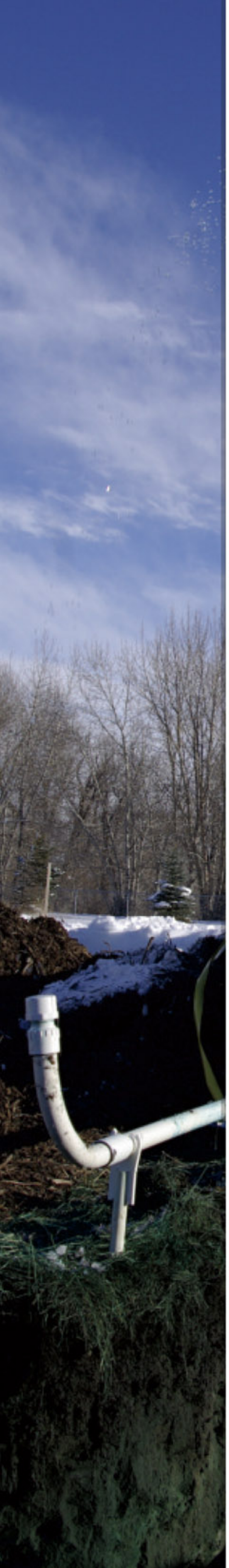
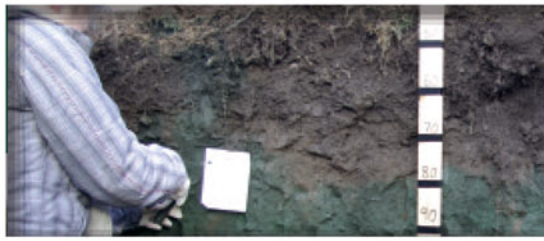


Alberta Private Sewage Systems 2009 Standard of Practice



SAFETY CODES COUNCIL

Standard of Practice Handbook

Safety Codes Council

Alberta Private Sewage Systems
Standard of Practice Handbook
2009

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Alberta Private Sewage System
Standard of Practice Handbook 2009

Standard Established by the Plumbing Technical Council,
Safety Codes Council

This Handbook is not a substitute for the Alberta Private Sewage Systems Standard of Practice—2009. While care has been taken to ensure accuracy, the examples and explanations in this handbook are for the purposes of illustration, and constitute opinion only. This is a convenience document; the legal document which must be referred to, especially in enforcement matters, is the Private Sewage Systems Standard of Practice—2009 as adopted for legislation for use in the Province of Alberta. The Safety Codes Council does not assume responsibility for errors or oversights resulting from the information contained herein.

The intent of this document is to provide explanatory and interpretive information only. This material is not a replacement for regulatory documents and is not to be used or referenced as such.

SAFETY CODES COUNCIL

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Safety Codes Council - Plumbing Technical Council

The Safety Codes Council is a statutory corporation that formulates and oversees the development and administration of safety codes and standards in Alberta. The Plumbing Technical Council is one of ten technical councils forming the Safety Codes Council and deals with all matters related to plumbing and private sewage systems. Based upon public review, the Plumbing Technical Council establishes the content of the Private Sewage Systems Standard of Practice and proposes its adoption to the Minister of Municipal Affairs by an Alberta Regulation, the *Private Sewage Disposal Regulation*.

Technical Task Group

This Standard of Practice is developed by a Plumbing Technical Council Task Group made up of industry, municipal, academic, and provincial and federal government stakeholders. Task Group Members represent the following stakeholder groups:

- Association of Alberta Municipal Districts & Counties
- Installation Contractors
- Association of Professional Engineers, Geologists, and Geophysicists of Alberta
- Manufacturers of onsite wastewater equipment
- Alberta Health
- Private Sewage Inspection Agencies
- University of Alberta
- University of Calgary
- Alberta Urban Municipalities
- Association
- Plumbing Technical Council
- Alberta Municipal Affairs
- Alberta Environmental Protection
- Health Canada
- Environment Canada
- Alberta Onsite wastewater Management Association

