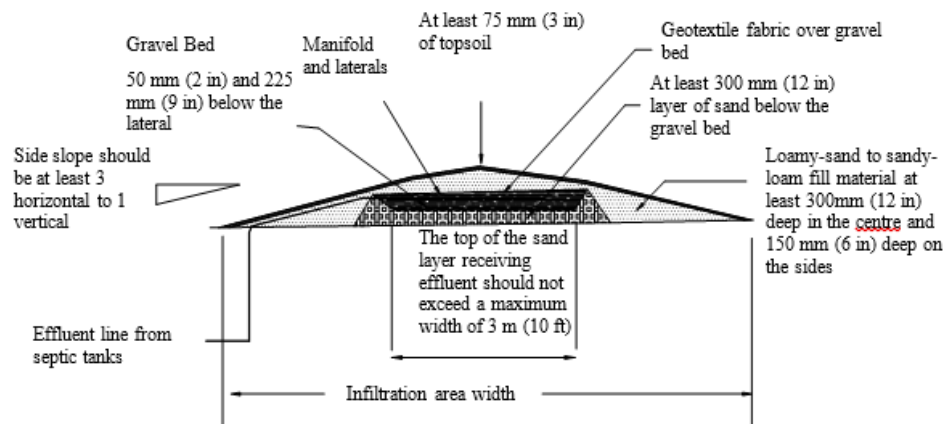
The effluent pump rate of discharge should be designed to evenly deliver effluent to the mound while maintaining head pressure. The minimum head pressure is measured at the farthest point of the distribution manifold.

16.3.1 Sizing the System

Proper sizing is key to ensuring the mound system meets the landowner's needs, both current and future. How the mound is designed and constructed will determine the effectiveness of this type of system in handling the sewage volumes produced. Under-sizing a mound will result in certain failure of this type of system.

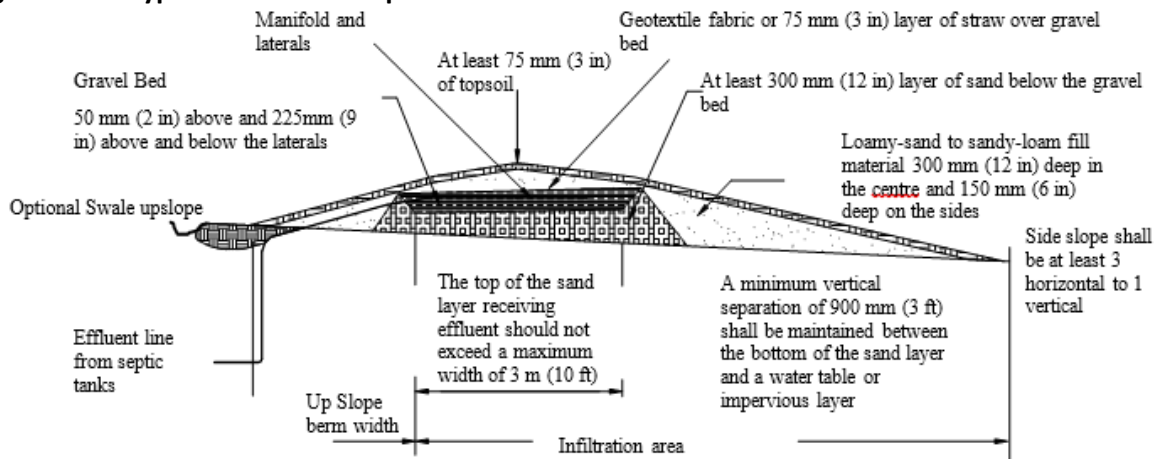
The infiltration area of the mound is that area of soil covered by the mound and that receives effluent. The berms located at the narrow ends of the mound are necessary for mound construction but the soil under these berms is not considered part of the total infiltrative area. To prevent seepage at the toe of the berm, the area of the soil receiving the effluent must be sized to absorb the expected loads.

Figure 16-3 - Type II Mound Cross Section



When mounds are located on slopes, a swale shall be constructed immediately up slope from the base of the mound to intercept and direct run-off water away from the mound.

Figure 16-4 - Type II Mound on Slope



16.3.1.1 Pressure Distribution Lateral Design

Pressure distribution laterals are essentially rigid plastic pipe having evenly spaced holes drilled in the pipe out of which the effluent will spray. Pressure distribution laterals must be custom made for each individual installation. The intent of a pressure distribution lateral system is to provide for the even distribution of effluent over the entire surface of the treatment area. This assures the entire design is used equally and prevents localized overloading.

16.4 INSTALLATION

16.4.1 Site Selection

If considering a mound, it is important to maintain the horizontal separation distances from water supply wells, surface waters, springs, cuts, the boundary of the property, and the building foundation. Mounds should not be constructed in flood plains, drainage ways, or depressions unless flood protection is provided.

16.4.2 Soil Depth

The mound system should be located so as not to impact on the water table.

Mound design begins by establishing the presence of restrictive layer and a limiting layer. This is accomplished by excavating test pits. By determining the depth to any impermeable layer or saturated soil, the required elevation of the sand layer can be determined.

16.5 CARE AND MAINTENANCE

Like other systems, poor maintenance could lead to early system failure. If mounds are improperly designed or constructed, the following problems can occur:

- Clogging of part or all of the distribution system.
- Seepage out of the side of the mound.
- Spongy areas on the side or top of the mound.
- Ponding of effluent in the mound, resulting in system overload and failure.

To minimize the risk of system failure:

- Divert all surface runoff away from the mound.
- Dose regularly throughout the day.
- Install water-saving devices on fixtures to prevent system overload.
- Keep all traffic off the mound.
- Keep shrubs and trees off the mound.
- Plant grass on the mound surface to prevent erosion.

In order to protect from freezing the mound is kept covered during the winter months with:

- at least 0.5 m (1.7 ft) of snow; or
- when there is inadequate snow cover, the use of straw bales.

Ensure there is grass cover over the entire area and **no** shrubs are planted on the top of the mound.

16.6 REQUIREMENTS

16.6.1 General

- 1) A Type II Mound shall meet all the requirements for a Soil Treatment Field except where noted in this section.
- 2) The geometry of the sand layer and the Type II mound shall have its longest axis perpendicular to the slope direction except where there is documentation that the direction of groundwater movement or slope of the restrictive layer is different from the slope of the land in which case the Type II mound's long axis shall be perpendicular to ground water flow or restrictive layer slope.

16.6.2 Sand Layer

- 1) The Sand layer shall:
 - a) meet the requirements of treatment system sand;

- b) have a surface area designed on the basis of an effluent hydraulic loading rate of not more than 40 L per square meter (0.83 imp. gal. per sq. ft.) per day except that:
 - i) have a width as measured along the top of the sand layer based on linear loading rate where the infiltration distance is the in situ soil portion of the vertical separation,
 - ii) have a width as measured along the top of the sand layer that does not exceed 3 m (10 ft),
 - iii) be at least 300 mm (1 ft) thick,
 - iv) be nominally level along its top surface, and
 - v) be constructed on or above the existing native soil.

16.6.3 Infiltration surface

- 1) The soil infiltration surface for a Type II mound is defined as being at the bottom of the upper-most 300 mm (1ft) depth of the sand layer as the first 300 mm (1 ft) is intended to improve the quality of effluent.
- 2) The native soil infiltration surface hydraulic loading rate shall:
 - a) be determined based on secondary treated effluent;
 - b) include, where the slope of the native soil surface is one percent or less, the area of contact with the in-situ soil that is within the berm forming the mound, excluding the end slopes; and,
 - c) include, where the slope of the native soil surface is greater than one percent or less, the area of contact with the in situ soil that is within the berm forming the mound and is downslope of the upslope edge of the sand layer, excluding the end slopes.

16.6.4 Berm

- 1) The soil forming the berm covering the native soil infiltration surface area shall
 - a) have a texture classification of coarse sand, medium sand, fine sand, loamy medium sand, sandy loam or loamy coarse sand;
 - b) be at a minimum of 150 mm (6 in) deep; and,
 - c) be sloped to ensure the drainage of surface water from the mound.
- 2) The berm shall be covered with 75 mm (3 in) of soil suitable for supporting grass cover.
- 3) The slopes of the finished mound berm surface shall not be steeper than 1:3 (one vertical to three horizontal).

16.6.5 Effluent distribution

- 1) The distribution of effluent onto the sand layer shall
 - a) be done using pressure distribution through pipes that are located in a void space created by:
 - i) a chamber covering more than 80% of the sand layer; or
 - ii) trench media to at least 225 mm (9 in.) depth below the distribution pipe and at least 5 cm (2 in.) above the pipe; and,
 - b) be based on achieving individual doses of effluent over the entire sand layer that do not exceed 20% of the average daily volume.
- 2) The effluent shall be applied using evenly spaced orifices that provides one orifice per every 0.5 square metres (5.5 sq. ft) or less of sand layer surface area.
- 3) Where chambers are used, the sand layer shall be covered with a minimum of 50 mm (2 in) of trench media.

- 4) The pressure distribution laterals shall be:
 - a) capped;
 - b) spaced not more than 900 mm (36 in) on center; and,
 - c) located not less than 400 mm (16 in) or more than 500 mm (20 in) from the edge of the trench media layer.

16.6.6 Monitoring ports

- 1) The monitoring ports required for soil treatment fields shall be located within 4.5 m (14.75 ft) of each end of the sand layer and, where the slope is less than 1%, along the centerline of the length of the mound or, in other cases, on the downstream edge of the sand layer.
- 2) In addition to the monitoring ports required for soil treatment fields, a sand mound must have at least two additional monitoring ports at the top of the sand layer infiltration surface located within 1.5 m (5 ft) of each end of the mound.
- 3) Where present, each row of chambers must have a monitoring port within 1.5 m (5 ft) of each end of the sand layer.

16.6.7 Location

- 1) A minimum parcel size of 465 m² (5000 ft²) is required for a Type II mound systems.
- 2) A mound may be installed greater than 150 m (500 ft) from the high water level of a lake, river, stream or other body of water located within a shoreland development area.
- 3) In a shoreland development area, the vertical separation shall be a minimum of 7.6 m (25 ft) in sandy soils and 1.5 m (5 ft) in clay soils between the infiltration surface and ground water.

16.6.8 Installation

- 1) The sand layer and berm fill material shall be put in place using methods that minimize compaction of the soil under the sand layer and prevent smearing or glazing of soil under the mound area that would be at least equivalent to using track-type machinery and ensuring at least 150 mm (6 in) of sand is kept beneath the track-type machinery.
- 2) The in situ soil shall be broken up and the sand layer material and berm fill material shall be integrated into the in situ soil.
- 3) The void space shall be covered with a separation material that will prevent the migration of soil particles into the void space and allow movement of air into the system unless the manufacturer of the chamber system used warrants that a filter fabric is not required.
- 4) Once the mound is constructed, the berm shall immediately have a suitable grass seed applied in order to establish a sod layer as soon as possible.

17 AT GRADE LFH

17.1 DEFINITION

LFH At-Grade systems are soil treatment fields that use the LFH horizon that is present in forested areas to disperse and treat the effluent.

17.2 FUNCTION

An LFH At-Grade system requires an LFH layer to be present. The LFH layer exists in forested areas and is comprised of leaf litter and partially decomposed organic material.

- L: Litter and slightly decomposed organic material. It is easy to recognize individual pieces.
- F: Fibric and moderately decomposed organic material.
- H: Humic and well decomposed organic material. Individual pieces are not recognizable.

Unlike other types of soil treatment fields, LFH At-Grade systems apply effluent to the ground surface without any soil cover. Because of this, several aspects of the system are designed to reduce the probability of human contact.

17.3 DESIGN

The major design differences for an LFH At-grade system are that:

- Timed dosing is required.
- Pressure distribution is required.
- Secondary effluent or better quality is required prior to discharge into the field.
- Additionally, like a Type II mound system there are two hydraulic loading rates to be considered. One is for the LFH layer. The second is for the limiting layer. The chambers must cover a sufficient area for 80% of the LFH infiltration surface. Like a mound berm, the covering material is used to provide sufficient area for the native soil infiltration surface that is based on the limiting layer hydraulic loading rate.

17.4 REQUIREMENTS

17.4.1 General

- 1) An At-Grade LFH shall meet all the requirements for a soil treatment field except where noted in this section.
- 2) The geometry of LFH At-Grade shall be arranged to have the longest axis perpendicular to the slope direction except where there is documentation that the direction of groundwater movement or slope of the restrictive layer is different from the slope of the land in which case the long axis shall be perpendicular to ground water flow or restrictive layer slope.
- 3) The effluent applied to the soil infiltration surface of an LFH At-grade system shall be secondary effluent or better quality.
- 4) The LFH At-grade system shall be located in a forested area that:
 - a) provide shelter from the cooling effect of winds and maximizes snow cover, and
 - b) has a minimum of 50 mm (2in) LFH layer that allows the relatively fast horizontal spread of the applied effluent over the soil infiltration surface that is under the cover material.

17.4.2 Infiltration surface

- 1) The LFH infiltration surface directly under the infiltration chambers shall
 - a) be designed based on a hydraulic loading rate of 40.7 litres per square metre per day (0.83 imp. gal. /ft²/day) or as limited by 13.4.2 Hydraulic Loading Rate (Article 4).
 - b) have an actual open area under the infiltration chambers covering 80% of the required LFH infiltration surface.
- 2) The native soil infiltration surface under the chambers and cover material shall:
 - a) be designed based on a hydraulic loading rate as determined by 13.4.2 Hydraulic Loading Rate; and,
 - b) include both sides of the infiltration chambers where the slope is less than or equal to 1% or only the downslope side of the infiltration chambers, where the slope is greater than 1%.
- 3) For clarity, the design and geometry of the native soil infiltration surface shall incorporate linear loading rates from the soil treatment field requirements.

17.4.3 Cover material

- 1) The material covering the soil infiltration surface shall be consistent with the ecology of the forested area and be effective at minimizing the risk of direct contact with the effluent by humans and animals.
- 2) Cover material shall be LFH cover material.
- 3) The depth of cover material shall be a minimum of 230 mm (9in) above the infiltration chambers after the settlement of cover material occurs.

Recommendation:

Fresh wood chips may settle as much as 50%.

- 4) The slope of the cover material shall be minimized to prevent slumping and loss of cover depth or be stabilized using acceptable methods.
- 5) The cover material shall have a maximum slope of 1:1 except that slopes greater than 1:2 require acceptable geo-tech erosion control and slope stabilization material used to contain and stabilize the cover material.
- 6) The cover material shall extend a sufficient distance beyond the infiltration chambers to ensure that the effluent applied at the design hydraulic loading rate infiltrates into the soil within the cover material to prevent risk of direct contact.

17.4.4 Effluent distribution

- 1) Effluent shall be evenly distributed using an effluent pressure distribution lateral pipe system
- 2) Time controlled dosing shall be used to evenly spread the effluent over a 24 hour period and to minimum the volume of any one dose.
- 3) Orifices shall be spaced no more than 600 mm (2 ft) apart.
- 4) Each pressure distribution lateral shall be level within
 - a) 2% end to end;
 - b) 2% within any 3 m (10ft) segment; and,
 - c) 100 mm (4 in) within any 600 mm (2ft) segment.

17.4.5 Monitoring ports

- 1) Monitoring ports shall be:
 - a) accessible from the surface of the cover material at finished elevation;
 - b) be fitted with a mechanically fastened top;
 - c) allow viewing of both the infiltration chamber interior and soil infiltration surface; and
 - d) provide access for sampling at the soil infiltration surface.

17.4.6 Installation

- 1) The LFH layer of the soil profile shall not be removed in the area of the native soil infiltration surface.
- 2) Brush and trees shall be cut off at ground level and stumps not removed.
- 3) The in situ soils shall not be compacted during installation.
- 4) The geometry of the LFH At-grade shall conform to the surface slope contour of the site it is placed on such that:
 - a) the long axis of the LFH At-grade system, including any 3 m (10 ft) segment of the system shall be oriented at 90 degrees to the slope direction; and;
 - b) the downslope edge of the LFH At-grade system where it makes contact with the in situ soil surface shall:
 - i) be level along its length within 2% as measured from end to end or in any 3 m (10 ft) segment;
 - ii) be level within 100 mm (4 in) as measured within any 600 mm (2 ft) segment of its length; and,
 - iii) when placed on a convex slope, the deflection of curvature of the LFH At-grade system where it meets the in situ soil will not exceed 15% as measured by the horizontal deflection from a plane drawn from each end of the LFH At-grade system.
- 5) An LFH At-grade system shall be at least 6 m (20 ft) from a property line that is located downslope of the system when the slope is more than 1%.

17.4.7 Materials

- 1) Chambers shall be:
 - a) certified to the American Association of State Highway and Transportation Officials H-10 or H-20 ratings.
- 2) LFH Cover material shall be:
 - a) wood chips of a size that easily allows the grain of the wood to be seen; or
 - b) peat moss that is seeded with a vegetative selection that is free of invasive species and suitable to the forest ecology and will stabilize the peat moss.
- 3) Material used to stabilize the cover material shall be a geo-tech erosion control and stabilizing material that:
 - a) will hold the LFH At-grade system cover material in place to prevent slumping; and,
 - b) is made of decomposable material.

18 JETS

18.1 DEFINITION

A jet type disposal system is an open discharge method of sewage disposal. Effluent from a septic tank is pumped by a sewage pump through a pipe to a location where the effluent is discharged into the air and onto the ground surface. (See Figure 18-1 or 18-2)

18.2 FUNCTION

The wastewater in jet spray systems is applied at relatively low rates to grassy or wooded areas. Vegetation and soil microorganisms metabolize most nutrients and organic compounds in the wastewater during percolation through the first several inches of soil. The effluent is then absorbed by deep-rooted vegetation, or treated as it passes through the soil to the ground water.

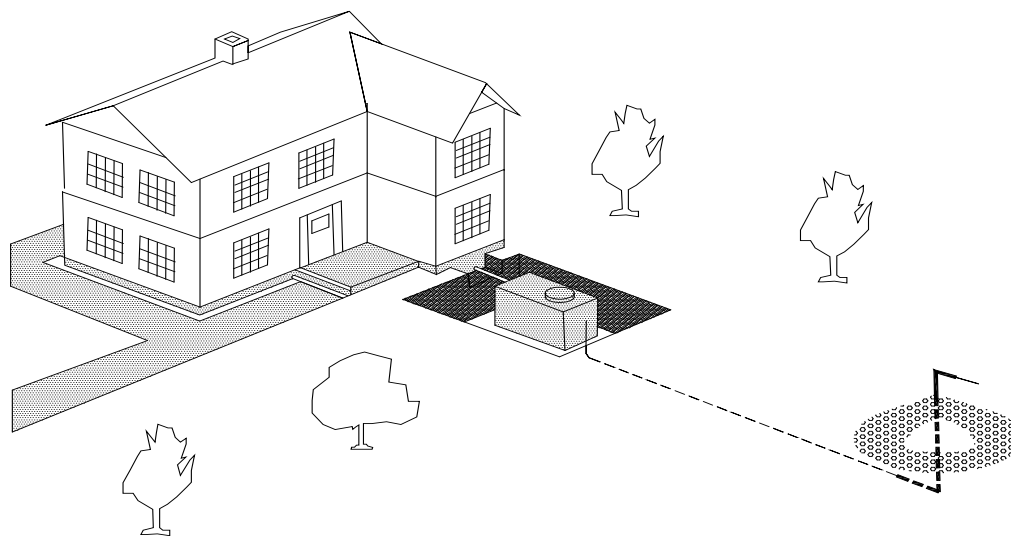
18.3 DESIGN

There are 2 basic versions of jet disposal systems utilized in Saskatchewan. The first system is the Jet Ejector System (see Figure 18-1 - Ejector System) and the second is the Surface Discharge System (see Figure 18-2 - Surface Discharge System).

18.3.1 Ejector System

This system is the more recommended method of open discharge disposal. In this method, effluent from the septic tank is pumped through a pipe to a location where the effluent is discharged into the air and onto the ground surface.

Figure 18-1 - Ejector System



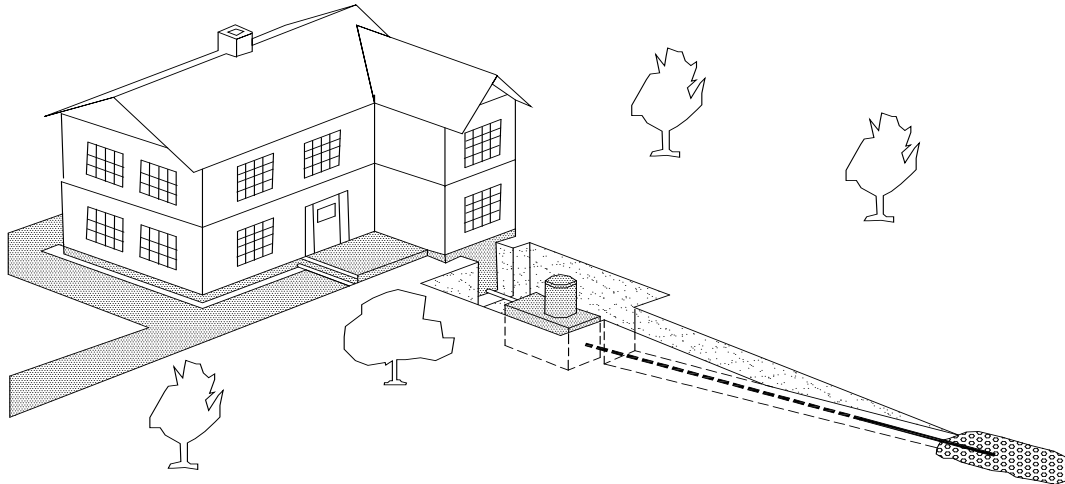
The overall efficiency of a jet spray system will be a function of the pollutant removal efficiencies of the entire treatment process especially the percolation rate of the soil and vegetation uptake.

18.3.2 Surface Discharge System

This system is the least recommended method of open discharge disposal. Some jurisdictions may not allow this method, please check with your local health inspector prior to construction. In this method, effluent from the septic tank is pumped through a pipe to a location where the effluent is discharged directly onto the ground surface.

The overall efficiency of this system is similar to the jet ejector system; it will depend on the pollutant

Figure 18-2 - Surface Discharge System



removal efficiencies of the entire treatment process especially the percolation rate.

18.4 INSTALLATION

18.4.1 Site Selection

Drifting aerosols can be a nuisance and may impact on nearby land use and human contact. All effluent must be contained on the property in which it was generated.

18.5 CARE AND MAINTENANCE

- 1) Construction factors include site preparation, runoff controls, piping return systems, pumps, septic tank maintenance (see septic tanks) and storage facilities. Where storm water runoff can be significant, measures must be taken to prevent excessive erosion including terracing of steep slopes, contour plowing, no-till farming, and establishing grass border strips.
- 2) Compaction and surface sealing (from motor vehicles, heavy equipment and fine layers from multiple wastewater applications) can reduce soil infiltration and increase runoff.

18.6 REQUIREMENTS

18.6.1 General

- 1) Unless otherwise approved by the local authority, jet type disposal systems shall:
 - a. serve not more than one dwelling unit located on a parcel/lot of land containing at least 4 ha;
 - b. not be used for any commercial business such as a restaurant or any other which will generate volumes of effluent greater than that of a single family dwelling;
 - c. not be installed in area that, in the opinion of the local authority, is considered to be a medium or high density acreage area;
 - d. not be located on more than four parcels per rolling quarter section; and
 - e. not be located on a lot that is less than 4 hectares (10 acres) in size.
- 2) Jet type disposal systems shall not be installed in flood plains, drainage ways or depressions.

- 3) To minimize human exposure, large buffer areas are required. A jet type disposal system, measured from the point of discharge, shall have a minimum setback distance as follows:
 - a. Building 60 m (200 ft)
 - b. City, Town, or Village 1 km (0.6 mile)
 - c. Recreation Areas 60 m (200 ft)
 - d. Property Boundary 60 m (200 ft)
 - e. Walk/Driveway 30 m (100 ft)
 - f. Cut or embankment 30 m (100 ft)
 - g. Ground water table 1.5 m (5 ft)
 - h. Well* 45 m (150 ft)
 - i. Water Course 45 m (150 ft)
 - j. Unless otherwise approved by the local authority (through consultation with Saskatchewan Ministry of Environment officials), the setback distance from a well that is used as a water source for a municipal waterworks should be at least 75 m (250 ft) in the case of a small municipality (less than 1,000 population) and at least 225 m (750 ft) in the case of a large municipality (1,000 or more population).
- 4) Point of discharge should not be onto:
 - a. any ground surface that slopes towards a well or surface water;
 - b. any ground growing garden vegetables or animal forage crops or any area that is accessible to animals.
- 5) The jet type surface discharge system must be located so as not to impact on the water table. If a contractor is in doubt as to what would be considered an appropriate separation, they are strongly urged to contact the local authority before installation.
 - a. A test pit dug adjacent to the discharge area may be required by the local authority where a shallow groundwater table is suspected.
- 6) Measures must be taken to prevent excessive erosion
- 7) The soil profile must also be managed to maintain infiltration rates by avoiding soil compaction and maintaining soil chemical balance.

Recommendation: Jet type disposal systems should not be installed in areas with course soils, particularly in areas with a high seasonal or year-round water table.

18.6.2 Jet Ejector-Specific Requirements

- 1) The jet outlet must be higher, 1.8 m (6 ft) minimum, above piping at the septic tank to allow effluent to drain back to the septic tank from the riser and prevent freezing of the effluent in the riser.
- 2) A screening mechanism shall be installed, before the pump uptake, to prevent pump damage and plugging of the effluent line.
- 3) A 1.2 m (4 ft) high (minimum) mound around the jet outlet to prevent erosion and provide some frost protection is required.
- 4) A 1.5 m (5 ft) fence around the perimeter of the effluent outfall area is required. This will restrict access of pests, pets, farm animals, and children.
- 5) Fieldstone shall be applied to the surface of the soil mound to prevent erosion from falling effluent.
- 6) Pipe of sufficient size to prevent excessive head pressure at the pump shall be used.
- 7) The volume of the effluent line shall not exceed the volume of the effluent chamber.

- 8) Because the sewage effluent line is always full, it must be installed below the frost level [Note: frost levels may vary. General minimum is 1.8 m (6 ft)].
- 9) Revolve elbow 90° every 3 months to prevent soil saturation.

18.6.3 Surface Discharge-Specific Requirements

- 1) The outlet pipe shall be carefully graded so the pipe can drain back into the septic tank between pump cycles to prevent freezing.
- 2) The effluent line shall be 32 mm (1½ in) to 50 mm (2 in) pipe.
- 3) Fieldstone shall be placed over and under the outlet pipe for physical protection of the pipe and to prevent erosion.
- 4) Pipe of sufficient size to prevent excessive head pressure at the pump shall be used.
- 5) The volume of the effluent line should not exceed the volume of the effluent chamber.
- 6) A screening mechanism shall be installed before the pump uptake to prevent pump damage and plugging of the effluent line.
- 7) A 1.5 m (5 ft) fence around the perimeter of the effluent out fall area is required. This will restrict access of pests, pets, farm animals, and children.

19 LAGOONS

19.1 DEFINITION

A lagoon is a shallow man-made artificial pond for the receiving, holding and treatment of sewage or effluent. The lagoon may be referred to as a “cell” or “lagoon cell”. Lagoons may be a single cell or operated in series or in parallel as a closed system.

19.2 FUNCTION

The purpose of the lagoon cell is to provide the right environmental conditions for a combination of natural, physical, biological, and chemical processes to treat wastewater.

19.2.1 Evaporative Lagoons

The lagoon method of sewage treatment and disposal consists of one or multiple cells where each cell is a large, typically rectangular pond surrounded by a raised, earthen berm. Sewage is pumped or drained by gravity into the lagoon cell where it is held and undergoes natural biological, chemical, and physical treatment processes. Evaporative lagoons must be designed so that no effluent is released (unless by an approved septic hauler). Instead, the liquid volume in the lagoon cell(s) is reduced slowly over time through evaporation and, in instances where the lagoon liner is clay, very slow infiltration into the surrounding soils. Evaporative lagoons are well suited for the Saskatchewan climate where annual evaporation tends to exceed precipitation.

The treatment of sewage in an evaporative lagoon benefits from wind, time, light, and natural biological functions. Exposure to wind results in wave action that helps to provide oxygen that is needed for natural treatment processes. Wind will also help to facilitate evaporation. The lagoon must be placed so that it is able to make the best use of the wind in the area.

Time is necessary to allow for adequate settling and for the other environmental processes (biological, chemical, and physical) to reduce the overall organic load in the wastewater. Time is also required for evaporation to maintain the working level of the lagoon.

Sunlight contributes to the growth of algae at the water surface which in turn produces oxygen within the cell. When designing a lagoon, it is important to place it in an area where it will receive the greatest amount of sunlight. It is also important to ensure that trees are not allowed to grow around it and that water plants are not allowed to grow on the surface – both reduce the level of sunlight reaching the water.

Bacteria are also important in the treatment of wastewater – both converting wastewater into other substances.

19.2.2 Advantages

- They use less energy than most wastewater treatment methods.
- They are simple to operate and maintain.
- They can handle intermittent use and shock loadings better than many systems, making them a good option for seasonal properties.
- They are very effective at removing disease-causing organisms (pathogens) from wastewater.

19.2.3 Disadvantages

- Lagoon systems require more land than other treatment methods.
- They are less efficient in cold climates and may require additional land or longer detention times in these areas.
- Odour can become a nuisance during algae blooms, spring thaw in cold climates, or with anaerobic lagoons and lagoons that are inadequately maintained.
- Unless they are properly maintained, lagoons can provide a breeding area for mosquitoes and other insects.
- Effluent from some types of lagoons contains algae and often requires additional treatment or “polishing” to meet local discharge standards.

19.2.4 In Series Versus In Parallel Lagoon Systems

Multiple lagoons are more common in community or commercial settings than for individual households, where lagoons may be in series, in parallel, or a combination of the two. Two or more smaller lagoons generally provide better quality wastewater treatment than one large lagoon.

Lagoons operating in series allow the movement of wastewater from one lagoon to the next. Each lagoon allows for more of the solid material in the wastewater to settle out.

Lagoons operating in parallel are all receiving wastewater at the same stage of treatment. This type of system is useful in cold climates where wastewater treatment slows down in cold temperatures.

19.3 DESIGN

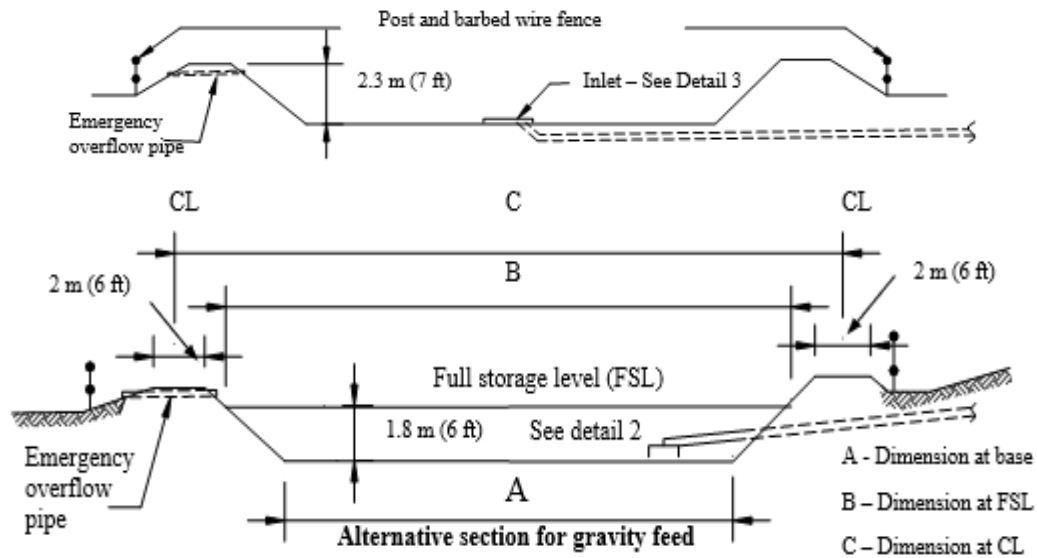
If properly designed, installed and maintained, a lagoon system can effectively treat household wastewater for many years. Lagoons are designed to handle all household wastes. Lagoon size is determined by the amount of sewage entering it.

The primary purpose of the lagoon is to contain the wastewater. The local authority may ask for testing of the lagoon liner in order to ensure it meets specifications. For in-situ materials or soil liners an on-site permeability of at least 10 times the laboratory value shall be used to calculate exfiltration losses.

Figure 19-1 - Sewage Lagoon Cross Section Gravity Feed

Figure 19-2 -Sewage Lagoon Cross Section Pressure Feed

Figure 19-3 - Sewage Lagoon Plan View



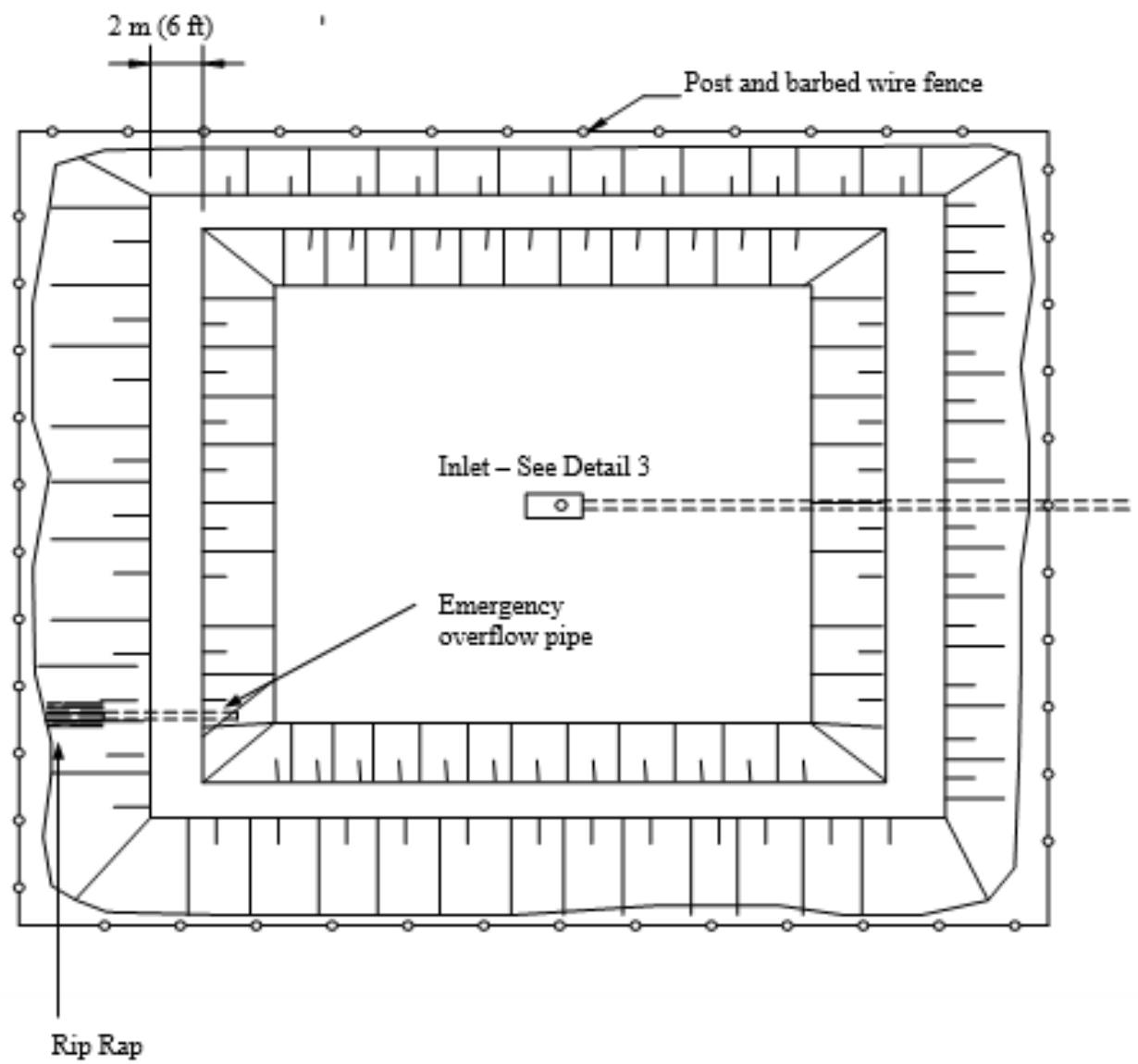
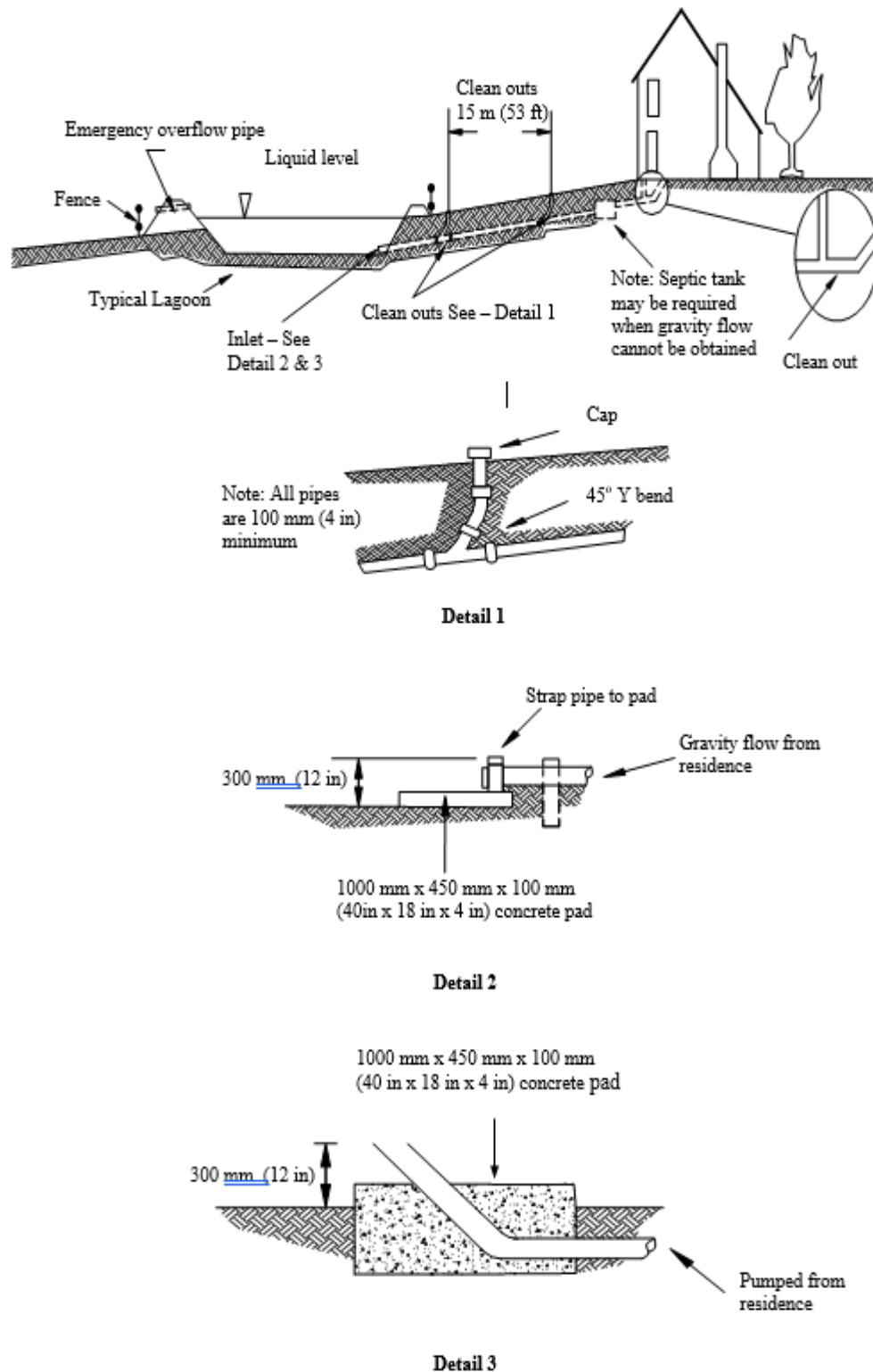


Figure 19-4 - Sewage Lagoon Details



19.3.1 Capacity

The dimensions of the lagoon are based on the expected sewage flow with evaporation being the only means of discharge (effluent can be pumped and hauled away by an approved septic hauler). Evaporation is the main instrument for effluent management as evaporation rates exceed rainfall rates in most regions of Saskatchewan. When considering the expected sewage flow, include a reasonable future growth that will occur within five years of the original completion of the project. This will allow for an adequately sized lagoon but will not oversize the lagoon during its initial operation.

19.3.2 Lagoon Sizing

Sizing a sewage lagoon must allow for evaporation of the effluent. For this reason, it is important to consider annual precipitation and evaporation rates in the overall design.

The sizing worksheet in Annex 9 – Lagoon Worksheet (Informative) is used to determine the required dimensions of a lagoon to accomplish the evaporation of 125% of the expected sewage per year based on average precipitation and evaporation rates.

19.4 INSTALLATION

Lagoon installation is generally site and situation specific, but there are general construction practices that all lagoons should adhere to.

19.4.1 Site Selection

A lagoon may treat either raw sewage or septic tank effluent, via either gravity flow or with the assistance of a “lift”. If the slope of the land places the ground level of the lagoon 2.4 m lower than the premises it serves, gravity should effectively move the sewage into the lagoon.

Should the lagoon be at a higher elevation than the premises it serves, the sewage must be “lifted” to the lagoon.

19.5 CARE AND MAINTENANCE

Properly built lagoon systems experience few problems. It is normal for a properly sized lagoon to have a musky odour during warmer weather, after prolonged periods of cloudy weather, ice cover or temporary overloading.

Although lagoons generally require minimal maintenance, it is important that the lagoon is properly maintained to ensure efficient wastewater treatment. Routine inspections must be performed to assess the condition of the banks, dykes, grounds around the lagoon, inlet and outlet pipes, and the appearance, level, and odour (if any) of the water. Records should also be kept of each inspection that includes observations of influencing factors, such as the weather. A well operated and maintained lagoon will have stored wastewater that is green in colour with no unpleasant odour.