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Michael Schmalz	Wayne Schmidt	Pat Given
Warren Alsip	Charles Hallett	Kevin McLeod
Angus Chu	Emile Beaudry	Quentin Schatz
John Semeniuk		

Photo Captions

Front Cover (clockwise from top left):

- Squirt test at the University of Calgary research site. The effect of the dye in the applied effluent can be seen on the soil as a greenish tinge. At the end of the pressure distribution lateral is a typical configuration used to provide a clean out and testing location at the end of the lateral that is required by the Standard of Practice. The science of sewage effluent treatment in the soil, and the movement of effluent through soil, gained through research, is considered in this Standard.
- A munsell soil colour book used to help determine the specific colour of soil in the field.
- Examination of the soil profile in a soil test pit. Soil characteristics determined by this process are critical for the development of a design for a private sewage system as set out in this Standard.
- The installation of a wastewater treatment plant used to treat sewage to a secondary treatment standard.
- Taking soil samples that will be tested to assess the removal of pathogen indicator organisms by the soil. This is part of a research project the University of Calgary undertook to assess the treatment capability of a private sewage system design. The soil is stained green by the dyed effluent applied through the effluent distribution lateral. The staining helps identify the flow pattern of the effluent in the soil. This soil face is approximately 600 mm from the center line of the distribution lateral at this sampling point.
- A long, narrow treatment mound needed to address the linear loading limits of the soil at the site where this residence is built. The photo shows a squirt test being conducted.
- A long narrow treatment mound with an elevated sand layer to meet the required vertical separation at a site with a shallow restrictive layer in the soil below.
- Inside an effluent dispersal chamber showing the distribution of the effluent spray. This photo was taken during a research project undertaken at the University of Calgary to determine the effectiveness of the spray distribution.

Back Cover:

A view down into a sewage effluent dose tank that shows UV disinfection equipment. The photo shows two UV disinfection units. The upper UV bulb assembly has been lifted to show the lights of the UV unit in operation.

Table of Contents

Use and Application of this Handbook

This handbook is a supplement to the Alberta Private Sewage Systems Standard of Practice 2009 that is adopted by regulation in Alberta under the Safety Codes Act. Official reference should be made to the published Alberta Private Sewage Systems Standard of Practice 2009. The content of this handbook is intended to assist in the interpretation of the articles included in the Standard and to help the user consider the interrelationship of various articles in the development of a private sewage system design.

The first part of this handbook reproduces the content of the Alberta Private Sewage Systems Standard of Practice in the left hand column. Additional explanatory text specific to the article, along with cross references to other text or drawings in the Handbook, is provided in the right hand column.

In the event of a discrepancy between this handbook and the Alberta Private Sewage Systems Standard of Practice the Standard of Practice, the Published Standard prevails as the official document.

Appendix B of the handbook includes explanatory text that assists in understanding the design and objectives of a private sewage system.

The handbook includes numerous drawings and graphics that assist in conceptualizing the result of applying the articles in the Standard of Practice to a system design.

Some of the tools and drawings included in this handbook are available online at the Safety Codes Council or Alberta Municipal Affairs web site and may be updated from the version included in this handbook.

In the interpretation of Articles it is important to recognize where the terms “and” or “or” are used between clauses of an Article Sentence. Where the word “and” is used between clauses, the requirements of each clause must be met. Where the word “or” is used between clauses, any one of the clauses may be used to meet the requirement of the sentence. The word “and” and “or” will be seen just prior to the last clause and should be read as being between every clause in the sentence.

Also important in interpreting the Standard of Practice is to apply the definition set out in the Standard of Practice for specific terms or words. Each term or word that has a specified definition as used in the Standard of Practice is set out in italics in the articles of the Standard. Reference back to the definition is important to the correct interpretation of the article. See page **237** for additional information on defined terms that often need further explanation.

Some editorial mistakes found in the Alberta Private Sewage Systems Standard of Practice are identified in this Handbook. Refer to official addendums issued through the Safety Codes Council and Alberta Municipals Affairs for official changes.