The following are routine maintenance practices to ensure trouble free operation:

- The reduction in sunlight availability to the water surface, and the associated reduction in oxygen production by algae, may be the result of plants with floating leaves and scum formation on the water surface. Floating debris may be removed from a boat with a rake or skimmer.
- Sludge accumulation around the inlet and in the bottom of the lagoon may result in objectionable odour or block the inlet pipe. It is recommended to measure the sludge depth at the bottom of the lagoon at least once per year and remove sludge as needed. It is important to flag the inlet pipe prior to any maintenance to ensure it is not damaged.
- Vegetation on the berm must be controlled/maintained, as well as any vegetation growing along the water's edge. Vegetative growth should be regularly mowed and weeded. It is important that a sterilant is not used to control weeds in and around sewage lagoons.

- Algae blooms may result when algae multiply quickly and then die-off after periods of cloudy weather or abrupt temperature changes. These mats of algae may block sunlight and produce foul odours and should be broken up and dispersed.

19.5.1 Common Problems

The following are problems that may occur in a lagoon and solutions to correct the problem:

- Lagoons may develop odours from algae blooms, anaerobic conditions, scum and turnover of the lagoon contents after thawing. The key to preventing odours from developing is proper operation and maintenance. Odour problems are often the result of a lack of oxygen and may be controlled by: aerating the cell with oxygen via a surface aerator or subsurface tubing; or adding sodium nitrate as an oxygen source. The treatment rate for sodium nitrate is 112 kg/ha (247 lbs/acre) of water surface area on the first day, and 56 kg/ha (123 lbs/acre) per day for each day thereafter that the odour persists. Sodium nitrate may be applied at a lift station, at a service hole prior to the lagoon, or broadcast from a boat.
- Should a lagoon begin to leak, bentonite may be used to temporarily seal (this treatment will only seal for a maximum of three years) the lagoon. A rate of 45 kg (100 lbs) of bentonite (available from well drilling supply companies) is required for every 93 m² (1,000 ft²) of surface to be sealed. The bentonite requires thorough mixing with the lagoon liquid and should be agitated to keep it in suspension for several hours before it is allowed to settle and form a seal.
- Burrowing animals, such as muskrats, may damage and weaken the dyke. Burrowing animals may be discouraged by weeding and mowing lagoon banks, as well as raising and lowering water levels which will interfere with water levels at the tunnel openings. If the rodents do become a problem, they should be eliminated and the damage to the dyke repaired.
- Seepage around the toe of the dyke should be frequently assessed as seepage may weaken the dyke and lead to structural damage. Damage of this type requires structural repair – consult the local authority.
- Erosion of the inner slope of the lagoon may be caused by wave action, surface run-off, improper grading, and burrowing animals. Installation of rip-rap, a stone or rock surface, both above and below the water surface may help to reduce erosion. Properly grading the dyke will prevent surface run-off around the perimeter of the dyke.

19.5.2 Safety

Fencing should be designed to prevent the entrance of children and to discourage trespassing. Livestock should also be prevented from entering.

19.6 LAGOON REQUIREMENTS

19.6.1 General

- 1) A lagoon shall be designed to provide sufficient surface area to evaporate 125% of the mean annual volume of sewage discharged into it based on published evaporation and precipitation rates for the area of the lagoon.
- 2) The design surface area shall provide adequate storage to hold expected volumes of sewage during winter months or other periods of low net evaporation.
- 3) Sewage moved by gravity should be via a drainpipe that is laid at a minimum slope of one percent (1 m per 100 m). The pumping equipment to “lift” sewage from a septic tank to the lagoon needs to be properly sized with regard to pump head loss and must have an adequate number of accessible valves to permit servicing.
- 4) A parcel/lot of land may not be less than 4 hectares (10 acres) in size for a lagoon to be placed on it.

19.6.2 Seepage

- 1) A lagoon shall be designed to control seepage to no more than 150 mm per year with:
 - a. A liner, consisting of porous material in which seepage is can be calculated using Darcy's Law. This is usually an interior surface layer of compacted clay of not less than 300 mm (12 in) thickness.
 - b. A flexible polymeric membrane liner having a minimum thickness of 0.5 mm or 20 mils and
 - i. membranes less than 60 mils are covered with a layer of fine grained soil to prevent liner damage, and
 - ii. membranes susceptible to weathering when exposed shall be covered with soil on both the side slopes and bottom.

19.6.3 Dimensions

- 1) Lagoons shall have a design working (liquid) depth of not greater than 1.8 m (6 ft) and no less than 0.9 m (3 ft).
- 2) The lagoon shall have a free board of 0.5 m (1.6 ft).
- 3) The lagoon shall have an emergency overflow pipe of 100 mm (4 in) diameter located at least 150 mm (6 in) above the full storage (working level) level of the wastewater.
- 4) The submerged inlet shall be placed not more than 450 mm (18 in) and not less than 300 mm (12 in) above the bottom of the lagoon.
- 5) An inlet receiving pit may be used to provide a constant cover of at least 600 mm (2ft) over the inlet to prevent freezing.

19.6.4 Fencing and Site Control

- 1) The lagoon must be adequately fenced in with a locking gate.
- 2) Fences shall be located away from the outside toe of the berm to facilitate mowing and maintenance operations.
- 3) Where a lagoon is located near developed areas a chain link fence may be required to prevent children from gaining entrance.
- 4) In addition, an access gate should be provided to allow entry of maintenance equipment.
- 5) Signs shall also be posted to identify the lagoon and advise against trespassing.

19.6.5 Berms

- 1) The berm should be constructed so that:
 - a. The clay soil making up the berm is well compacted in 30 cm lifts and void of all topsoil and organics;
 - b. The area below the berm has been stripped of all topsoil, organics and highly permeable soils; and,
 - c. The berm should be keyed to the native soil.
- 2) The berm shall have a minimum slope of one vertical to three horizontal.
- 3) The berm shall have a top width of 2 m (6 ft).
- 4) The top of the berm shall be above the surrounding grade in order to prevent surface water entry.

19.6.6 Installation

- 1) The inlet pipe shall be protected from frost. This can be achieved by ensuring that there is always a minimum depth of 600 mm over the inlet pipe by using straw bales to create a small containment area or by ensuring that the lagoon is designed for a higher operating level.

- 2) Where a synthetic liner is used, the liner shall be bedded as per manufacturer's specifications.
- 3) A workable landscape and maintenance schedule shall be provided that will ensure the berm is adequately maintained.
- 4) Laying of the plastic should begin from the centre of the lagoon with all seams overlapped and sealed with waterproof plastic tape. Particular attention should be given to sealing any pipe entries.
- 5) The ends of the liner material may be anchored in a trench in the top of the berms around the perimeter of the lagoon.

19.6.7 Setback Requirements

- 1) Setbacks are measured from the outside edge of the berm edge to the outside edge of the features below
 - a. Building 60 m (200 ft)
 - b. Recreation Areas 60 m (200 ft)
 - c. Property Boundary 30 m (100 ft)
 - d. Roadway 90 m (300 ft)
 - e. Cut or embankment 30 m (100 ft)
 - f. Ground water table 1.5 m (5 ft)
 - g. Well* 90 m (300 ft)
 - h. Water Course 90 m (300 ft)
- 2) Unless otherwise approved by the local authority (through consultation with Saskatchewan Ministry of Environment officials), the setback distance from a well that is used as a water source for a municipal waterworks should be at least 75 m (250 ft) in the case of a small municipality (less than 1,000 population) and at least 225 m (750 ft) in the case of a large municipality (1,000 or more population).
- 3) The isolation distance between the base of the lagoon and the high water table must be 1.5 m (5 ft) where the soil is clay or similar material, or 7.6 m (25 ft) where the soil is sand or similar. The local authority may allow a lesser distance between the base of the lagoon and the water table if the lagoon is adequately lined with clay, plastic or other impermeable material.

20 PACKAGE TREATMENT PLANTS

20.1 DEFINITION

A package sewage treatment plant is a unit which complies with:

- the National Sanitation Foundation International Standard for Wastewater Technology, NSF-40 Standard, Residential Wastewater Treatment Systems, Class 1;
- Bureau de Normalisation du Québec Onsite Residential Wastewater Treatment Technologies CAN/BNQ 3680-600; or
- other Standard(s) recognized by the Saskatchewan Health Authority.

20.2 FUNCTION

Package sewage treatment plants are often aerobic treatment plants that use various methods, depending on their design, to expose sewage to oxygen. Increased levels of oxygen in the sewage provide for the establishment of large aerobic bacteria populations. These aerobic bacteria populations accelerate the decomposition of the suspended solids in sewage. Resulting effluent can then be pumped or drained into a system that is approved by the local authority.

20.3 DESIGN

Package sewage treatment plants perform best when they are subjected to a constant and consistent volume and quality of sewage. It takes some time to initially establish a bacteria population as there is a balance between the size of bacteria population, the amount of solids discharged to the package sewage treatment plant that the bacteria can use as food, and the amount of oxygen available to the bacteria. If there is a sudden increase in the amount of solids, there may be a decrease in the quality of effluent discharged from the package treatment plant until the bacteria population increases in size to accommodate the new volume of solids.

The minimum treatment capacity of a package sewage treatment plant should be not less than 1800 L (400 gals) per day, and not less than the expected volume of sewage per day.

20.4 INSTALLATION

A package treatment plant shall be installed as per the manufacturer's specifications.

20.5 CARE & MAINTENANCE

Routine maintenance of a package treatment plant is required to ensure quality of effluent. Refer to the manufacturer's recommendations for specific maintenance protocol. The quality of the effluent should meet the objectives specified by the standard to which the package treatment plant is certified.

20.6 REQUIREMENTS

20.6.1 General

- 1) All package treatment plants shall be certified to NSF 40 class 1 or CAN/BNQ-3680-600.
- 2) Sewage that exceeds the maximum limits for residential strength sewage should not be discharged to a package sewage treatment plant.
- 3) A packaged sewage treatment plant shall not receive wastewater having a strength that exceeds typical wastewater unless it can be demonstrated the package sewage treatment plant has the capacity to treat the organic loading of the wastewater to achieve the effluent quality required by this guide.
- 4) Effluent from a package sewage treatment plant must be treated in an approved private sewage works.
- 5) Access openings and manhole extensions shall prevent water from entering the package sewage treatment plant.

20.6.2 Installation

- 1) The bottom of an excavation for a package sewage treatment plant should provide a uniform base to support the tank in a level position. The tank must have a stable base to prevent damage due to settling, shifting or cracking after installation.
- 2) Piping connected to the packaged sewage treatment plant should be supported to within 300 mm (1 ft) from the tank on a solid base, or equivalent.

20.6.3 Setback Requirements

- 1) When installing a package sewage treatment plant, it shall have a minimum setback distance as follows:
 - a. Building..... 1 m (3 ft)
 - b. Property Boundary 3 m (10 ft)
 - c. Walk/Driveway..... 1.5 m (5 ft)
 - d. Cut or embankment 3 m (10 ft)
 - e. Ground water table..... 1.5 m (5 ft)
 - f. Well 9 m (30 ft)
 - g. Water Course 9 m (30 ft)

APPENDICES

ANNEX 1 – EXPECTED VOLUME OF SEWAGE PER DAY (NORMATIVE)

| Expected Volume of Sewage per Day | Expected sewage volume in litres (gallons) per day |
|---|---|
| Airport | 10 (2.2) per passenger |
| Apartment | 190 (42) per person |
| Assembly Hall/Town Hall/Churches | 10 (2.2) per seat |
| Automotive Service Station/Garage/Gas Station | 45 (10) per vehicle served 50 (11) per employee 550 (121) per double pump unit |
| Bar/Tavern/Cocktail Lounge | Customer 75 (16.5) Employee 50 (11) |
| Bowling Alley | 400 (88) per lane |
| Cabin, Resort | 150 (33) per person |
| Cafeteria (workplace – no food service) | 10 (2.2) per customer 40 (9) per employee |
| Camps: Campgrounds (fully serviced sites – service building(s) with flush toilets, showers) Campgrounds (fully serviced sites only) Day camps (No Meals Served) Also see Picnic Parks, Youth Camp | 130 (28.6) per person 180 (40) per site 50 (11) per person |
| Construction Camp (semi-permanent) | 190 (42) per person |
| Cottages and Small Dwellings with Seasonal Occup. | 150 (33) per person |
| Country Club | 400 (88) member present 50 (11) per employee |
| Dance Halls | 45 (10) per person |
| Dining Hall | 30 (6.6) per meal served |
| Dormitory, Bunkhouse | 150 (33) per person |
| <i>Dwelling</i> single family and duplex | 340 (75) per person at 2 persons per bedroom 2 bedrooms and less, or at 1.5 persons per bedroom 3 bedrooms and more |
| <i>Dwelling</i> (includes Mobile Home Trailers) - other than single family or duplex | 675 (150) per bedroom |
| Golf Club | 45 (10) per member |
| Hospital | 630 (139) per bed |
| Hotel/Motel – Resort | 200 (44) per person 40 (9) per employee |
| Industrial and Commercial <i>Building</i> (does not include process water, showers or a cafeteria) | 50 (11) per employee |
| Industrial and Commercial <i>Building</i> (with showers) | 90 (18) per employee |
| Laundry, Self Service | 2100 (462) per machine |
| Mobile Home/Trailer Park | 675 (150) per bedroom |
| Motel/Hotel | 200 (44) per single bed |

APPENDICES

| | | |
|------------------------|------------------------------------|---|
| Nursing and Rest Homes | | 350 (77) per person |
| Office <i>Building</i> | | 50 (11) per employee |
| Picnic Parks: | toilets only | 20 (4.5) per picnicker |
| | bathhouses, showers, flush toilets | 40 (9) per picnicker |
| Prison | | 450 (99) per inmate 40 (9) per employee |
| Restaurant | (including coffee shops) | 40 (9) per customer |
| | Licensed | 50 (11) per customer |
| Rooming House | | 150 (33) per seat |
| School, Day: | Cafeteria, gym, showers | 80 (17.5) per student |
| | Cafeteria only | 60 (13.2) per student |
| | No cafeteria, gym, showers | 40 (9) per student |
| School, Boarding: | | 280 (62) per student |
| Shopping Center | | 5 (1) parking space 40 (9) per employee |
| Store, Department | | 2000 (440) per toilet room 40 (9) per employee |
| Swimming Pool (public) | | 40 (9) per person/employee |
| Theatres | Movie | 10 (2) auditorium seat |
| | Drive-In | 20 (4.5) car space |
| Visitor Centre | | 20 (4.5) per visitor |
| Youth Camp | | 190 (42) per person |

Note:

Volume in Brackets () is based on approximate conversion of volume from litres to imperial gallons. Always use volume in litres per day/unit numbers to calculate the typical sewage volume. The provided volumes are provided only for the purpose of designing onsite sewage treatment systems.

Values for the above table have been taken from:

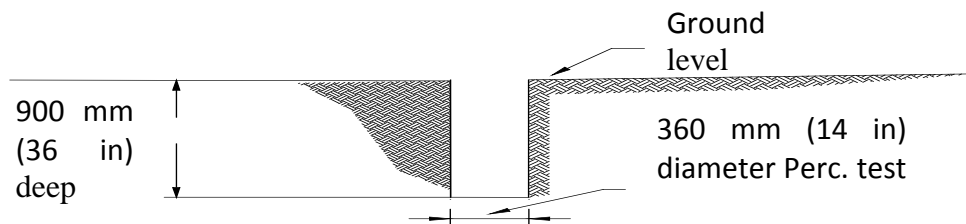
- Alberta Private Sewage Systems Standard of Practice 1999 – Handbook. Safety Codes Council. Edmonton, Alberta.
- The American Society of Plumbing Engineers: Data Book, 1981-82, Volume II- Special Plumbing Systems Design.
- The United States Environmental Protection Agency: Design Manual - Onsite Wastewater Treatment and Disposal Systems. 1980.
- The United States Environmental Protection Agency: Design Manual - Onsite Wastewater Treatment Systems Manual. 2002.

ANNEX 2 - HOW TO CONDUCT A PERCOLATION TEST (NORMATIVE)**Tools Needed**

- shovel or post hole digger
- flash light
- 1.2 m (5 ft) long pole, with clearly marked lengths of 12.5 cm (5 in) and 15 cm (6 in) from the bottom
- permanent marking pen
- garden hose or pail to fill hole with water
- reporting form and pen
- lawn chair

Method

- 1) Percolation test holes should be made at points and elevations selected as typical in the area of the proposed absorption field. The tests should be repeated in four different locations, within the planned dispersal area, to arrive at a reliable typical permeability or percolation rate representative of the soil at the proposed infiltrative surface. On some sites, it will be appropriate to conduct more than four tests, to understand the variation in soil permeability.
- 2) Test holes should be 30 cm (12 in) square or 36 cm (14 in) round and excavated to the proposed depth of the absorption field (or as instructed by the designer). It is generally easiest to dig a larger hole part way down, then dig an 18 to 20 cm (7 to 8 in) deep accurately sized test hole in the base of the larger hole.



- 3) To make the percolation test more accurate, any smeared soil should be removed from the walls of the test holes. This is best achieved by digging the hole approximately 5cm undersized (2 in) and then enlarging the hole to the accurate size as follows: using a rigid knife, insert the blade into the top side of the hole opposite you approximately 2.5cm (1 in) deep, holding the blade with its cutting edge vertical. Pull the blade away to break out a chunk of soil, repeat about 2.5cm (1 in) apart around the hole, then repeat for another “ring” below until reaching the base. The result will be a hole with a ragged inner surface which looks like a freshly broken clod of soil.
- 4) The base of the hole should be cleaned of debris and be approximately flat, use a metal scoop or similar. It should also be picked to present a natural surface. Note that a picking action (use a pointed tool) is needed, not a scratching action (which just produces smears that are indented).
- 5) Place 5 cm (2 in) of clean fine gravel in the bottom of the hole. If the sidewalls are likely to collapse, use a paper basket to support the sidewalls (see note below). Place a piece of white plastic or similar provided with clear marks at 12.5 cm (5 in) and 15 cm (6 in) from the bottom of the test hole prior to adding the gravel. For greater accuracy a float and pointer arrangement can be set up.

APPENDICES

- 6) If the soil contains considerable amounts of silt or clay, and certainly for any soil with “clay” as part of the texture description, the test holes should be pre-soaked before proceeding with the test. Pre-soaking is accomplished by keeping the hole filled with water for 4 hours or more. The water should be added carefully and slowly to avoid disturbing the soil (including the sidewall soils). The test should be carried out immediately after pre-soaking;
- 7) To undertake the test, fill the test hole (the accurately sized test hole) with water. The water should be added carefully and slowly to avoid disturbing the soil (including the sidewall soils). When the water level is 12.5 cm (5 in) or less from the bottom of the hole, refill the hole to the top. No recording of time needs be done for these 2 fillings.
- 8) When the water level, after the second filling (procedure (7)) is 12.5 cm (5 in) or less from the bottom of the hole, add enough water to bring the depth of water to 15 cm (6 in) or slightly more. Note that these measurements are from the base of the soil bottom (using the marker installed in step (5)), not the gravel layer.
- 9) Observe the water level until it drops to the 15 cm (6 in) depth, at precisely 6 in, commence timing, when the water level reaches the 12.5 cm (5 in) depth, stop timing, record the time in minutes.
- 10) Repeat procedures 8 & 9 until the last 2 rates of fall do not vary more than 2 minutes per inch or by more than 10% (whichever is less).
- 11) Report slowest rate for each hole.
- 12) Leave the excavated material for inspection, cover the test holes with other suitable dirt and flag the test hole locations.

Paper basket to protect hole

If sidewalls of the hole are likely to collapse, one option is to make a paper basket to protect and support the sidewalls as follows:

1. Cut the bottom out of a large paper bag (grocery bag) and cut the bag open along a side.
2. Lay bag on a soft surface. Punch holes in the bag about 5 to 7.5 cm (2 to 3 inches) apart using a pencil or similar.
3. Roll into a tube, with the short dimension being the axis of the tube, and place in the test hole.
4. Open the tube until the paper is in contact with the sidewalls of the test hole, then roll the top of the tube over to stiffen it.
5. After placing the tube in the hole, place the plastic marker and add the base gravel layer.

Percolation rate for design

Select the percolation rate to be used for sizing of the dispersal area. This will be the median (middle) value from all the tests conducted.

APPENDICES

ANNEX 3 – SEWAGE VOLUME AND QUALITY WORKSHEET (INFORMATIVE)

Step 1) Collect the following information

- Number of bedrooms
- Presence of garburator
- Home-based businesses
- Other non-residential waste producers
- Number and size of large capacity fill and drain tubs
- Water treatment devices
- Other high volume fixtures

Step 2) Confirm that the following wastes are excluded from the soil treatment field.

- Storm water
- Surface water
- Abattoir waste
- Sub-surface seepage water
- Clearwater waste
- Commercial or industrial process wastes
- Iron filter backwash

from 8.1.1.7

Step 3) Determine the unadjusted Peak Daily Flow (PDF) and Average Daily Flow (ADF)

| | | | | |
|--|---|---|---|---|
| Number of Bedrooms <div style="border: 1px solid black; width: 150px; height: 25px; margin: 0 auto;"></div> number | X | Number of People Per Bedroom <div style="border: 1px solid black; width: 100px; height: 25px; margin: 0 auto;"></div> people from 8.1.2.4 | = | Maximum Occupancy <div style="border: 1px solid black; width: 150px; height: 25px; margin: 0 auto;"></div> people |
|--|---|---|---|---|

| | | | | |
|---|---|--|---|---|
| Maximum Occupancy <div style="border: 1px solid black; width: 150px; height: 25px; margin: 0 auto;"></div> people | X | 75 imp. gal/ppl/day from 8.1.2.2 | = | Unadjusted Peak Daily Flow (PDF) <div style="border: 1px solid black; width: 150px; height: 25px; margin: 0 auto;"></div> imp. gal./day |
|---|---|--|---|---|

| | | | | |
|---|---|--|---|--|
| Maximum Occupancy <div style="border: 1px solid black; width: 150px; height: 25px; margin: 0 auto;"></div> people | X | 50 imp. gal/ppl/day from 8.1.2.3 | = | Unadjusted Average Daily Flow (U-ADF) <div style="border: 1px solid black; width: 150px; height: 25px; margin: 0 auto;"></div> imp. gal./day |
|---|---|--|---|--|

APPENDICES

Step 4) Adjust the base PDF and ADF

a) Add additional peak flows

from 8.1.2.5

Unadjusted Peak
Daily Flow
(U-PDF) imp. gal./day

+

Garburator peak
flow imp. gal./day

+

Home-based
business additional
peak flow imp. gal./day

+

Other non-
residential waste
producers peak flow imp. gal./day

+

Large capacity fill
and drain tubs peak
flow imp. gal./day

+

Water treatment
devices peak flow imp. gal./day

+

Other high volume
fixtures peak flow imp. gal./day

=

Peak Daily Flow
(PDF) imp. gal./day

b) Add additional average flows

from 8.1.2.6

Unadjusted Average
Daily Flow (U-ADF) imp. gal./day

+

Garburator average
flow imp. gal./day

+

Home-based
business additional
average flow imp. gal./day

+

Other non-
residential waste
producers average
flow imp. gal./day

+

Large capacity fill
and drain tubs
average flow imp. gal./day

+

Water treatment
devices average flow imp. gal./day

+

Other high volume
fixtures average
flow imp. gal./day

=

Average Daily Flow
(ADF) imp. gal./day

Step 5) Select Sewage Quality (select one of three)

from 8.1.1

APPENDICES

| | Raw - 80% of the time does not exceed (assumed) | | | Primary Effluent - 80% of the time does not exceed (assumed) | | |
|-------------------------------------|---|------------|---------------------|--|------------|---------------------|
| Options | BOD5 (mg/L) | TSS (mg/L) | Oil & Grease (mg/L) | BOD5 (mg/L) | TSS (mg/L) | Oil & Grease (mg/L) |
| residential waste (no garburator) | 220 | 220 | 50 | 150 | 100 | 15 |
| residential waste (with garburator) | 286 | 286 | 65 | 195 | 130 | 19.5 |
| other (enter data) | | | | 0 | | |

32%
removal

55%
removal

70% removal

APPENDICES

ANNEX 4 – SEPTIC TANK WORKING CAPACITY WORKSHEET (INFORMATIVE)

Step 1) Collect the following information

- Peak Daily Flow
- Maximum Occupancy

Step 2) Calculate unadjusted sludge and scum storage volume in the working chamber

| | | | | | | |
|----------------------|--|---|---------------|--|---|----------------------------------|
| Maximum Occupancy | | X | 88 | | = | Unadjusted S&S Storage Volume |
| | | | | | | |
| people | | | imp. gallons | | | imp. gallons |
| from 8.1.2.4 | | | from 12.6.2.3 | | | |

Step 3) Adjust sludge and scum volume in the working chamber

| | | | | | | |
|-------------------------------------|--|---|---|--|---|-----------------------|
| Unadjusted S&S Storage Volume | | X | Adjustment Factor | | = | S&S Storage Volume |
| | | | | | | |
| imp. gallons | | | Enter - 1.5 where a garburator is present, or - 1.0 in all other cases | | | imp. gallons |
| | | | from 12.6.2.3 | | | |

Step 4) Calculate the hydraulic capacity based on 24 hours of retention at peak flow

| | | | | | | |
|-------------------------|--|---|---------------|--|---|---------------------------------|
| PDF | | X | 1 | | = | Hydraulic Capacity Volume |
| | | | | | | |
| imp. gallons per day | | | day | | | imp. gallons |
| | | | from 12.6.2.1 | | | |

APPENDICES

Step 5) Calculate the minimum hydraulic capacity plus sludge and scum storage volume

| Hydraulic Capacity Volume | | S&S Storage Volume | | Calculated Minimum Working Capacity |
|---------------------------------|---|-----------------------|---|--|
| | + | | = | |
| imp. gallons | | imp. gallons | | imp. gallons |

Step 6) Compare Calculated Minimum Working Capacity to Table 11-1 and select maximum

| Calculated Minimum Working Capacity | | Septic Tank Minimum Working Capacity | | Working Capacity Required |
|--|----|--|--|---------------------------------|
| | OR | | | |
| imp. gallons | | imp. gallons | | imp. gallons |
| | | from table 12-1 in 12.6.2 | | Select larger number |

APPENDICES

ANNEX 5 – ABSORPTION FIELD WORKSHEET (INFORMATIVE)

Step 1) Collect the following information

- Primary effluent BOD concentration
- Peak daily flow
- Soils information
- Soil absorption field influent quality

Step 2) Determine the volume of sewage per day

Peak Daily Flow
(PDF)

imp. gal./day

from worksheet
1

Step 3) Determine the unadjusted hydraulic loading rate and linear loading rate of limiting layer

Texture

from site
evaluation

&

Structure

from site
evaluation

&

Grade

from site
evaluation

&

Infiltration Depth

from site
evaluation

Unadjusted
Hydraulic
Loading Rate
(HLR)

imp. gal/ft²/day

from Table 13-3

use >30 to 150
mg/L BOD
column for
primary effluent

Linear Loading
Rate (LLR)

imp. gal/ft/day

from Table 13-5

APPENDICES

- Step 4) Determine the maximum width of the field perpendicular to the slope
(note: each trench is a maximum of 3 ft wide.)

| | | |
|---|---|--|
| Linear Loading Rate (LLR) | Unadjusted Hydraulic Loading Rate (HLR) | Maximum System Width |
| <div style="border: 1px solid black; width: 100px; height: 30px; margin: 0 auto;"></div> <div style="text-align: right; margin-top: -10px;">÷</div> | <div style="border: 1px solid black; width: 100px; height: 30px; margin: 0 auto;"></div> <div style="text-align: right; margin-top: -10px;">=</div> | <div style="border: 1px solid black; width: 100px; height: 30px; margin: 0 auto;"></div> |
| imp. gal/ft/day from Table 13-5 | imp. gal/ft ² /day from Table 13-3 | ft |

- Step 5) Calculate optional credits for hydraulic loading rate (select one and circle)
from 13.4.2.3

| Scenario | Credit |
|---|--------|
| Primary effluent and gravity distribution | 1 |
| Primary effluent and pressure lateral distribution system | 1.2 |
| Primary effluent, gravity lateral distribution system and chamber system | 1.1 |
| Primary effluent, pressure lateral distribution system and chamber system | 1.3 |
| Secondary effluent and pressure lateral distribution system and chamber system | 1.1 |
| Secondary effluent and pressure lateral distribution system and chamber system and timed dosing | 1.2 |

- Step 6) Calculate the hydraulic loading rate

| | | |
|---|---|--|
| Unadjusted Hydraulic Loading Rate (HLR) | Credit | Adjusted Hydraulic Loading Rate (A- HLR) |
| <div style="border: 1px solid black; width: 100px; height: 30px; margin: 0 auto;"></div> <div style="text-align: right; margin-top: -10px;">×</div> | <div style="border: 1px solid black; width: 100px; height: 30px; margin: 0 auto;"></div> <div style="text-align: right; margin-top: -10px;">=</div> | <div style="border: 1px solid black; width: 100px; height: 30px; margin: 0 auto;"></div> |
| imp. gal/ft ² /day | from above step | imp. gal/ft ² /day |

13.4.2.3.a states that where primary effluent and gravity distribution the resulting loading rate shall not exceed the loading rate for secondary effluent or as limited elsewhere in the standard

Confirm max HLR listed in 13.4.2.4 and 13.4.2.5 not exceeded.

- Step 7) Calculate the minimum required infiltration surface area for the soil using adjusted effluent loading

APPENDICES

rate

Peak Daily Flow
(PDF)

 ÷

imp. gallons per
day

Adjusted
Hydraulic
Loading Rate (A-
HLR)

 =

imp. gal/ft²/day

Minimum Soil
Infiltration Area
Required

ft²

Step 8) Calculate organic loading rate

Primary Effluent
BOD

 ×

mg/L

Adjusted
Hydraulic
Loading Rate (A-
HLR)

 ×

imp. gal/ft²/day

Conversion
Factor

0.01003532 =

valid for imperial
units only

Organic Loading
Rate (OLR)

lb BOD₅/1000
ft²/day

Confirm organic loading rate meets 13.4.3

Step 9) Calculate the total length of absorption field

Minimum Soil
Infiltration Area
Required

 ÷

ft²

Constructed
width of trench
or actual
chamber width

 =

ft

Total length of
absorption field
or sum of all
trenches or
laterals

ft

Step 10) Select number of lateral trenches and determine length of each lateral

Total length of
absorption field
or sum of all
trenches

 ÷

ft

Number of
lateral trenches

 =

number

selected by
designer

review 13.4 &
14.6

Maximum length
of each trench or
lateral

ft

Step 11) Summarize

APPENDICES

| | | | |
|---|------------|--|--|
| PDF | (adjusted) | | imp. gal./day |
| HLR | (adjusted) | | imp. gal/ft ² /day |
| LLR | | | imp. gal/ft/day |
| OLR | | | lb BOD ₅ /1000 ft ² /day |
| Minimum native soil infiltration area | | | ft ² |
| Constructed width of trench or actual chamber width | | | ft |
| Total lateral or trench length | | | ft |
| Number of trenches or laterals | | | |
| Length of each trench or lateral | | | ft |
| Maximum system width | | | ft |

ANNEX 6 – TYPE I MOUND WORKSHEET (INFORMATIVE)

- Step 1) Collect the following information
- Primary effluent BOD concentration
 - Peak daily flow
 - Soils information
 - Soil absorption field influent quality
 - Slope of the land
 - Depth of excavation for infiltration surface

Note: Worksheet does not apply where slope of land is greater than 10%

- Step 2) Determine the volume of sewage per day

Peak Daily
Flow (PDF)

imp.
gal./day

from
worksheet 1

- Step 3) Determine the native soil hydraulic loading rate of limiting layer

Texture

from site
evaluation

Structure

from site
evaluation

Grade

from site
evaluation

&

&

&

Infiltration
Depth

from site
evaluation

Native Soil
Hydraulic Loading
Rate (HLR)

imp. gal/ft²/day

from Table 13-3

use >30 to 150 mg/L BOD
column for primary effluent

Native Soil
Linear Loading
Rate (LLR)

imp. gal/ft/day

from Table 13-
5

APPENDICES

Step 4) Determine the width of the type I mound

Native Soil
Linear
Loading Rate
(LLR)

imp.
gal/ft/day

Native Soil
Hydraulic Loading
Rate (HLR)

imp. gal/ft²/day

from step 3

Maximum Rock
Layer Top Width
(A)

ft

15.6.4 requires a width less than 10 ft

Note: Linear loading does not apply to alternative Type I mounds as the vertical separation must be > 48 in.

Step 5) Determine the native soil infiltration surface length

Peak Daily
Flow (PDF)

imp.
gal./day

from step 1

Native Soil Linear
Loading Rate (LLR)

imp. gal/ft/day

from table 13-5

Minimum System
Length (B)

ft

Step 6) Determine the native soil infiltration surface area

Peak Daily
Flow (PDF)

imp.
gal./day

from step 1

Native Soil
Hydraulic Loading
Rate (HLR)

imp. gal/ft²/day

from table 13-3

from step 3

Native Soil
Infiltration Surface
Area

ft²

APPENDICES

Step 7) Calculate organic loading rate

| | | | | | | |
|--|---|--|---|---------------------|---|--|
| Primary Effluent BOD | | Native Soil Hydraulic Loading Rate (HLR) | | Conversion Factor | | Organic Loading Rate (OLR) |
| <div style="border: 1px solid black; width: 150px; height: 25px; margin: 0 auto;"></div> | X | <div style="border: 1px solid black; width: 150px; height: 25px; margin: 0 auto;"></div> | X | 0.01003532 | = | <div style="border: 1px solid black; width: 150px; height: 25px; margin: 0 auto;"></div> |
| mg/L | | imp. gal/ft ² /day | | imperial units only | | lb BOD ₅ /1000 ft ² /day |
| Field measurement or assume meets primary effluent definition | | from step 3 | | | | |

Confirm organic loading rate meets 13.4.3

Step 8) Determine the minimum depth of rock under distribution lateral or chamber

| | | |
|--|---|--|
| Upslope Depth of Rock (D) | | Downslope Depth of Rock (E) |
| <div style="border: 1px solid black; width: 150px; height: 25px; margin: 0 auto;"></div> | = | <div style="border: 1px solid black; width: 150px; height: 25px; margin: 0 auto;"></div> |
| ft | | ft |
| from 15.6.6 | | from 15.6.6 |

Step 9) Determine mound depths

| | | | | |
|--|---|--|---|--|
| Depth of Chamber or Diameter of Distribution Lateral | | Depth of Rock over Distribution Lateral | | Depth from Bottom of Distribution Lateral or Chamber to top of Rock or Chamber (F) |
| <div style="border: 1px solid black; width: 150px; height: 25px; margin: 0 auto;"></div> | + | <div style="border: 1px solid black; width: 150px; height: 25px; margin: 0 auto;"></div> | = | <div style="border: 1px solid black; width: 150px; height: 25px; margin: 0 auto;"></div> |
| ft | | ft | | ft |
| from manufacturer or 13.4.12 | | from 15.6.6 | | |
| | | Select 0 if chambers used | | |

Note: depth of cover is the minimum cover, the top of the mound must be graded to promote surface drainage

APPENDICES

Step 10) Determine upslope mound height

| Depth from Bottom of Distribution Lateral or Chamber to top of Rock or Chamber (F) | Upslope Depth of Rock (D) | Depth of Cover over Chamber or Rock and Pipe at Edge (G) | Depth of Upslope Excavation at Edge of Rock Layer | Upslope Total Height of Mound Above Grade (M) |
|--|---------------------------|--|---|---|
| <input type="text"/> | <input type="text"/> | <input type="text"/> | <input type="text"/> | <input type="text"/> |
| ft | ft | ft | ft | ft |
| from manufacturer or 13.4.12 | from step 8 | from 15.6.5 | from 15.6.4 | |
| | Select 0 if chambers used | | maximum 12" | |

Note: depth of cover is the minimum cover, the top of the mound must be graded to promote surface drainage

Step 11) Determine the downslope mound height

| Maximum Rock Layer Top Width (A) | Slope of land (Percent) | Upslope Total Height of Mound Above Grade (M) | Down-slope Total Height of Mound Above Grade (N) |
|----------------------------------|-------------------------|---|--|
| <input type="text"/> | <input type="text"/> | <input type="text"/> | <input type="text"/> |
| ft | % (as decimal) | ft | ft |
| | from site evaluation | | |
| | E.g. 1% = 0.01 | | |

Step 12) Determine the depth above the chambers or pipe and stone at centre of mound

| Depth of Cover over Chamber or Rock and Pipe at Edge (G) | Slope of Mound at Crest | Maximum Rock Layer Top Width (A) | Depth of Cover at centre of Mound (H) |
|--|-------------------------|----------------------------------|---------------------------------------|
| <input type="text"/> | <input type="text"/> | <input type="text"/> | <input type="text"/> |
| Ft | decimal (e.g. 0.04) | ft | ft |
| from step 10 | from 15.6.5.1 | from step | |

Step 13) Determine total depth at edge of rock layer

| | | | | | | |
|--|---|--|---|------------------------------|---|--|
| Depth of Cover over Chamber or Rock and Pipe at Edge (G) | | Depth from Bottom of Distribution Lateral or Chamber to top of Rock or Chamber (F) | | Upslope Depth of Rock (D) | | Total Depth from Infiltration Surface to Top of Mound Fill |
| <input type="text"/> | + | <input type="text"/> | + | <input type="text"/> | = | <input type="text"/> |
| ft | | ft | | ft | | ft |
| from step 10 | | from step 10 | | | | Note: not the height above grade |

Step 14) Determine upslope width

| | | | | | | |
|---|---|---|---|------------------------------|---|--|
| Upslope Total Height of Mound Above Grade (M) | | Horizontal to Vertical Slope Factor | | Upslope Correction Factor | | Upslope Width of Mound Berm (J) |
| <input type="text"/> | x | <input type="text"/> | x | <input type="text"/> | = | <input type="text"/> |
| ft | | unitless | | unitless | | ft |
| from step 10 | | from 15.6.5 e.g. 3 for 3H to 1V | | from table in step 15 | | |

Step 15) Determine downslope width

| | | | | | | |
|--|---|---|---|--------------------------------|---|--|
| Down-slope Total Height of Mound Above Grade (N) | | Horizontal to Vertical Slope Factor | | Downslope Correction Factor | | Downslope Width of Mound Berm (I) |
| <input type="text"/> | x | <input type="text"/> | x | <input type="text"/> | = | <input type="text"/> |
| ft | | unitless | | unitless | | ft |
| from step 12 | | from 15.6.5 e.g. 3 for 3H to 1V | | from table in step 16 | | |

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| Slope Percentage | Downslope Correction Factor | Up Slope Correction Factor |
|------------------|-----------------------------|----------------------------|
| 0 | 1 | 1 |
| 1 | 1.03 | 0.97 |
| 2 | 1.06 | 0.94 |
| 3 | 1.1 | 0.92 |
| 4 | 1.14 | 0.89 |
| 5 | 1.18 | 0.88 |
| 6 | 1.22 | 0.85 |
| 7 | 1.27 | 0.83 |
| 8 | 1.32 | 0.8 |
| 9 | 1.38 | 0.79 |
| 10 | 1.44 | 0.77 |
| 11 | 1.51 | 0.75 |
| 12 | 1.57 | 0.73 |
| 13 | 1.64 | 0.72 |
| 14 | 1.72 | 0.71 |
| 15 | 1.82 | 0.69 |
| 16 | 1.92 | 0.68 |
| 17 | 2.04 | 0.66 |
| 18 | 2.17 | 0.65 |
| 19 | 2.33 | 0.64 |
| 20 | 2.5 | 0.62 |
| 21 | 2.7 | 0.61 |
| 22 | 2.94 | 0.6 |
| 23 | 3.23 | 0.59 |
| 24 | 3.57 | 0.58 |
| 25 | 4 | 0.57 |

Table based on berm side slope of 3:1. For other side slopes use:

- Downslope correction factor = $100 \div [100 - (\text{side slope} \times \% \text{ ground slope})]$

- Upslope correction factor = $100 \div [100 + (\text{side slope} \times \% \text{ ground slope})]$

Note: For a side slope of 4:1, use "4". For a 5% ground slope, use "5".