Part 1 Scope and Definitions

Section 1.1. General

1.1.1. Intent

1.1.1.1. Intent

1) The intent of this Standard is to set out performance objectives, design standards, prescriptive-based solutions and requirements for materials and equipment related to on-site wastewater treatment system designs regarding the

a) initial treatment of wastewater,

b) final treatment of wastewater in soil,

c) containment of wastewater and treated effluent,

d) risk of contact with wastewater or treated effluent,

e) operational control of a system, and

f) structural adequacy of a system,

g) to result in an on-site wastewater treatment system that reduces the risk to public health and the natural environment to a level that is deemed acceptable.

1.1.2. Scope

1.1.2.1. Application

1) This Standard establishes requirements for the design, installation, and site selection of *on-site wastewater treatment systems* that are defined further as[1]

a) including any portion of the on-site soils or imported *soils* used to achieve the required treatment performance,

The Standard uses a numbering format defined in Article 1.1.4.4 and is consistent in each section regarding:

- Objectives and Design Requirements where the subsection ends with a number 1 such as in subsection 2.3.1;
- Prescriptive Requirements and Installation Standards where the subsection ends with a "2" as in subsection 2.3.2.; and
- Requirements for Materials where the subsection ends with "3" as in subsection 2.3.3.

Knowing this helps the user navigate the Standard.

This Standard is focused on the treatment of wastewater to reduce risk to health and the environment as opposed to simple disposal of wastewater.

The application of this Standard does not apply to the sewer pipe leaving the development or the plumbing in the development. However, consideration of the plumbing in the building is required and the owner's choice of plumbing fixtures in the building will impact the design of the private sewage system.

The characteristics of the soil are the most important consideration in the design of a private sewage system.

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b) including systems where water re-use for irrigation is included as a method to achieve the final treatment and return of the wastewater to the environment,[2]

c) including systems designed to contain wastewater in a safe manner until the wastewater can be removed and transported to another location for treatment and final disposition,

d) including earthen pit privies and vault privies as they relate to the management of the waste received but does not include

- **i)** self-contained, portable *privies*, and
- **ii)** any related structural components not required for the management of the *wastewater*,

e) not including systems used for the management of wastewater resulting from industrial processes or otherwise considered an industrial wastewater, and

f) not including systems that discharge into a natural body of water or man-made body of water, other than a wastewater or effluent lagoon described in this Standard.

[1] *Note: Sentence (1) — Regulations adopting this Standard may set limits on the application of this Standard under that regulation as it applies to the volume of wastewater generated by the development or limitations regarding the use of systems following this Standard based on larger scale cumulative loading impacts. Reference to the applicable legislation is required for the proper application of this Standard.*

[2] *Note: Clause (c) — Such systems would include irrigation where the effluent is utilized for a beneficial purpose but is ultimately returned to the environment through the soil to achieve final treatment.*

Explanations & Related Articles

Section 8.5 sets out requirements for drip dispersal irrigation systems.

Subsection 3.1 sets out requirements for holding tanks.

Part 10 sets out requirements for Privies.

Industrial wastewater may contain contaminants that are not contemplated by this standard. Industrial process wastewater is regulated by Alberta Environment so it is excluded from this Standard. This does not exclude from this Standard the domestic waste from toilets, showers and basins in the industrial facility.

Regardless of the quality of the treated wastewater, the discharge of treated wastewater to surface water is not allowed under this Standard. Discharges to surface water are regulated under Alberta Environment regulations and standards.

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2) This Standard includes specific requirements for *on-site wastewater treatment systems* that fall within the following broad categories:

a) systems serving residential and commercial developments that generate
   i) up to 5.7 m^3 (1,250 Imp. gal.) per day of wastewater volume, and
   ii) wastewater of a strength equal to or less than typical wastewater,

b) systems serving small residential and commercial developments that generate up to 5.7 m3 (1,250 Imp. gal.) per day of wastewater volume and
   i) the wastewater is of a strength greater than typical wastewater, or
   ii) where treatment objectives require a disinfection or nutrient reduction component in the treatment train,

c) systems serving developments that generate more than 5.7 m3 (1,250 Imp. gal.) of wastewater per day,

d) systems that employ water re-use for irrigation as a method of returning it to the environment, and

e) pit privies and vault privies.