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Step 16) Determine end slope length

| | | | | | | |
|---|--|---|--|-------|---|---|
| | Upslope Total Height of Mound Above Grade (M) | | Down-slope Total Height of Mound Above Grade (N) | | Horizontal to Vertical Slope Factor | End Slope Width of Mound Berm (K) |
| (| <div style="border: 1px solid black; width: 100px; height: 20px; margin: 0 auto;"></div> | + | <div style="border: 1px solid black; width: 100px; height: 20px; margin: 0 auto;"></div> |) ÷ 2 | X | <div style="border: 1px solid black; width: 100px; height: 20px; margin: 0 auto;"></div> = <div style="border: 1px solid black; width: 100px; height: 20px; margin: 0 auto;"></div> |
| | ft | | ft | | | ft |
| | from step 10 | | from step 11 | | | |
| | | | | | unitless | |
| | | | | | from 15.6.5 | |
| | | | | | e.g. 3 for 3H to 1V | |

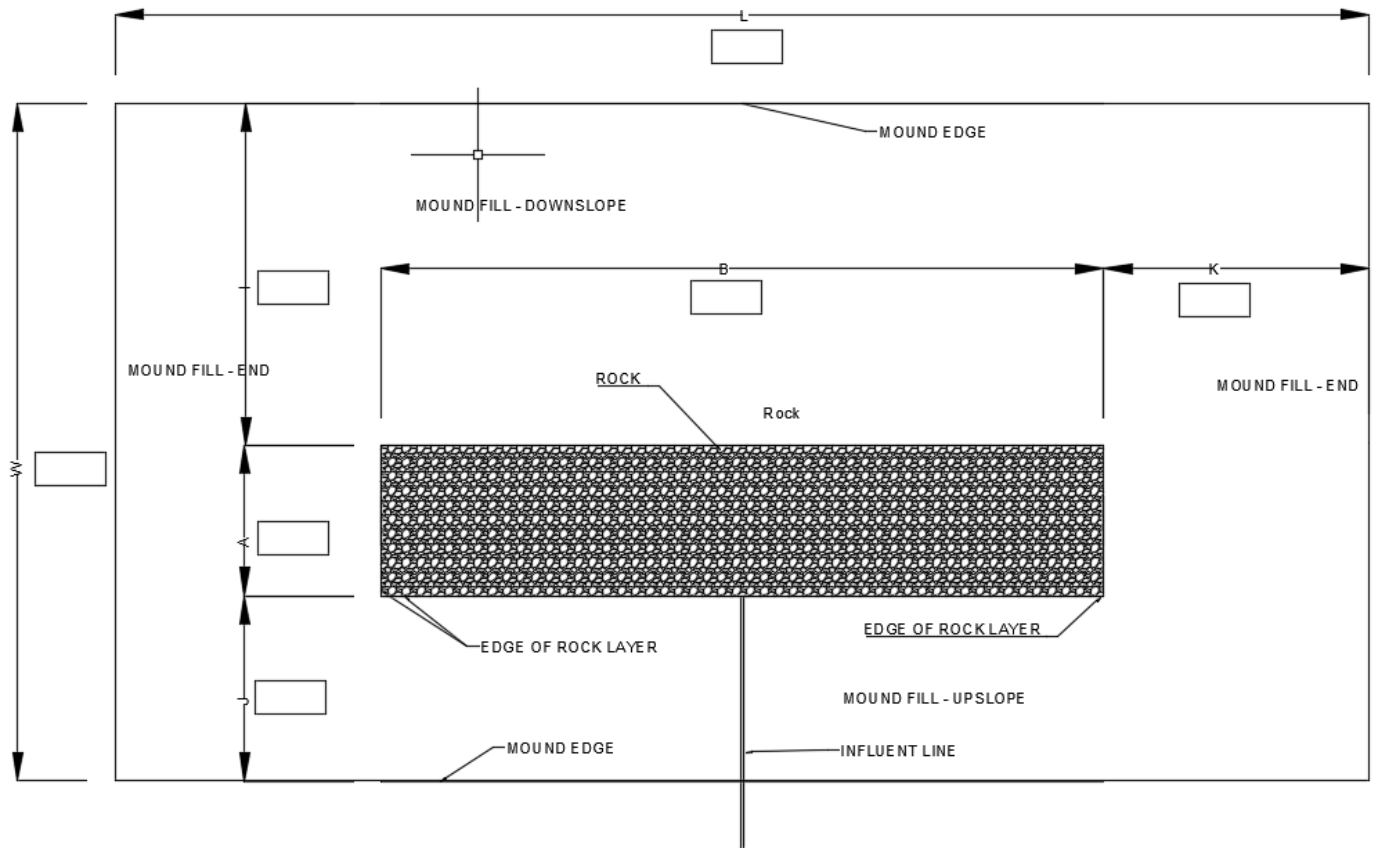
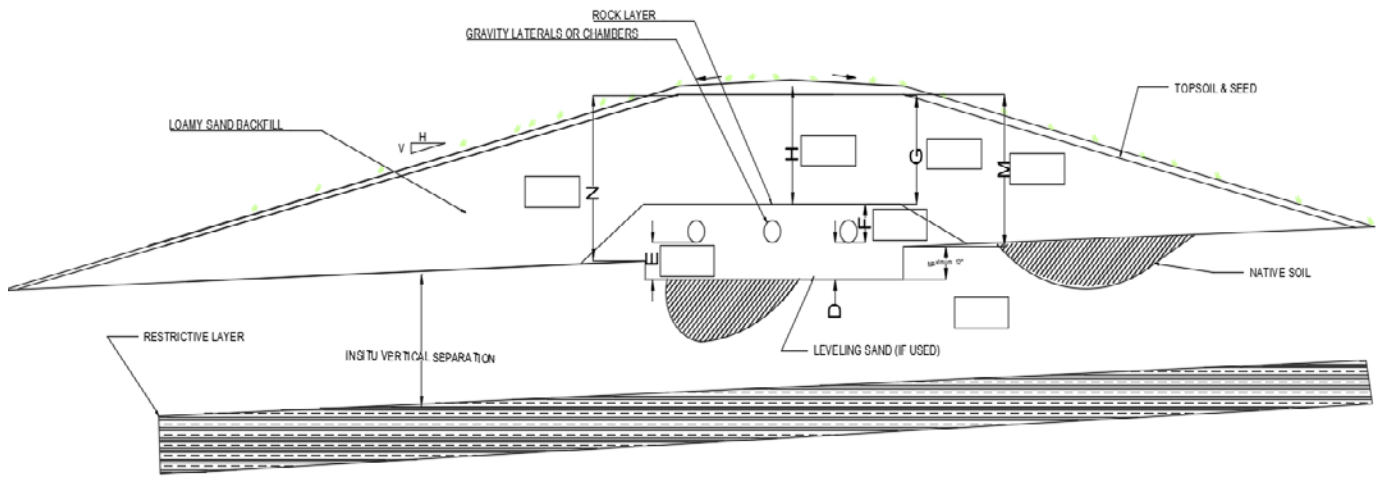
Step 17) Determine total mound berm width and length

| | | | | | | | |
|--|---|---|--|---|--|---|--|
| Minimum System Length (B) | | 2 | | X | End Slope Width of Mound Berm (K) | | Total Length of Mound Berm (L) |
| <div style="border: 1px solid black; width: 100px; height: 20px; margin: 0 auto;"></div> | + | | | | <div style="border: 1px solid black; width: 100px; height: 20px; margin: 0 auto;"></div> | = | <div style="border: 1px solid black; width: 100px; height: 20px; margin: 0 auto;"></div> |
| ft | | | | | ft | | ft |
| Maximum Rock Layer Top Width (A) | | | Downslope Width of Mound Berm (I) | | Upslope width of Mound Berm (J) | | Total Width of Mound Berm (W) |
| <div style="border: 1px solid black; width: 100px; height: 20px; margin: 0 auto;"></div> | + | | <div style="border: 1px solid black; width: 100px; height: 20px; margin: 0 auto;"></div> | + | <div style="border: 1px solid black; width: 100px; height: 20px; margin: 0 auto;"></div> | = | <div style="border: 1px solid black; width: 100px; height: 20px; margin: 0 auto;"></div> |
| ft | | | ft | | ft | | ft |

Step 18) Design a gravity distribution network

Step 19) Summarize on diagrams

APPENDICES



APPENDICES

ANNEX 7 – TYPE II MOUND WORKSHEET (INFORMATIVE)

- Step 1) Collect the following information
- Primary effluent BOD concentration
 - Peak daily flow
 - Soils information
 - Soil absorption field influent quality
 - Slope of the land

- Step 2) Determine the volume of sewage per day

Peak Daily Flow
(PDF)

imp. gal./day
from worksheet
1

- Step 3) Determine the native soil hydraulic loading rate of limiting layer

Texture

from site
evaluation

&

Structure

from site
evaluation

&

Grade

from site
evaluation

&

Infiltration
Depth

from site
evaluation

Native Soil
Hydraulic
Loading Rate
(HLR)

imp.
gal/ft²/day
from table 13-
3

use <30 mg/L
BOD column
for secondary
effluent

Native Soil
Linear Loading
Rate (LLR)

imp. gal/ft/day

from table 13-5

Use 8.3 where
vertical
separation is
greater than 48
inches

APPENDICES

Step 4) Determine the width of the sand layer

| Native Soil Linear Loading Rate (LLR) | | Sand Hydraulic Loading Rate (S-HLR) | | Maximum Sand Layer Width (A) |
|--|---|--|---|--|
| | ÷ | 0.83 | = | |
| imp. gal/ft ² /day | | imp. gal/ft ² /day | | ft |
| | | from 16.6.2.1 | | 16.6.2 requires a width less than 10 ft |

Step 5) Determine the native soil infiltration surface length

| Peak Daily Flow (PDF) | | Native Soil Linear Loading Rate (LLR) | | Minimum System Length (B) |
|--------------------------|---|--|---|---------------------------------|
| | ÷ | | = | |
| imp. gal./day | | imp. gal/ft/day | | ft |
| from step 1 | | from step 3 | | |

Note: System width can be selected as up to 10 ft for locations where there is more than 48" native soil vertical separation

Step 6) Determine the native soil infiltration surface area

| Peak Daily Flow (PDF) | | Native Soil Hydraulic Loading Rate (HLR) | | Native Soil Infiltration Surface Area |
|--------------------------|---|---|---|---|
| | ÷ | | = | |
| imp. gal./day | | imp. gal/ft ² /day | | ft ² |
| from step 1 | | from Table 13-3 from step 3 | | |

APPENDICES

Step 7) Determine sand layer area

| Maximum Sand Layer Width (A) | | Maximum System Length (B) | | Sand Layer Area |
|------------------------------|---|---------------------------|---|-----------------|
| | X | | = | |
| ft from step 4 | | ft from step 5 | | ft ² |

Step 8) Determine the width of the native soil infiltration surface

| Native Soil Linear Loading Rate (LLR) | | Native Soil Hydraulic Loading Rate (HLR) | | Minimum Native Soil Width |
|---------------------------------------|---|---|---|---------------------------|
| | ÷ | | = | |
| imp. gal/ft/day from step 3 | | imp. gal/ft ² /day from 16.6.2.1 from step 3 | | ft |

Step 9) Calculate organic loading rate

| Secondary Effluent BOD | | Native Soil Hydraulic Loading Rate (HLR) | | Conversion Factor | | Organic Loading Rate (OLR) |
|--|---|--|---|-------------------|---|---|
| | X | | X | 0.01003532 | = | |
| mg/L Field measurement or assume meets secondary effluent definition | | imp. gal/ft ² /day from step 3 | | | | lb BOD ₅ /1000 ft ² /day |

Confirm organic loading rate meets 13.4.3

APPENDICES

Step 10) Determine the minimum depth of sand

| | | | | |
|--|---|--|---|--|
| Desired Vertical Separation <input style="width: 100px; height: 20px;" type="text"/> ft from 13.4.5 | - | Available Native Vertical Separation between Original Ground Surface and Restrictive Layer <input style="width: 100px; height: 20px;" type="text"/> ft from 13.4.5.2 from site evaluation | = | Upslope Depth of Sand (D) <input style="width: 100px; height: 20px;" type="text"/> ft |
|--|---|--|---|--|

Note: First 1 foot of sand layer depth is used for treatment and not vertical separation

Step 11) Determine the downslope depth of sand

| | | | | | | |
|--|---|--|---|--|---|---|
| Maximum Sand Layer Width (A) <input style="width: 100px; height: 20px;" type="text"/> ft | X | Slope of land <input style="width: 100px; height: 20px;" type="text"/> % (decimal) from site evaluation | + | Upslope Depth of Sand (D) <input style="width: 100px; height: 20px;" type="text"/> ft | = | Downslope Depth of Sand (E) <input style="width: 100px; height: 20px;" type="text"/> ft |
|--|---|--|---|--|---|---|

Step 12) Determine mound depths

| | | |
|---|--|--|
| Sand Layer Depth Required for Treatment <input style="width: 100px; height: 20px;" type="text"/> 1 ft from 16.6.3.1 | Depth of Chamber or Rock and Pipe (F) <input style="width: 100px; height: 20px;" type="text"/> ft from manufacturer or 16.6.5 | Depth of Cover over Chamber or Rock and Pipe at Edge (G) <input style="width: 100px; height: 20px;" type="text"/> ft from 16.6.4 |
|---|--|--|

Note: depth of cover is the minimum cover, the top of the mound must be graded to promote surface drainage

APPENDICES

Step 13) Determine the depth above the chambers or pipe and stone at centre of mound

| | | | | | | |
|--|---|-------------------------------|---|---------------------------------|-------------|--|
| Depth of Cover over Chamber or Rock and Pipe at Edge (G) | | Slope of Mound at Crest | | Maximum Sand Layer Width (A) | | Depth of Cover at centre of Mound (H) |
| <input type="text"/> | + | <input type="text"/> | x | 0.5 | x | <input type="text"/> |
| ft | | decimal (e.g. 0.04) | | | | ft |
| from step 12 | | from 16.6.4.1 | | | from step 4 | |

Step 14) Determine total depth at edge of sand layer

| | | | | | | | | |
|--|---|--|---|--|---|------------------------------|---|---|
| Depth of Cover over Chamber or Rock and Pipe at Edge (G) | | Depth of Chamber or Rock and Pipe (F) | | Sand Layer Depth | | Upslope Depth of Sand (D) | | Upslope Total Depth of Mound (M) |
| <input type="text"/> | + | <input type="text"/> | + | <input type="text" value="1"/> | + | <input type="text"/> | = | <input type="text"/> |
| ft | | ft | | ft | | ft | | ft |
| from step 12 | | from step 12 | | from step 12 Required for treatment not for vertical separation | | from step 10 | | |

| | | | | | | | | |
|--|---|--|---|--|---|-----------------------------------|---|--|
| Depth of Cover over Chamber or Rock and Pipe at Edge (G) | | Depth of Chamber or Rock and Pipe (F) | | Sand Layer Depth | | Downslope Depth of Sand (E) | | Down-slope Total Depth of Mound (N) |
| <input type="text"/> | + | <input type="text"/> | + | <input type="text" value="1"/> | + | <input type="text"/> | = | <input type="text"/> |
| ft | | ft | | ft | | ft | | ft |
| from step 12 | | from step 12 | | from step 12 Required for treatment not for vertical separation | | from step 11 | | |

APPENDICES

Step 15) Determine upslope width

| | | | | | | |
|--|---|---|---|------------------------------|---|------------------------------------|
| Upslope Total Depth of Mound (M) | | Horizontal to Vertical Slope Factor | | Upslope Correction Factor | | Upslope width of Mound Berm (J) |
| | X | | X | | = | |
| ft | | unitless | | unitless | | ft |
| from step 14 | | from 16.6.4.3 | | from table in step 16 | | |
| | | e.g. 3 for 3H to 1V | | | | |

Step 16) Determine downslope width

| | | | | | | |
|--|---|---|---|--------------------------------|---|--------------------------------------|
| Downslope Total Depth of Mound (N) | | Horizontal to Vertical Slope Factor | | Downslope Correction Factor | | Downslope Width of Mound Berm (I) |
| | X | | X | | = | |
| ft | | unitless | | unitless | | ft |
| from step 14 | | from 16.6.4.3 | | from table in step 16 | | |
| | | e.g. 3 for 3H to 1V | | | | |

| Slope Percentage | Downslope Correction Factor | Up Slope Correction Factor |
|------------------|-----------------------------|----------------------------|
| 0 | 1 | 1 |
| 1 | 1.03 | 0.97 |
| 2 | 1.06 | 0.94 |
| 3 | 1.1 | 0.92 |
| 4 | 1.14 | 0.89 |
| 5 | 1.18 | 0.88 |
| 6 | 1.22 | 0.85 |
| 7 | 1.27 | 0.83 |
| 8 | 1.32 | 0.8 |
| 9 | 1.38 | 0.79 |
| 10 | 1.44 | 0.77 |
| 11 | 1.51 | 0.75 |
| 12 | 1.57 | 0.73 |
| 13 | 1.64 | 0.72 |
| 14 | 1.72 | 0.71 |
| 15 | 1.82 | 0.69 |
| 16 | 1.92 | 0.68 |

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| | | |
|----|------|------|
| 17 | 2.04 | 0.66 |
| 18 | 2.17 | 0.65 |
| 19 | 2.33 | 0.64 |
| 20 | 2.5 | 0.62 |
| 21 | 2.7 | 0.61 |
| 22 | 2.94 | 0.6 |
| 23 | 3.23 | 0.59 |
| 24 | 3.57 | 0.58 |
| 25 | 4 | 0.57 |

Table based on berm side slope of 3:1. For other side slopes use:

- Downslope correction factor = $100 \div [100 - (\text{side slope} \times \% \text{ ground slope})]$

- Upslope correction factor = $100 \div [100 + (\text{side slope} \times \% \text{ ground slope})]$

Note: For a side slope of 4:1, use "4". For a 5% ground slope, use "5".

Step 17) Determine end slope length

| | | | |
|--|--|---|--|
| Downslope Total Depth of Mound (M) | Upslope Total Depth of Mound (N) | Horizontal to Vertical Slope Factor | End Slope width of Mound Berm (K) |
| (<input type="text"/>) | + (<input type="text"/>) | ÷ 2 | |
| ft | ft | | |
| X <input type="text"/> | | | = <input type="text"/> |
| unitless | | | ft |
| from 16.6.4.3 | | | |
| e.g. 3 for 3H to 1V | | | |

Step 18) Determine total mound berm width and length

| | | |
|---------------------------------|--------------------------------------|-----------------------------------|
| Minimum System Length (B) | End Slope width of Mound Berm (K) | Total Length of Mound Berm (L) |
| <input type="text"/> | X <input type="text"/> | = <input type="text"/> |
| ft | ft | ft |

| | | | |
|------------------------------------|--|------------------------------------|----------------------------------|
| Maximum Sand Layer Width (A) | Downslope width of Mound Berm (I) | Upslope width of Mound Berm (J) | Total Width of Mound Berm (W) |
| <input type="text"/> | + <input type="text"/> | + <input type="text"/> | = <input type="text"/> |
| ft | ft | ft | ft |

APPENDICES

Step 19) Confirm sufficient native soil width is covered by mound

For slopes of less than 1%

Total Width
of Mound
Berm (W)

ft
from step 18

must be
greater than

Minimum Native
Soil Width

ft
from step 8

For Slopes greater than 1%

Downslope
Width of
Mound Berm
(I)

ft

Maximum
Sand Layer
Width (A)

ft

Must be greater
than

Minimum Native
Soil Width

ft
from step 8

If not, redo with different berm
slopes.

Step 21) Design a pressure distribution
network

Step 22) Summarize on
diagrams

APPENDICES

Figure A7-1 - Plan View of Mound (Design)

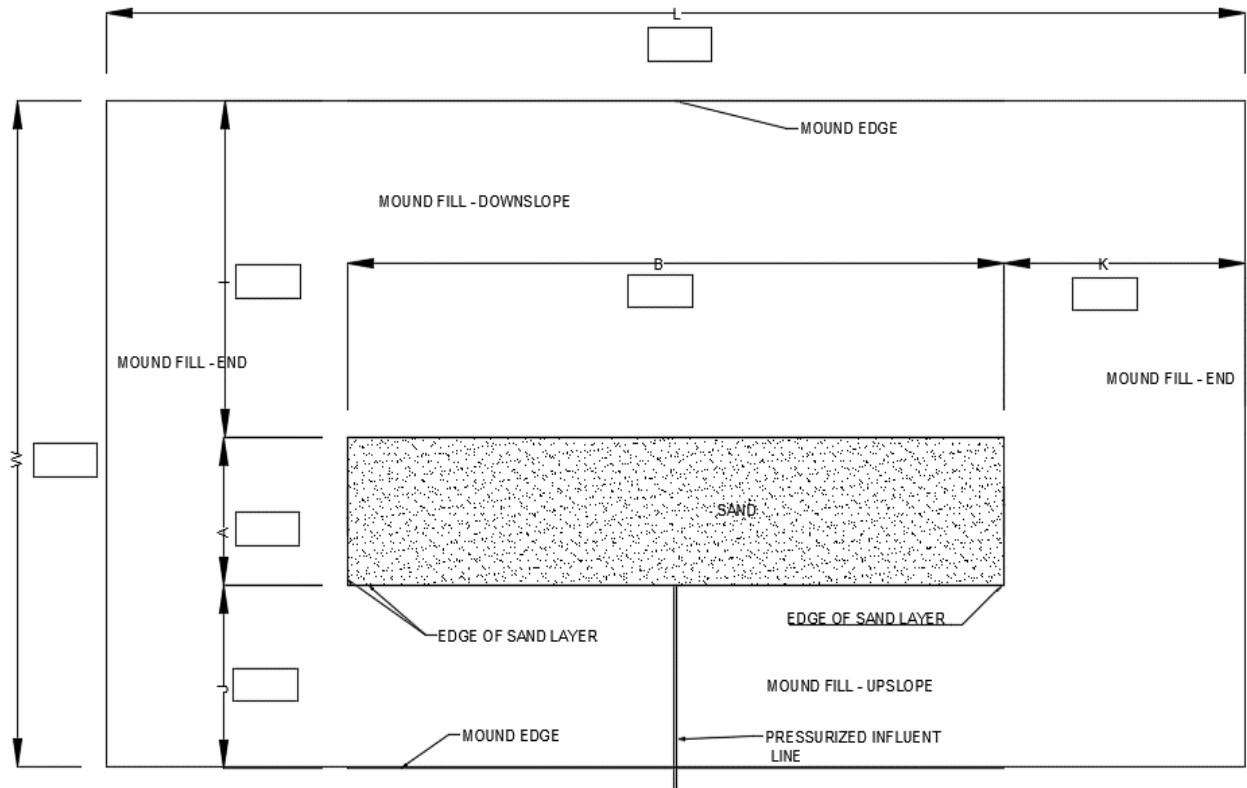
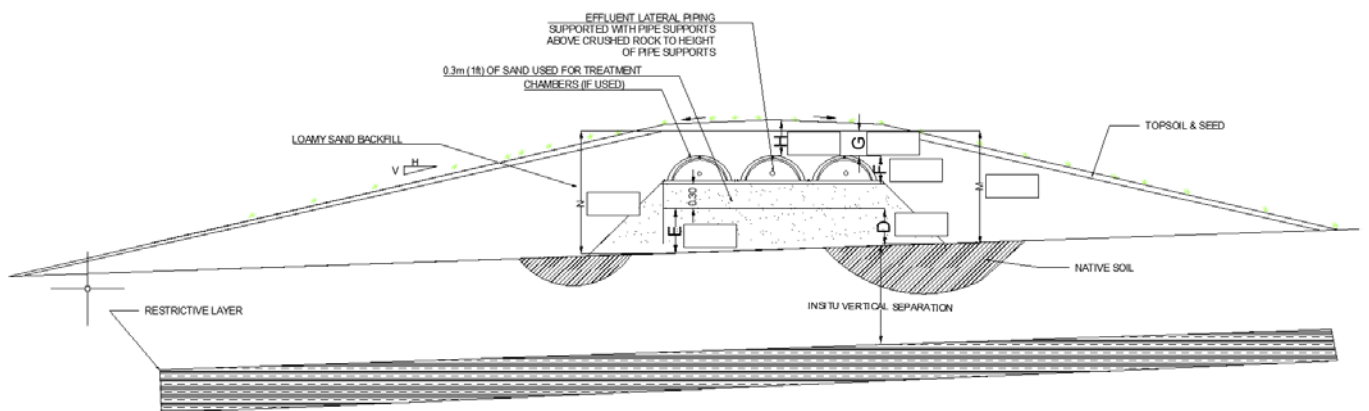


Figure A7-2 - Cross-Section of Mound (Design)



APPENDICES

ANNEX 8 – PRESSURE DISTRIBUTION WORKSHEET (INFORMATIVE)

- Step 1) Collect the following information
- Soils information
 - Absorption field or Type II Mound Design
 - Piping layout
 - Site elevations

- Step 2) Select the pressure head to be maintained at the orifices

Design Pressure at
Lateral Orifices

ft

from 13.4.13.3

- Step 2) Select the size of the orifices in the laterals

Orifice Diameter

in

from 13.4.13.3

Minimum size is 1/8 in. (3.2 mm). Larger sizes are less likely to plug.

- Step 3) Select the spacing of the orifices and determine the number of orifices to be installed in the distribution laterals

Length of Individual
Distribution Lateral

ft

from 13.4.13.3

based on design

Spacing between
Orifices

ft

from 13.4.13.2

based on design

Number of Orifices per
Lateral

round up to whole number

note: see 16.6.5.2 for Type II mounds

Number of Orifices per
Lateral

Number of Laterals

based on design

Total Number of Orifices
on All Laterals

Note: if distribution laterals are different lengths, each lateral must be calculated separately.

APPENDICES

Step 4) Determine the minimum pipe size of the distribution laterals

| | | |
|---|---|---|
| Orifice Diameter | Length of Individual Distribution Lateral | Number of Orifices per Lateral |
| <div style="border: 1px solid black; height: 20px; width: 100%;"></div> | <div style="border: 1px solid black; height: 20px; width: 100%;"></div> | <div style="border: 1px solid black; height: 20px; width: 100%;"></div> |
| in | ft | |
| from step 2 | from step 3 | from step 3 |

Use table 13-11 and 13-12 to determine lateral pipe size

Diameter of Lateral Pipe

ft

from table 13-12 and
13-13

Step 5) Determine the total flow from all lateral orifices

| | | |
|---|---|---|
| Total Number of Orifices on All Laterals | Flow for Each Orifice | Total Flow from all Orifices |
| <div style="border: 1px solid black; height: 20px; width: 100%;"></div> | <div style="border: 1px solid black; height: 20px; width: 100%;"></div> | <div style="border: 1px solid black; height: 20px; width: 100%;"></div> |
| | X | = |
| | imp. gal./min | imp. gal./min |
| from step 3 | from table 13-14 and 13-15 | |

Step 6) Select the type and size of effluent delivery pipe

| | |
|---|---|
| Pipe Material | Pipe Diameter |
| <div style="border: 1px solid black; height: 20px; width: 100%;"></div> | <div style="border: 1px solid black; height: 20px; width: 100%;"></div> |
| | inch |
| from design | from design |

Use tables 13-8 and 13-9. A larger pipe will reduce pressure loss

Step 7) Calculate the equivalent length of pipe for pressure loss due to fittings

| | | |
|---|---|---|
| Number of 90 deg Elbows | Equivalent Length of Pipe per Fitting | Total Equivalent Pipe Length for 90 deg Elbows |
| <div style="border: 1px solid black; height: 20px; width: 100%;"></div> | <div style="border: 1px solid black; height: 20px; width: 100%;"></div> | <div style="border: 1px solid black; height: 20px; width: 100%;"></div> |
| | X | = |
| | ft | ft |
| | from tables 13-10 or 13- 11 | |

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| | | |
|---|--|--|
| <p>Number of 45 deg Elbows</p> <div style="border: 1px solid black; width: 150px; height: 20px; margin-bottom: 5px;"></div> | <p>Equivalent Length of Pipe per Fitting</p> <div style="border: 1px solid black; width: 150px; height: 20px; margin-bottom: 5px;"></div> <p style="text-align: center; font-size: small;">ft from tables 13-10 or 13-11</p> | <p>Total Equivalent Pipe Length for 45 deg Elbows</p> <div style="border: 1px solid black; width: 150px; height: 20px; margin-bottom: 5px;"></div> <p style="text-align: center; font-size: small;">ft</p> |
| <p>Number of Gate and Ball Valves</p> <div style="border: 1px solid black; width: 150px; height: 20px; margin-bottom: 5px;"></div> | <p>Equivalent Length of Pipe per Fitting</p> <div style="border: 1px solid black; width: 150px; height: 20px; margin-bottom: 5px;"></div> <p style="text-align: center; font-size: small;">ft from tables 13-10 or 13-11</p> | <p>Total equivalent Pipe Length for Gate and Ball Valves</p> <div style="border: 1px solid black; width: 150px; height: 20px; margin-bottom: 5px;"></div> <p style="text-align: center; font-size: small;">ft</p> |
| <p>Number of Tee on Branch</p> <div style="border: 1px solid black; width: 150px; height: 20px; margin-bottom: 5px;"></div> | <p>Equivalent Length of Pipe per Fitting</p> <div style="border: 1px solid black; width: 150px; height: 20px; margin-bottom: 5px;"></div> <p style="text-align: center; font-size: small;">ft from tables 13-10 or 13-11</p> | <p>Total Equivalent Pipe Length for Tee on Branch</p> <div style="border: 1px solid black; width: 150px; height: 20px; margin-bottom: 5px;"></div> <p style="text-align: center; font-size: small;">ft</p> |
| <p>Number of Tee on Run</p> <div style="border: 1px solid black; width: 150px; height: 20px; margin-bottom: 5px;"></div> | <p>Equivalent Length of Pipe per Fitting</p> <div style="border: 1px solid black; width: 150px; height: 20px; margin-bottom: 5px;"></div> <p style="text-align: center; font-size: small;">ft from tables 13-10 or 13-11</p> | <p>Total Equivalent Pipe Length for Tee on Run</p> <div style="border: 1px solid black; width: 150px; height: 20px; margin-bottom: 5px;"></div> <p style="text-align: center; font-size: small;">ft</p> |
| <p>Number of Male/Female Pipe Adapters</p> <div style="border: 1px solid black; width: 150px; height: 20px; margin-bottom: 5px;"></div> | <p>Equivalent Length of Pipe per Fitting</p> <div style="border: 1px solid black; width: 150px; height: 20px; margin-bottom: 5px;"></div> <p style="text-align: center; font-size: small;">ft from tables 13-10 or 13-11</p> | <p>Total Equivalent Pipe Length for Male/Female Pipe Adapters</p> <div style="border: 1px solid black; width: 150px; height: 20px; margin-bottom: 5px;"></div> <p style="text-align: center; font-size: small;">ft</p> |
| | | <p>Total Equivalent Pipe Length of Fittings</p> <div style="border: 1px solid black; width: 150px; height: 20px; margin-bottom: 5px;"></div> <p style="text-align: center; font-size: small;">ft</p> <p>add all above totals</p> |

APPENDICES

Step 8) Calculate the equivalent length of pipe from pump to the farthest end of header of distribution laterals

| | | | | |
|-------------------|---|--|---|------------------------------|
| Length of Piping | | Total Equivalent Pipe Length of Fittings | | Total Equivalent Pipe Length |
| | + | | = | |
| ft from design | | ft from step 7 | | ft |

Step 9) Calculate the pressure head loss in the pipe including fittings

| | | | | |
|------------------------------|---|-------------------------------|-------|--------------------------------|
| Total Equivalent Pipe Length | | Friction Loss per 100 feet | | Total Major Pressure Head Loss |
| | X | | /100= | |
| ft from step 8 | | ft from table 13-8 or 13-9 | | ft |

Step 10) Calculate the total pressure head required at the pump

| | | | | |
|---|---|----|--|----------------------|
| Total Major Pressure Head Loss | | ft | | |
| | + | | | |
| Lift Distance of effluent from effluent level in tank to orifices | | ft | | from site evaluation |
| | + | | | |
| Design Pressure at Lateral Orifices | | ft | | from step 2 |
| | + | | | |
| Head loss allowed if inline filter used | | ft | | from manufacturer |
| | + | | | |
| Add 1 ft to allow for pressure loss along distribution lateral | 1 | ft | | |
| | = | | | |
| Total Minimum Pressure Head at Design Conditions | | ft | | |

APPENDICES

Step 11) Select the size of the drain back orifice if used and determine the flow from the drain back orifice. Then calculate total flow requirement for pump

| | | |
|--|---|--|
| <p>Size of Drain Back Orifice</p> <div style="border: 1px solid black; height: 20px; width: 100%;"></div> <p>ft</p> <p>from design</p> | <p>Total Minimum Pressure Head at Design Conditions</p> <div style="border: 1px solid black; height: 20px; width: 100%;"></div> <p>ft</p> <p>from step 10</p> | <p>Flow from Drain Back Orifice at Total Design Pressure Head</p> <div style="border: 1px solid black; height: 20px; width: 100%;"></div> <p>imp.gal./min</p> <p>from table 13-14 or 13-15</p> |
| <p>Flow from Drain Back Orifice at Total Design Pressure Head</p> <div style="border: 1px solid black; height: 20px; width: 100%;"></div> <p>imp.gal./min</p> <p>from table 13-14 or 13-15</p> | <p>+</p> | <p>Total Flow from all Orifices</p> <div style="border: 1px solid black; height: 20px; width: 100%;"></div> <p>imp. gal./min</p> <p>from step 10</p> |
| <p>=</p> | | <p>Total Flow at Design Conditions</p> <div style="border: 1px solid black; height: 20px; width: 100%;"></div> <p>imp.gal./min</p> |

Step 12) Details of pumping requirements

| | | |
|--|-----------|---|
| <p>Total Flow at Design Conditions</p> <div style="border: 1px solid black; height: 20px; width: 100%;"></div> <p>imp.gal./min</p> <p>from step 11</p> | <p>at</p> | <p>Total Minimum Pressure Head at Design Conditions</p> <div style="border: 1px solid black; height: 20px; width: 100%;"></div> <p>ft</p> <p>from step 10</p> |
|--|-----------|---|

note: many pumps are sold in us gallons. Convert imp. gallons to us Gallons

Step 13) Repeat the calculations if it is necessary to change the pump specifications

If the flow rate through the orifices is too high, reduce the orifice diameter, increase the orifice spacing, or include a distributing valve to sequentially dose small portions of the system.

If the pressure head required is too high, select a lower design pressure, reduce the flow rate or increase the effluent delivery pipe size.

Step 14) Confirm the design complies with the Guide

The worksheet does NOT consider all requirements of the Guide. Please ensure that all public health and environmental considerations are addressed.

Please work safely and follow safe practices near trenches and open excavations.

APPENDICES

ANNEX 9 – LAGOON WORKSHEET (INFORMATIVE)

Step 1) Collect the following information

- Estimated Annual Precipitation (Annual)
- Estimated Annual Evaporation (Annual)
- Estimated Daily Sewage Flow -
- Operating Depth - recommended 1.2m (6ft)
- Horizontal to vertical slope of berms - recommended 3:1

Step 2) Determine the volume of sewage per day

Average Daily Flow (ADF)

m³/day

from worksheet 1

Step 3) Determine the annual sewage volume.

Average Daily Flow (ADF)

m³/day

at maximum occupancy

X

365

days per year

=

Annual Sewage Volume

m³/year

Step 4) Determine the net annual evaporation (Revap)

Annual Evaporation

mm/yr

from Annex 11

-

Annual Precipitation

mm/yr

from Annex 11

=

Revap

mm/yr

Step 5) Determine the rate of evaporation (Vevap)

Revap

mm/yr

from step 4

X

Conversion Factor

0.001

(1m/1000mm)X(1000
L/mm)X(1/1m²)

=

Vevap

m³/m²/yr

APPENDICES

Step 6) Calculate lagoon area (m²)

$$\begin{array}{ccccccc}
 \text{Annual Sewage Volume} & & \text{Evaporation Factor} & & \text{Vevap} & & \text{Area of Lagoon} \\
 \boxed{} & \times & \boxed{1.25} & \div & \boxed{} & = & \boxed{} \\
 \text{cubic meters/year} & & & & \text{m}^3/\text{m}^2/\text{yr} & & \text{m}^2 \\
 \text{from step 3} & & & & \text{from step 5} & &
 \end{array}$$

Step 7) Calculate lagoon dimensions (Length & Width) at desired water level assuming square lagoon

$$\begin{array}{ccccccc}
 & & \text{Area of Lagoon} & & & & \\
 \text{Square Root} & \sqrt{(\boxed{})} & = & \boxed{} \\
 & \text{m}^2 & & \text{m} & & &
 \end{array}$$

This is the water surface size "B" at the lagoon operating depth (Figure 19-1)

Lagoon is square so length = width = B at water level

Step 8) Length of side from water level to inside edge of berm top

$$\begin{array}{ccccccc}
 \text{H:Vslope} & & \text{Freeboard} & & & & \\
 \boxed{} & \times & \boxed{} & = & \boxed{} \\
 \text{m} & & \text{m} & & \text{m} & &
 \end{array}$$

Step 9) Size at centre of berm "C" length

$$\begin{array}{ccccccc}
 \text{B} & & \text{E} & & \text{Berm top width} & & \text{C} \\
 \boxed{} & + 2 \times (\boxed{}) & + & \boxed{} & = & \boxed{} \\
 \text{m} & & \text{m} & & \text{m} & & \text{m}
 \end{array}$$

H:V slope

Freeboard

Berm Slope (horizontal to vertical slope)

Height of Berm above water surface

Step 10) Size at base of lagoon "A" length

$$\begin{array}{ccccccc}
 \text{B} & & \text{H:V slope} & & \text{Water depth} & & \text{A} \\
 \boxed{} & - & \boxed{} & \times & \boxed{} & = & \boxed{} \\
 \text{m} & & \text{imp. gal/ft}^2/\text{day} & & \text{m} & & \text{m}
 \end{array}$$

ANNEX 10 – SITE EVALUATION REPORT (INFORMATIVE)

| A. SYSTEM OWNER INFORMATION | | | |
|---|--|---|--|
| Name of System Owner | | Land Location | |
| Company Name (if applicable) | | GPS Coordinates (of system) | |
| Phone Fax | | Address (of installation) | |
| E-mail | | | |
| B. SYSTEM INSTALLER INFORMATION | | | |
| Name of System Installer | | Email | |
| Company Name (if applicable) | | Primary business address | |
| Phone | | Fax | |
| C. SYSTEM DESIGN INFORMATION | | | |
| Type of system to be installed | | Completed Soils Investigation Worksheet Completed | <input type="checkbox"/> Yes <input type="checkbox"/> No |
| Property Size | <input type="checkbox"/> ft ² <input type="checkbox"/> m ² | Design Worksheets Attached (from Saskatchewan Onsite Wastewater Disposal Guide) | <input type="checkbox"/> Yes <input type="checkbox"/> No |
| <p style="color: red;">Note: A soils investigation is not required for holding tanks, septic tanks, sewage ejectors, and lagoons.</p> | | | |
| D. SITE DIAGRAM INFORMATION | | | |
| <p>The site diagram on Page 4 of this worksheet is required as part of an onsite wastewater permit application. The checklist below shows all features required as part of the site diagram. For some of the features listed below, setback distances (the distance from the feature to the closest portion of the proposed private sewage works) and other information are required:</p> <ul style="list-style-type: none"> <input type="checkbox"/> Lot Boundaries <input type="checkbox"/> Property Dimensions <input type="checkbox"/> Location of Proposed Private Sewage Works <input type="checkbox"/> Location of Any Existing Private Sewage Works (if applicable) <input type="checkbox"/> Surface Slope and Site Drainage Direction <input type="checkbox"/> Surface Gradient at proposed location of private sewage works: _____ % <input type="checkbox"/> Location of Surface Water Feature(s): (note: include all features up to 800m outside the boundaries) Specify type of feature(s) (e.g. Dugout): _____ Setback Distance(s): _____ <input type="checkbox"/> Location of Well(s) Setback Distance(s): _____ <input type="checkbox"/> Locations of Test Pits/Boreholes/Percolation Tests. Specify type and number: _____ <input type="checkbox"/> Locations of Trees, Bushes, or Vegetation that Favours Wet Soils (e.g. Cattails) Setback Distance(s): _____ <input type="checkbox"/> Locations of all Buildings on the same Lot Setback Distance(s): _____ <input type="checkbox"/> Locations of Easements/Right-of-Ways/etc.: Setback Distance(s): _____ | | | |
| E. OFFICE USE ONLY | | | |
| Reviewer | | Review Date | |
| Permit # | | Nexus # | |

| F. SOILS INVESTIGATION | | | | | | | | | | | |
|------------------------------------|--|--|--|--|--|--|--|--|--|--|--|
| Depth to Groundwater | | | | | | | | Root Depth | | | |
| Depth to Seasonally Saturated Soil | | | | | | | | Organic Surface Layer Depth | | | |
| Depth to Restrictive Soil Layer | | | | | | | | Other Relevant Observations (e.g. weather conditions): | | | |
| Depth to High Permeability Layer | | | | | | | | | | | |