Explanations & Related Articles

This Standard applies to single family dwellings and large commercial developments. Additional requirements are set for developments discharging high strength wastewater or peak daily flow exceeds 5.7 cubic meters.

See Section 2.4. for specific requirements; Article 8.1.1.9. for requirements regarding groundwater mounding prediction; and the Private Sewage Disposal Regulation Section 4.(3), pg. **234** for requirements for professional involvement in large systems.

Section 8.5 sets out requirements for drip dispersal irrigation. Surface spray irrigation is not allowed under this standard

Part 10 sets out requirements for privies (out houses). Privies are an effective method of waste management where minimal use is expected.

Standard of Practice	Explanations & Related Articles

3) This Standard sets out specific requirements for

a) holding tanks and septic tanks,

b) packaged sewage treatment plants,

c) treatment fields,

d) treatment mounds,

e) open discharge systems,

f) wastewater or effluent lagoons,

g) sand filters,

h) gravel filters, and

i) privies.

A subsection or part of the standard addresses each of these designs. See the table of contents for location in the standard.

4) This Standard does not set out specific requirements for *LFH At-Grade systems*.

5) This Standard does not include or establish requirements related to administrative programs needed for the effective overall management of *on-site wastewater treatment systems.*

Administrative programs such as permitting and inspection requirements are not addressed by this standard. Administrative requirements such as these are addressed in other regulations. See notes on legislative authority, Appendix B pg. **232.**

6) This Standard sets out acceptable system designs and *effluent* treatment standards suitable for general use in Alberta.

7) This Standard sets requirements suitable for the design of *private sewage systems* in Alberta but does not set out the additional requirements for, or provide direction on, the selection of the type of *on-site wastewater treatment system* and required *effluent* quality that may be needed to manage *cumulative impacts*

a) on a multi-lot/subdivision scale or water shed scale caused by multiple on-site wastewater treatment systems, or

b) where systems are located in a sensitive receiving environment.[1]

[1] Note: Clause (b) — The determination of treatment objectives, effluent quality and system types required for a development may need to consider any cumulative impact or loading limits established under other

The note to this sentence is of particular importance. Development density and thus impact on the receiving environment along with the sensitivity to treated wastewater loading will vary substantially throughout the province.

In some cases, the limitations on design and use of private sewage systems will be limited by these factors or require additional design and performance standards to be met. Other legislation in Alberta may include the Land Use Planning Framework and the Cumulative Impact Management Act.

legislation. Loading limits required to prevent unacceptable impacts on ground water or surface water, caused by the total wastewater generated from multi-lot subdivisions or where needed to protect a sensitive receiving environment, need to be considered in the selection and use of onsite wastewater treatment systems.

1.1.3. Objectives

1.1.3.1. General

1) The objective of an *on-site wastewater treatment system* is to treat *wastewater* and return it to the environment so that

a) risks to health are not created,

b) the impact on ground and surface waters is minimized, and

c) the environment is not harmed.

This is an overarching requirement of this standard that must be met by a system. If the system causes unacceptable impact it is not acceptable, even though it may meet other requirements of the standard.

1.1.4. Interpretations

1.1.4.1. Supplementary Information

1) Intent statements, notes, and warning statements are included to provide additional information regarding specific requirements.

The intent statements included with many of the articles and located at the end of the Article are important and give the user of the standard valuable insight to the interpretation of the article.

1.1.4.2. Liability

1) This Standard does not provide or imply any assurance or guarantee about the life expectancy, durability, operating performance, or workmanship of the equipment, materials, or undertaking.

Beware and use very good judgment in your design to ensure the objectives stated in Article 1.1.3.1 above are met.

1.1.4.3. Units of Measurement

1) Metric units of measure are the official measurement used in this Standard with approximate imperial equivalents provided in brackets for user convenience.

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Explanations & Related Articles

1.1.4.4. Numbering

1) The numbering system in this Standard uses the following format:

2	Part,
2.5.	Section,
2.5.1.	Subsection,
2.5.1.1.	Article,
2.5.1.1.(1)	Sentence,
2.5.1.1.(1)(c)	Clause,
2.5.1.1.(1)(c)(i)	Subclause.

1.1.5. Definitions

1.1.5.1. Interpretation of Words and Phrases

1) Words and phrases used in this Standard that are not included in the list of definitions shall have the meanings that are commonly assigned to them in the context in which they are used in this Standard, taking into account the specialized use of terms by the trades and professions to which the terminology applies.

2) Words and phrases regarding soils and soil characteristics used in this Standard, including defined terms, shall be interpreted and used in a manner consistent with definitions established under the Canadian System of Soil Classification.[1]

[1] Note: Sentence (2) — Canadian System of Soil Classification definitions can be used to gain more description of the terms and direction on how to identify and classify soils. Additional and more detailed definitions can also be found in the Canadian Soil Information System (CanSIS) Manual for Describing Soils in the Field.

Terms and words that have a specific meaning in this standard are italicized anywhere they are used in this standard.

Having a clear understanding of the term as used in the standard can make a big difference in the interpretation of the meaning.

1.1.5.2. Defined Terms

1) Italicized words and terms in this Standard shall have the following meanings:

Administrator means an Administrator appointed pursuant to Section 14 of the Safety Codes Act.

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

Aquifer, Domestic Use (DUA) means a geologic unit (either of a single lithology or inter-bedded units) that is above the Base of Groundwater Protection having one or more of the following properties:

a) a bulk hydraulic conductivity of 1 x 10^{-6} m/s or greater and sufficient thickness to support a sustained yield of 0.76 L/min or greater,

b) is currently being used for domestic purposes, or

c) any *aquifer* determined by Alberta Environment to be a DUA.1

[1] *Note: While it is possible that peat deposits and muskeg may meet the definition of a DUA, based on hydraulic conductivity and unit thickness, Alberta Environment generally does not consider peat deposits or muskeg to be a DUA because groundwater in them is unlikely to be used as a domestic source.*

A DUA is ground water that can be pumped from the ground in a reasonable amount for use. Seasonally saturated fine textured soils are typically not in this class as the water in the ground and rate of recovery into a well through fine textured soils would not provide an adequate volume of water for any use.

Berm is the raised area around a *treatment mound*, *sand filter, lagoon* or *privy*.

Biochemical oxygen demand (BOD_5) means the amount of oxygen (expressed as mg/L) utilized by micro-organisms in the oxidation of organic matter during a 5-day period at a temperature of 20°C (68°F). This measure is typically used for raw *wastewater* samples.

BOD_5 is a key indicator of wastewater strength. The higher the number, the higher strength of the wastewater. This measure is typically applied to raw sewage. $CBOD_5$ is typically used as a measure of effluent (treated wastewater) strength. See definition of $CBOD_5$ below.

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

As farm buildings are excluded from the Safety Codes Act and Alberta Building Code, this definition does not include farm buildings. This term must be used consistent with the Alberta Building Code.

Standard of Practice	Explanations & Related Articles
Building sewer means a pipe connected to a *building* drain, starting 1 m (3.25 ft.) outside a wall of a *building* and that connects to a public sewer or on-site *wastewater treatment system*.	
Carbonaceous biochemical oxygen demand (CBOD$_5$) means the amount of oxygen (expressed as mg/L) utilized by micro-organisms in the non−nitrogenous oxidation of organic matter during a 5-day period at a temperature of 20°C (68°F). This measure is typically used for effluent samples.	The key difference from BOD$_5$ values is that the CBOD$_5$ value excludes the measure of oxygen needed by bacteria to change ammonia to nitrate.
Certified means investigated and identified by a designated testing organization as conforming to recognized standards, requirements, or test reports as set out in this standard or acceptable to the *administrator*.	In this standard this reference is typically to CSA or NSF certified components.
Clearwater waste means *wastewater* with impurity levels that will not be harmful to one's health.	The discharge from a drinking fountain is an example. This definition is taken from the Plumbing Code adopted in Alberta.
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 manner in which the *soil* material behaves when subjected to compression; classifications of moist *soil consistence* include loose, very friable, friable, firm, very firm, and extremely firm.	Methods of determining soil consistence can be found in the Canadian System of Soil Classification. Moist soils characterized as very firm or firmer consistence are not well suited to private sewage treatment systems.
Cumulative impacts means the total impact attributable to numerous individual influences.	
Development means *buildings* or other constructed facilities.	
Diameter means, unless otherwise indicated, the nominal *diameter* by which a pipe, fitting, trap, or other item is commercially designated.	
Distribution header means a non-perforated pipe that distributes *effluent* by gravity to gravity *distribution laterals, weeping lateral*	The term as used in this Standard is specific to gravity flow.