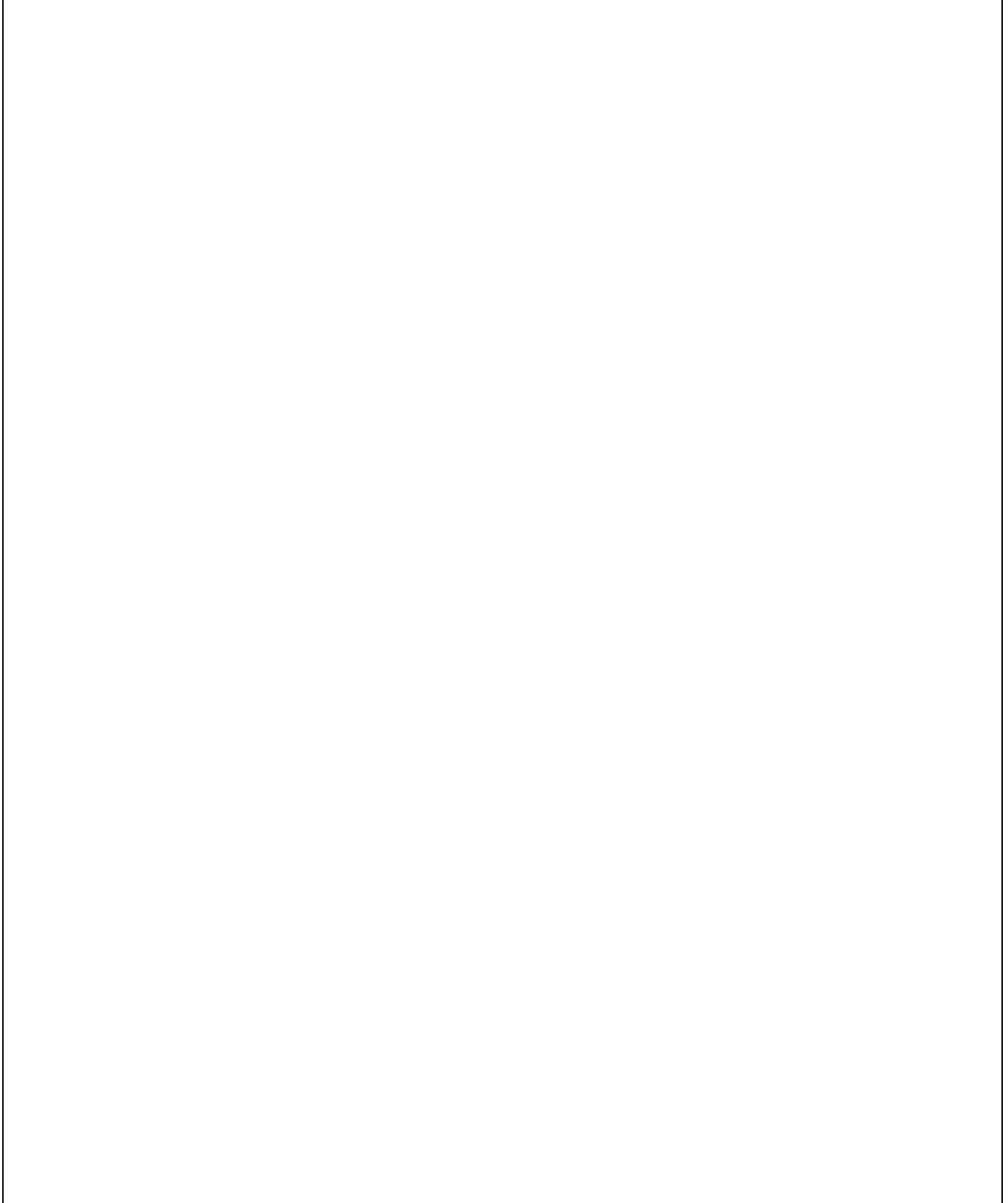
| G. TEST PIT/BOREHOLE LOGS | | | | | | | | | | | |
|---------------------------|----------|-------------|-------------|-----------------|----------------------|------------|-----------------|------------|------------|-------------------|--|
| Logged By: | | | | | | Date: | | | | | |
| Depth of Soil Layer: | | | | | Colour: | | | | | | |
| Horizon: | | | | | Soil Sample Depth: | | | | | | |
| Moisture: | Dry | Moist | Wet | | Consistency (moist): | Loose | V. Friable | Friable | Firm | V.Firm or E. Firm | |
| Texture: | Loam | Clay Loam | Clay | Sandy Clay Loam | Silt Loam | Silty Clay | Silty Clay Loam | Sandy Loam | Loamy Sand | Sand | |
| Structure/Grade: | Granular | Blocky | Prismatic | Columnar | Platey | Massive | Single Grained | 1 | 2 | 3 | |
| Roots: | None | Some | Common | Many | | | | | | | |
| % Coarse Fragments | | | % | Small Stones | Gravel | Cobbles | Boulders | Other: | | | |
| Mottling Abundance | None | Few | Common | Many | Mottling Size: | Fine | Medium | Large | | | |
| Mottling Contrast: | Faint | Distinct | Course | | Gleying: | None | Weak | Moderate | Strong | | |
| Inclusions: | None | Coal Flecks | Coal Chunks | Sandstones | Shale Stones | Wood | Other: | | | | |
| Comments: | | | | | | | | | | | |
| Logged By: | | | | | | Date: | | | | | |
| Depth of Soil Layer: | | | | | Colour: | | | | | | |
| Horizon: | | | | | Soil Sample Depth: | | | | | | |
| Moisture: | Dry | Moist | Wet | | Consistency (moist): | Loose | V. Friable | Friable | Firm | V.Firm or E. Firm | |
| Texture: | Loam | Clay Loam | Clay | Sandy Clay Loam | Silt Loam | Silty Clay | Silty Clay Loam | Sandy Loam | Loamy Sand | Sand | |
| Structure/Grade: | Granular | Blocky | Prismatic | Columnar | Platey | Massive | Single Grained | 1 | 2 | 3 | |
| Roots: | None | Some | Common | Many | | | | | | | |
| % Coarse Fragments | | | % | Small Stones | Gravel | Cobbles | Boulders | Other: | | | |
| Mottling Abundance | None | Few | Common | Many | Mottling Size: | Fine | Medium | Large | | | |
| Mottling Contrast: | Faint | Distinct | Course | | Gleying: | None | Weak | Moderate | Strong | | |
| Inclusions: | None | Coal Flecks | Coal Chunks | Sandstones | Shale Stones | Wood | Other: | | | | |
| Comments: | | | | | | | | | | | |

Copy this page if more soil logs are needed

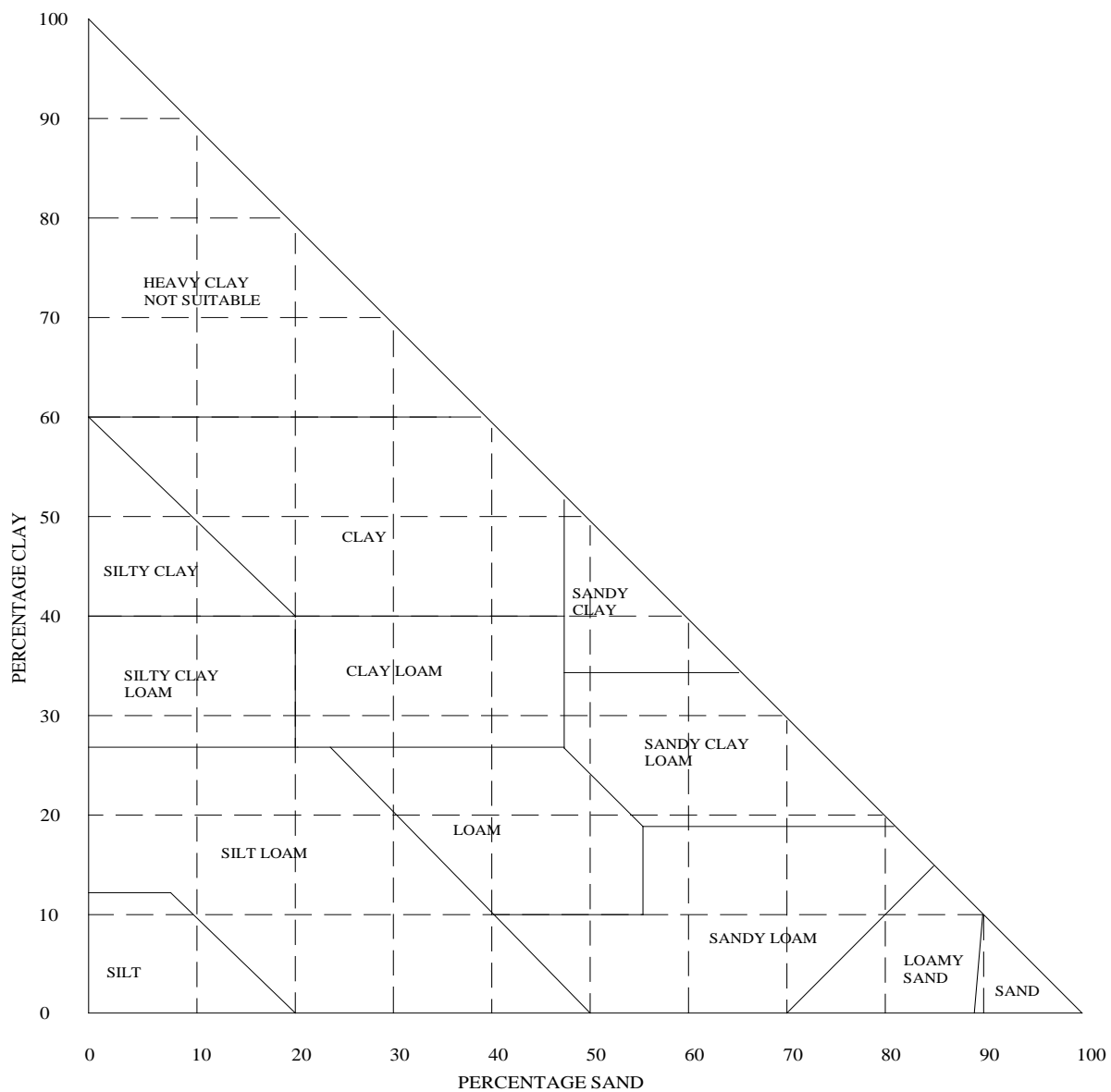
| | | | | | | | | | | | |
|----------------------|----------|-------------|--------------|-----------------|----------------------|------------|-----------------|------------|------------|-------------------|--|
| Logged By: | | | | | Date: | | | | | | |
| Depth of Soil Layer: | | | | | Colour: | | | | | | |
| Horizon: | | | | | Soil Sample Depth: | | | | | | |
| Moisture: | Dry | Moist | Wet | | Consistency (moist): | Loose | V. Friable | Friable | Firm | V.Firm or E. Firm | |
| Texture: | Loam | Clay Loam | Clay | Sandy Clay Loam | Silt Loam | Silty Clay | Silty Clay Loam | Sandy Loam | Loamy Sand | Sand | |
| Structure/Grade: | Granular | Blocky | Prismatic | Columnar | Platey | Massive | Single Grained | 1 | 2 | 3 | |
| Roots: | None | Some | Common | Many | | | | | | | |
| % Coarse Fragments: | % | | Small Stones | Gravel | Cobbles | Boulders | Other: | | | | |
| Mottling Abundance | None | Few | Common | Many | Mottling Size: | Fine | Medium | Large | | | |
| Mottling Contrast: | Faint | Distinct | Course | | Gleying: | None | Weak | Moderate | Strong | | |
| Inclusions: | None | Coal Flecks | Coal Chunks | Sandstones | Shale Stones | Wood | Other: | | | | |
| Comments: | | | | | | | | | | | |

| | | | | | | | | | | | |
|----------------------|----------|-------------|--------------|-----------------|----------------------|------------|-----------------|------------|------------|-------------------|--|
| Logged By: | | | | | Date: | | | | | | |
| Depth of Soil Layer: | | | | | Colour: | | | | | | |
| Horizon: | | | | | Soil Sample Depth: | | | | | | |
| Moisture: | Dry | Moist | Wet | | Consistency (moist): | Loose | V. Friable | Friable | Firm | V.Firm or E. Firm | |
| Texture: | Loam | Clay Loam | Clay | Sandy Clay Loam | Silt Loam | Silty Clay | Silty Clay Loam | Sandy Loam | Loamy Sand | Sand | |
| Structure/Grade: | Granular | Blocky | Prismatic | Columnar | Platey | Massive | Single Grained | 1 | 2 | 3 | |
| Roots: | None | Some | Common | Many | | | | | | | |
| % Coarse Fragments: | % | | Small Stones | Gravel | Cobbles | Boulders | Other: | | | | |
| Mottling Abundance | None | Few | Common | Many | Mottling Size: | Fine | Medium | Large | | | |
| Mottling Contrast: | Faint | Distinct | Course | | Gleying: | None | Weak | Moderate | Strong | | |
| Inclusions: | None | Coal Flecks | Coal Chunks | Sandstones | Shale Stones | Wood | Other: | | | | |
| Comments: | | | | | | | | | | | |

H. SITE DIAGRAM



I. SOIL TEXTURE TRIANGLE



Plot soil results on the above diagram.

ANNEX 11 – MAPS (NORMATIVE)

Figure A11-1 - Mean Annual Precipitation

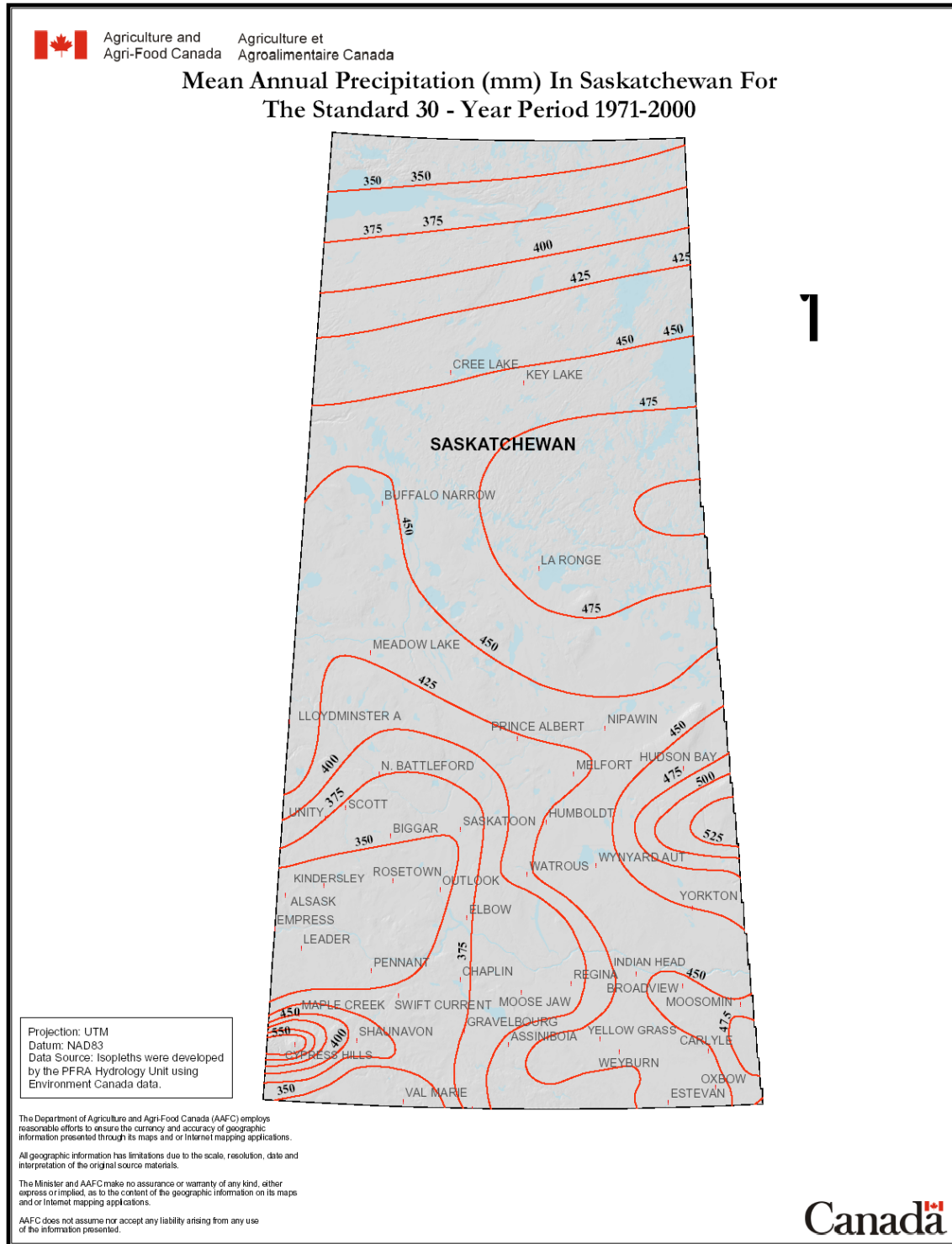
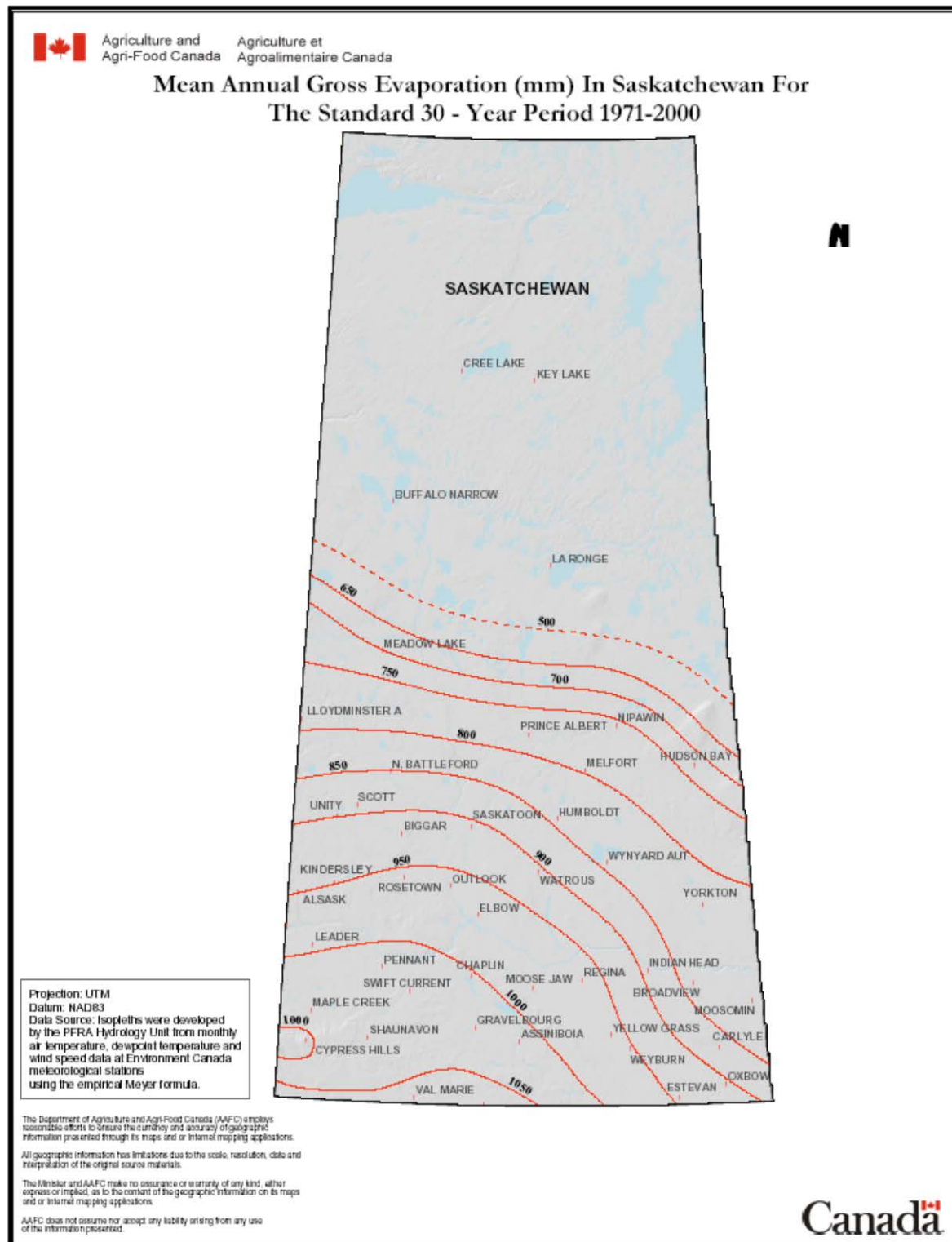


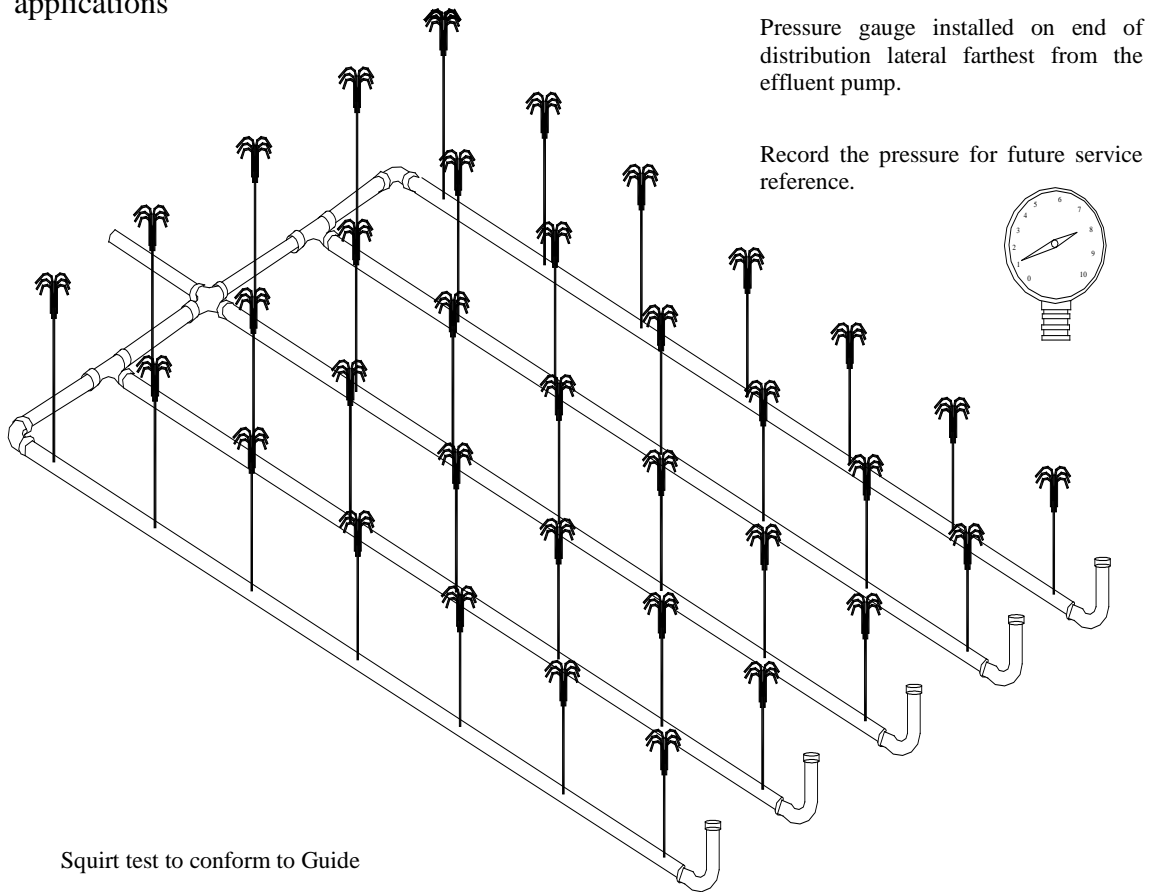
Figure A11-2 - Mean Annual Gross Evaporation



ANNEX 12 – SQUIRT TEST (INFORMATIVE)

Figure A12-1 - Squirt Test

The squirt test may be useful in the testing or providing the design of pressure distribution systems for treatment mounds and other pressure distribution applications



ANNEX 13 – DISTRIBUTION BOX (INFORMATIVE)**13.1 DEFINITION**

A distribution box is a device used for ensuring that effluent from a septic tank or treatment plant is distributed in equal amounts to each line of a gravity distribution system. Distribution boxes are commonly used in the Type I Mound systems and Absorption Field systems.