Standard of Practice | **Explanations & Related Articles**

pipes, or *weeping lateral trenches* from the *effluent sewer* or *effluent line*.

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

This piping is perforated by drilling orifices in the pipe of a diameter specific to the design and spaced at intervals selected by the designer within the constraints set by the Standard.

Drain media means clean washed gravel, clean crushed rock, or other media into which *effluent* is distributed or used to collect *effluent* below treatment filter media and meets the specific material requirements set out in this Standard for its specific purpose.

This is typically used in a treatment field weeping lateral trench. It is essentially washed gravel. It is also used above the sand layer of a treatment mound.

Dwelling or ***Dwelling unit*** means a suite operated as a housekeeping unit that is 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 a plumbing system for use as drain, waste, and venting piping.

This is heavy wall sewer pipe as opposed to the thin wall pipe. This heavy walled pipe is required for connection to septic tanks and treatment plants. It is not for use in pressure applications which is anywhere a pump is used to move the sewage or effluent.

Effective particle size (D_{10}) means the size of opening of an ideal sieve that would retain 90% of a sample, while passing 10% of the sample.

This is referenced in regard to sand used in treatment mounds and sand filters. The D_{10} size impacts the hydraulic conductivity of the sand. The smaller the D_{10} size, the lower the hydraulic conductivity will be.

Effluent means the liquid discharged from any *on-site wastewater treatment system* component.

Essentially any form of treated wastewater. It is also called a dose tank/chamber in the industry.

Effluent chamber or ***Effluent tank*** means a chamber within a tank or any tank that receives and stores *effluent* (from which *effluent* is periodically discharged into other components of the treatment system).

Effluent hydraulic linear loading means the cumulative total of *effluent* applied to the *soil* profile below a *soil treatment area*, expressed as volume per unit length per unit time (e.g., gpd/ lineal ft.), along the axis of the *soil treatment area* that is oriented at 90 degrees to the assumed direction of subsurface flow (typically this is consistent with surface slope direction).

This is an important aspect of the soils capability to allow the horizontal movement of the added effluent through the soil so it does not surface. See Appendix B pg. 301 for more description and its application in the standard.

Standard of Practice	Explanations & Related Articles
Effluent hydraulic loading rate means the quantity of *effluent* applied to a given treatment component, usually expressed as volume per unit of infiltrative surface area per unit time, e.g., liters per day per square metre (Lpd/m^2) or imperial gallons per day per square foot (gpd/ ft^2).	This is the amount of effluent applied per day per square foot of square meter on a trench bottom for example.
Effluent line means piping for the flow of *effluent* under pressure and supplied by a pump.	The pressure piping delivering effluent to a soil based effluent treatment system.
Effluent sewer means piping for the flow of *effluent* through the action of gravity.	A pipe relying on gravity for the movement of effluent. It is not under pressure.
Equalization tank *means* a tank that provides storage of *effluent* to enable timed dosing by pumps to manage flow variations, resulting in a more uniform delivery of *wastewater* or *effluent* to a subsequent component over time, usually a day or more; also known as a surge tank.	
Field capacity means the maximum amount of water that can be held by a *soil* without draining by gravity.	If the amount of water in the soil is more than its field capacity, it is becoming saturated and flow through the soil will be predominantly saturated flow.
Field header means a main gravity *weeping lateral pipe* that also distributes *effluent* to other *weeping lateral pipes* in a level *treatment field*.	Flow is by gravity in this header pipe.
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.	The filter fabric used should be non-woven and suitable for the use applied in this definition. See pg. **327** for specifications recommended by manufacturers.
Fines means particles that can pass through a 200 sieve, or are less than 80 microns (0.08 mm) in particle *size*.	Fines are sand particles as the finest class for sand is 0.05 mm. A size less than that is silt.

Standard of Practice	Explanations & Related Articles
Gleyed means a characteristic of a *soil* that has undergone gleysation which is a *soil*-forming process, operating under poor drainage conditions, which 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 limit the suitability of *soil* for an *effluent* treatment system. See the Canadian Soil Information System for a more definitive definition and further information on identifying *gleyed soils.*	A characteristic of seasonally saturated soils. This picture shows gleyed and mottled soil.  Credit: Onsite Installer; Oct. 2009 issue, More About Soils. Online at http://www.onsiteinstaller.com/editorial/2009/10
Grade means the gradient, slope, or rate of ascent or descent.	Typically arrows showing slope on a drawing will go from the high ground to low ground and show the grade of the slope in percent.
Grain or particle size analysis means establishing the percentage of *sand*, *silt*, or *clay* particles in a *soil* sample by means of a standard hydrometer method and sieve analysis, as set out in the Canadian Soil Information System (CanSIS Analytical Methods Manual 1984), http://sis.agr.gc.ca/cansis/publications/manuals/1984-30/intro.html, or other more recent and equivalent method recognized in the *soil* sciences.	The particle size distribution (percentage of sand, silt and clay) is what determines the soil texture classification. For sandy soils it is necessary to determine the particle size distribution of the sand fraction of the soil to identify the range of sand from coarse sand to very fine sand. See note [2] at end of Article 7.1.1.2 sentence (3).
Greywater means *wastewater* that does not include waste from toilets or urinals, and it must be effectively managed and treated in accordance with this Standard.	
Groundwater mounding means the rise in elevation of the *seasonally saturated soil* or regional *water table* caused by the addition of *effluent* to the *soil* or the creation of a perched *water table* below the *soil treatment area* resulting from the added *effluent*.	
Groundwater Under the Direct Influence of Surface Water (GWUDI) means groundwater having incomplete/undependable subsurface filtration of surface water and infiltrating precipitation.[1]	An example is an alluvial aquifer. If a recoverable water source is not separated by an impermeable geologic barrier that exists between surface infiltration and the groundwater it is likely classified as a GWUDI. For more detailed classification criteria see Alberta Environment publication, STANDARDS AND GUIDELINES FOR

[1] *Note: Refer to the Alberta Environment document entitled "Assessment Guideline for Groundwater Under the Direct Influence of Surface Water (GWUDI)" for determining whether a groundwater source is GWUD*

MUNICIPAL WATERWORKS, WASTEWATER AND STORM DRAINAGE SYSTEMS where criteria for determining a GWUDI is set out in Section 1.2.1.4. of that document. Online source http://www.environment.gov.ab.ca/info/library/6979.pdf.

Holding tank means a tank designed to retain *wastewater* or *effluent* until transferred into mobile equipment for treatment offsite.

Infiltration means: **1.** entry of water or *effluent* into the *soil*; **2**. undesirable inflow or seepage of water into a system component; for example, infiltration of surface water into a tank through a leaking pipe or through an access riser/tank seam that is not water-tight.

Lagoon means an artificial pond for the storage, treatment and stabilization of *wastewater* or *effluent*.

LFH At-grade system means a system for the dispersal and final treatment of *effluent* in a well-established forested area having a substantial LFH (litter, fermented, humic) layer where the *distribution lateral piping* is placed on the surface of the undisturbed forest floor inside a chamber that is covered with wood chips suited for the ecology of the forest.

These systems are not addressed by the standard. See Article 1.1.2.1 (5). Because they are not addressed by the standard a variance must be applied for before using this system design on a specific site.

Limiting condition means *soil* or site characteristic that reduces efficiency of *soil* treatment or hydraulic conductivity and thus restricts design options for a system.

This differs from a restrictive layer where hydraulic conductivity is near zero. It is the limiting condition in the soil that is the most likely area to take a soil sample from that would be sent to the lab for determination of the soil texture; however, this may not always be the case.