13.2 FUNCTION

The distribution box regulates and distributes the flow of effluent from the septic tank into the distribution pipes. Equal distribution is necessary to prevent one distribution line from becoming overloaded while others remain unused.

13.3 DESIGN

The distribution box must be watertight, rigidly constructed, and fitted with a durable watertight cover. Commercial distribution boxes are available and are approved for use in Saskatchewan.

Figure A13-1 - Typical Disposal Field using a Distribution Box

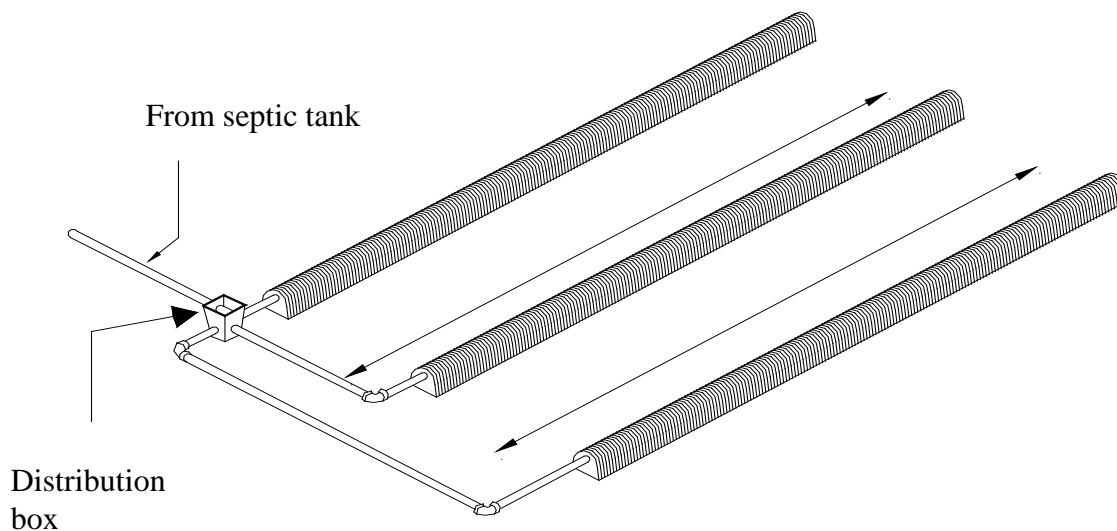
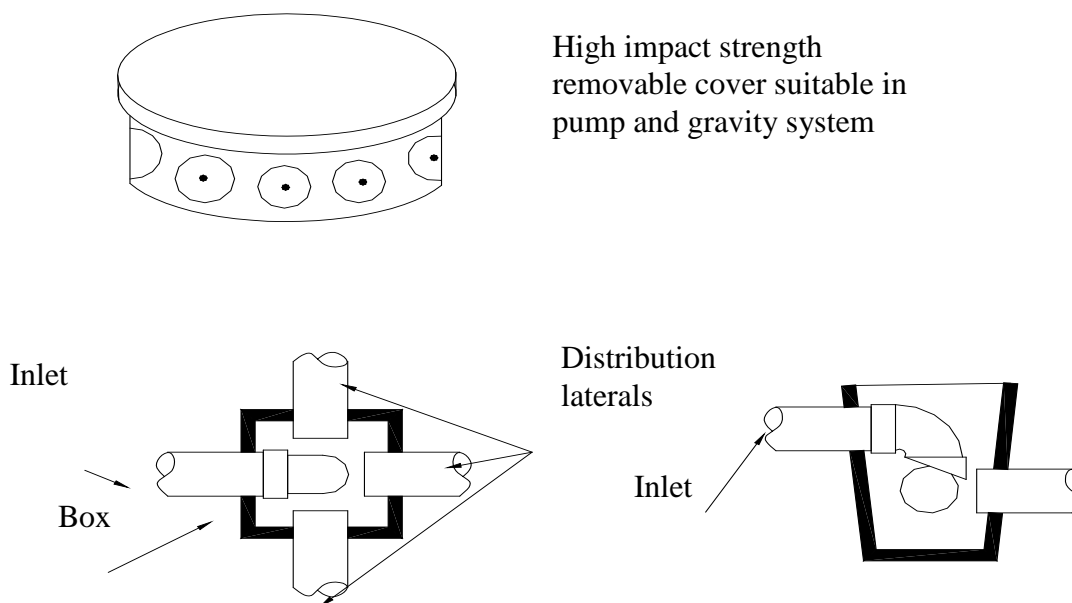


Figure A13-2 - Distribution Box Details

Distribution boxes may be circular or rectangular depending on the manufacturer. An example of a distribution box is listed below.



13.4 INSTALLATION

The distribution box should be installed as level as possible to ensure equal distribution to each line is obtained. The distribution box should be installed as per manufacturer's recommendations. Typically, this is on sand or crushed rock. Many distribution boxes also have flow adjusting baffles.

Joining of the distribution piping with a distribution box should be made with non-shrinking gasket material.

Common mistakes include:

- Roughly packing fill material on top of the box which will result in damage or make the box uneven. Careful construction of systems will ensure the distribution boxes work as designed.
- Once a distribution box is installed, the owner must ensure that the ground above the box is not driven on by any vehicles or equipment.
- Shallow burial may result in distribution box freeze up. Be sure to check manufacturer specifications.
- Location of the distribution box should be marked once the treatment area is landscaped for ease of access.

13.5 CARE AND MAINTENANCE

When installed correctly, the distribution box can be maintenance free. Proper installation is critical to ensure the box does not freeze during cold months. To achieve this, all effluent must evenly flow from the box into the all distribution lines. Ponding of effluent in an uneven box can result in freeze up and overload to a portion of the sewage system.

The distribution box is very subject to movement caused by frost heave. After use over one winter, it is normal to find the distribution box off level and distributing a large amount of effluent to the lower end and little or no effluent to gravity or weeping laterals connected to the higher end of the now sloping distribution box.

To minimize this problem, it is important to:

- keep the distribution box as small as possible;
- keep the outlets as close together as possible; and,
- prevent the momentum of the incoming effluent from washing directly onto an outlet.

ANNEX 14 – OPERATIONAL TIPS FOR SEPTIC SYSTEMS (INFORMATIVE)

14.1 WATER USAGE

A newly installed septic tank starts treating sewage immediately. As the tank fills, the natural processes begin. Tank additives are not required for these processes to begin.

Less water going into the septic tank means less turbulence in the tank, better settling of solids, and cleaner tank effluent. The results are less frequent tank pumping, a longer lasting septic system, and better sewage treatment.

- Repair leaky fixtures. Check your toilet by dropping food dye in the toilet tank and see if it shows up in the bowl without flushing.
- Consider low flow toilets, showerheads, and water faucets. Even properly functioning toilets rank as the number one water user, standard toilets use 3.5 to 5 gallons per flush. Low flow appliances and devices can reduce water usage by 25-30%.
- Use dishwasher only when full.
- Avoid house over-occupancy.
- Reroute drainage such as run-off from the roof, hot tubs, and yard drainage away from septic system area to avoid over-saturation.
- Plug bathtub before starting water.
- Plug sink while washing or shaving.
- Distribute laundry chores and other heavy water uses so that the system has time to work between doses.

A too-often-for-too-long saturated condition in an absorption field eventually results in clogged soil-based treatment fields that may have to be replaced. **It is critical to maintain unsaturated conditions within and beneath the septic system.**

14.2 DISPOSAL PRACTICES

Just as important as how much water goes into your system is *what* goes into your system. Again, remember that all phases of onsite wastewater treatment rely on a mixture of biological organisms to clean and purify the wastewater – a community of bugs is working for you, so do not dispose of products that will kill off these hard-working bugs. Never dispose of these chemicals in a septic system: gasoline, motor oil, antifreeze, paints, varnishes, paint thinners, medicines, drain cleaners, extremely caustic or acidic household cleaners, herbicides, and/or photographic chemicals.

Don't use your toilet as a trash can. Never put any wastes such as disposable diapers, sanitary napkins, paper towels, facial tissues, coffee grounds, hair, or anything plastic – cigarette filters, tampon applicators, or condoms – into a toilet or sink drain where a soil treatment field is the ultimate treatment. Any of these may plug up the system and are very slow to decompose, if they breakdown at all. At best, you will end up paying for a septic hauler more frequently to remove them from your septic tank. At worst, you will need to install a new soil treatment field as these items may destroy the ability of a soil treatment field to work.

Grease from cooking, if dumped down the drain, will solidify on route to the septic tank and thus could clog the system. It could also solidify in the soil treatment field and cause it to fail.

14.3 CLEANING

Cleaning frequency of a septic tank depends upon the tank capacity, the number of people using the system, and the use of appliances such as a garbage disposal.

The tank should be cleaned when half of the initial liquid capacity is occupied by solids. Some tanks may need cleaning at two years or sooner. Every three years is a reasonable schedule for an average household.

The tank should be pumped based on the sludge and scum accumulation. Arrange for a tank to be pumped out when any of the following are noted:

- Total solids accumulations are more than 1/3 of the internal height of the tank.
- The scum layer reaches the top of inlet T in a two (or more) compartment tank.
- Any obvious carry-over of solids to the second compartment.
- Premature effluent filter clogging.
- An increase in TSS or O&G noted in downstream components.

Before pumping the tank, check for a high water table that might cause the tank to buckle or float. Check for monitoring wells or ports. After pumping, refill the tanks with water, if so specified in the maintenance plan or manufacturer guidelines.

Remember, commercial septic tank additives will not eliminate the need for periodic clean out.

It is not necessary to leave solids in the septic tank to “start” it again. The tank should always be completely emptied.

14.4 ADDITIVES

While many products on the market claim to help septic systems work better, the truth is there is no magic potion to cure an ailing system. Some proprietary products that claim to “clean” septic tanks contain chemicals that may cause the scum and sludge to be discharged from the tank to the septic system. In essence, they change a simple maintenance item (regular pumping of tank) into a major system failure (clogged media/lateral).

There are two types of septic system additives: biological (bacteria, enzymes and yeast) and chemical. At best, an additive is benign; it provides no benefit and it costs you some money. At worst, it can damage concrete and clog the soil. Products that contain solvents can contaminate the groundwater. The general consensus among septic system experts is that septic system additives are unnecessary, possibly harmful, and should not be used. The naturally occurring bacterial population in your tank does not need to be augmented for proper operation of your system. The best results come from a balanced and well-maintained system that is not overloaded or abused.

As a rule, only three things should go into the septic tank: human wastes, toilet paper and waste from bathing fixtures and kitchen sinks.

14.5 PHYSICAL CARE

Unless specifically designed for vehicle traffic, no portion of your septic system should be driven on. If your tank is in an area subject to traffic, install a barricade to prevent damage to the tank and/or risers.

Traffic is generally prohibited from septic system sites to prevent compaction of the soil and to minimize the breaking and collapsing of buried pipes. Soil compaction can severely limit the transfer of oxygen and therefore hasten the development of anaerobic conditions. Remember we want aerobic conditions in the septic system media.

Similarly, septic system sites should not be paved in any manner.

In order to protect from freezing, the site should be kept covered during the winter months with at least 0.5 m of snow or straw bales when snow cover is inadequate. Grass cover should be established over the entire site. Shrubs or trees should not be planted on the top of site areas to prevent root interference/clogging.

14.6 TENANTS

If you rent your property, please make your tenants aware that your property is served by a septic system. You have a considerable investment in your septic system, don’t take a chance on needing an expensive absorption field replacement.

Another reason to properly operate and maintain a septic system is the potential for health problems from polluted water. A failing system could contaminate groundwater, and consequently nearby wells or nearby surface water. Inadequately treated sewage contains nutrient levels (nitrogen from urine and feces; phosphorus from soaps and detergents) which could be too high for the natural environment to handle. Sewage also contains pathogens, viruses, heavy metals, and chemicals from products improperly disposed of in septic systems.

14.7 COMMON SEPTIC SYSTEM PROBLEMS

Roots in and around your septic system can cause serious problems. Roots can clog pipes, break apart tanks, infiltrate the gravel/sand in your septic system and render a system completely inoperable. If roots are observed infiltrating your tank during an inspection, you must have them removed as soon as possible. If your soil treatment field is slow to accept the applied hydraulic loading during an inspection, you may be required to excavate certain areas of your system to investigate possible root intrusion. If you act promptly and remove the roots, there is a high probability you will be able to salvage your system and keep it operational.

ANNEX 15 – TEST PITS (INFORMATIVE)

Test pits (observation holes) are excavated to allow the designer to evaluate the soil profile in an undisturbed condition. Test pits need to be located near the proposed treatment area but not impacting on the infiltrative surface or likely drainage path of effluent.

The minimum number of test pits per site is two (2). However, the appropriate number of tests will depend on the size of the drain field area and the variability of soil conditions. The designer must select a representative location of any test pits and in some cases two pits will not be enough. For example, if soils are extremely variable or the area is large, additional test pits are necessary.

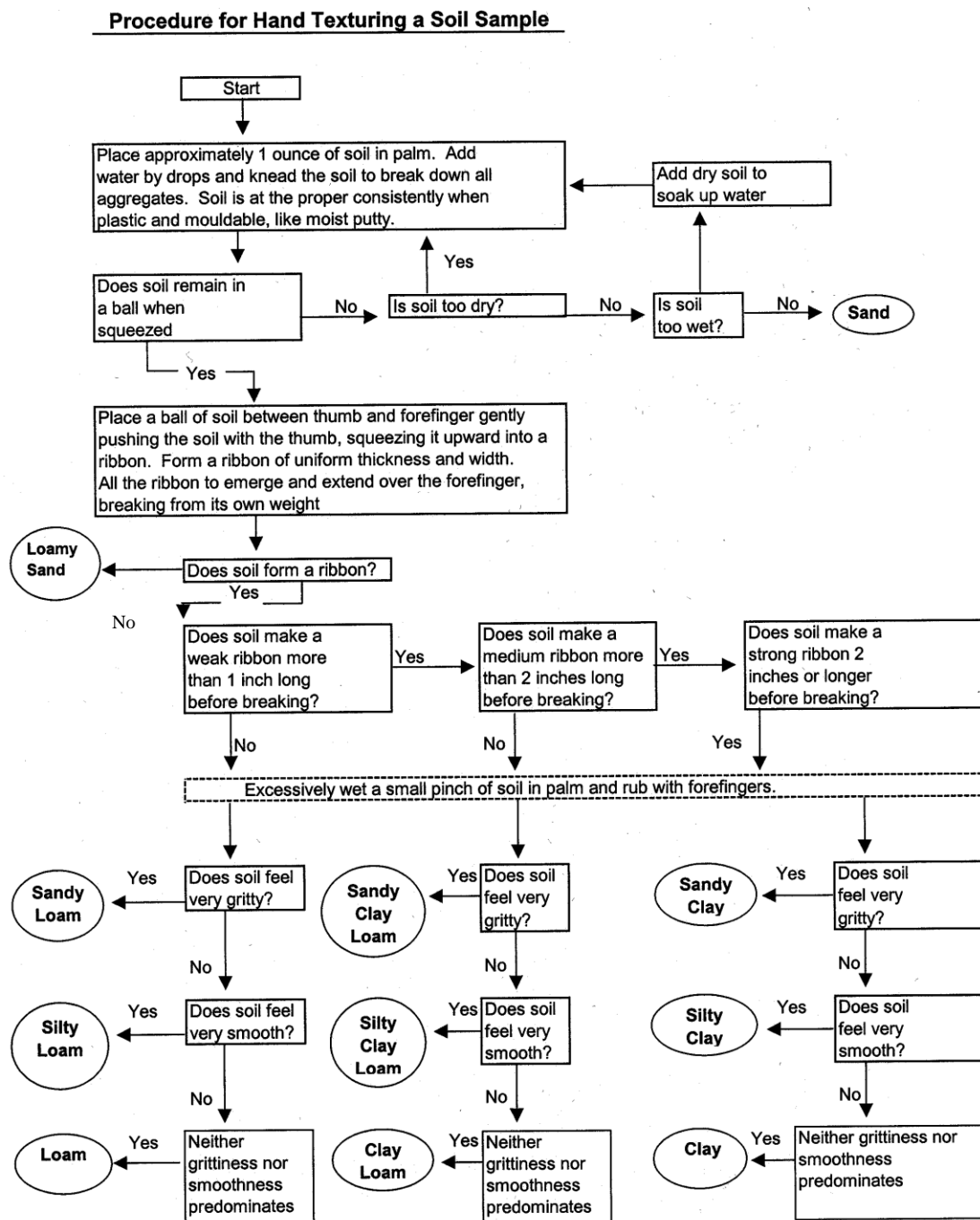
The approximate depth of the test pits is that which provides soil and water table information. This is at least 300 mm (12 in) deeper than the vertical separation distance required below the proposed soil treatment field or refusal (where you cannot dig further), whichever is shallower. Often, this is a minimum of 1.2 m (4 ft) below the ground surface. However, in areas where there is a 900 mm (3 ft) trench system receiving primary effluent, the excavation needs to be 2.7 m (9 ft) deep.

Test pits are preferred over boreholes, however, boreholes can be used as long as at least one test pit is constructed. The test pits are to be excavated and ramped in a manner that allows for safe entry for inspection without a ladder.

There are numerous safety requirements for any excavation. There are occupational health and safety requirements explained in excavating and trenching publications by the Government of Saskatchewan. Additionally, there are specific requirements for locating buried infrastructure. Safety information is beyond the scope of this Guide and designers and contractors must learn and understand their obligations to complete their work safely.

ANNEX 16 – PROCEDURE FOR HAND TEXTURING A SOIL SAMPLE (INFORMATIVE)

Figure A16-1 - Hand Texture Procedure



ANNEX 17 – CONVERSION FACTORS (INFORMATIVE)

| | |
|--|--|
| 1 pound = 0.45359 kilograms | 1 cubic yard = 765 litres |
| 1 kilogram = 2.2046 pounds | 1 cubic centimetre = 0.06102 cubic inches |
| 1 inch = 2.540 centimetres | 1 cubic decimeter = 0.0353 cubic ft |
| 1 foot = 0.3048 metres | 1 litre = 0.0353 cubic ft |
| 1 yard = 0.9144 metres | 1 cubic metre = 1.308 cubic yards |
| 1 yard = 36.00 inches | 1 cubic metre = 35.3 cubic ft |
| 1 mile = 1.609 kilometres | 1 cubic metre = 220 Imperial gals |
| 1 centimetre = 0.3937 inches | 1 cubic metre = 1000 litres |
| 1 metre = 3.281 ft | 1 Imperial gals = 4.546 litres |
| 1 metre = 1.094 yards | 1 Imperial gals = 277.42 cubic inches |
| 1 metre = 39.37 inches | 1 Imperial gals of water = 10 lbs |
| 1 kilometre = 0.6214 miles | 1 Imperial gals per sq. ft. = 49 litres per square metre |
| 1 square inch = 6.452 square centimetres | 1 Imperial gals = 1.20 U.S. gals |
| 1 square foot = 0.093 square metres | 1 litre = 0.220 Imperial gals |
| 1 square yard = 0.836 square metres | 1 litre per sq metre = 0.020 Imperial gals per square foot |
| 1 acre = 0.405 hectares | 1 U.S. gals = 3.785 litres |
| 1 square mile = 259 hectares | 1 U.S. gals = 231 cubic inches |
| 1 square mile = 2.59 square kilometres | 1 U.S. gals = 0.83 Imperial gals |
| 1 square centimetre = 0.155 sq inches | 1 litre = 0.264 U.S. gals. |
| 1 square metre = 10.765 square ft | 1 foot pressure head = 304.8 mm pressure head |
| 1 square metre = 1.196 square yards | 1 foot pressure head = 0.434 psi |
| 1 hectare = 2.471 acres | 1 psi = 2.301 ft pressure head |
| 1 hectare = 10,000 square metres | 1 psi = 6.894757 kPa |
| 1 square kilometre = 0.386 square miles | 1 kPa = 0.145037 psi |
| 1 cubic inch = 16.387 cubic centimetres | 1,000 mm pressure head = 9.807 kPa |
| 1 cubic foot = 28,317 cubic centimetres | 1 kPa = 102 mm pressure head |
| 1 cubic foot = 6.23 Imperial gals | 1 kPa = 0.335 feet pressure head |
| 1 cubic foot = 28.3 litres | |
| 1 cubic yard = 0.765 cubic metres | |
| 1 cubic yard = 168 Imp gals | |

APPENDICES