Linear loading (See *Effluent hydraulic linear loading*).

Mobile soil water content means the amount of water in a *soil* between the *soil's field capacity* and the hydroscopic water holding ability of the *soil* that is displaced as additional water is added to the *soil* volume.

Field capacity minus hydroscopic water content = mobile water content of the soil.

Mottling means a *soil* zone of 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*.

This characteristic of the soil indicates sustained or periodic saturation of the soil.

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

On-site wastewater treatment system means a system for the management and/or treatment of *wastewater* at or near the *development* that generates the *wastewater* including that portion of the *building sewer* 1.8 m (6 ft.) upstream of any *equalization tank*, *settling tank*, *septic tank*, *packaged sewage treatment plant*, *holding tank*, or *berm* of a sewage *lagoon*, and includes the final *soil*-based *effluent* dispersal and treatment system but does not include the plumbing *building* drain from the *development* which ends 1 m (3.25 ft.) outside a *building*.

Open discharge system means a system designed to discharge *effluent* to the ground surface to accomplish evaporation and absorption of the *effluent* into the *soil* as a method of treatment.

Packaged sewage 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*.

Packed bed filter means a container(s) packed with a filter media that receives *effluent* from an *effluent* distribution system to achieve the aerobic, biological, and physical treatment of *wastewater* as it passes through and comes in contact with the filter media.

Percolation test means a procedure to estimate the rate the *soil* can accept and move clean water in saturated flow conditions.

Note: The percolation test cannot be used as design criteria applied to a system. The percolation test was recognized in previous standards as design criteria but has been removed in this Standard. Research indicates that due to the variability in the results of this procedure and indirect relationship to long term effluent loading rates, this should not be relied on for the design of a soil based treatment system.

Potable means suitable 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 treatment means physical treatment processes involving removal of particles, typically by settling and flotation with or without the use of coagulants; (e.g. a grease interceptor or a *septic tank* provides *primary treatment*).

Private sewage system (See *On-site wastewater treatment system*).

Primary treated effluent level 1 means *effluent* that

a) 80% of the time has
   i) $CBOD_5$ of less than 150 mg/L,
   ii) *TSS* of less than 100 mg/L, and
   iii) oil and grease content of less than 15 mg/L, and

b) does not exceed
   i) $CBOD_5$ of 230 mg/L,
   ii) *TSS* of 150 mg/L, and
   iii) oil and grease content of 30 mg/L.

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.

Property means the land described in the Certificate of Title issued under the Land Titles Act.

Re-circulating gravel filter means a system where *effluent* is re-circulated through filter media a number of times on an intermittent basis before being discharged for additional treatment or into a final treatment and dispersal system (This design is often used to treat higher strength *wastewater*. It is sometimes referred to as a "re-circulating *sand filter*" in the industry).

Restricting layer or ***Restricting horizon*** means a horizon or condition in the *soil* profile or underlying strata that restricts the movement of fluids creating a limiting *soil*/site condition; examples include fragipan, spodic horizons, fine textured *soil* with massive *structure*, or certain bedrock, etc.; *see also* ***limiting condition.***

A vertical separation must be maintained above a restricting layer to the point at which effluent is applied to the soil. See Article 8.1.1.4. for required vertical separations.

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Sand filter means a *single-pass sand filter* that is intermittently dosed and that uses specifically graded *sand* or other media as the media for filtration and treatment of *effluent*.	
Sand filter media means the granular filter media used in a *sand filter* for the treatment of the *effluent*.	
Sand filter surface area means the area of the level plane section of the *sand filter media* receiving the *effluent* immediately below the *drain media* or chambers containing the pressurized *effluent* distribution piping.	
Sand layer (when referring to a *treatment mound*) means the required depth and area of specifically graded *sand* that will receive the *effluent* distributed through a gravel bed or chambers located immediately above the *sand layer*.	
Seasonally saturated soil means that a *soil* is seasonally saturated by a periodic high *water table* and is identified by the presence of *mottling* or *gleying* in the *soil*.	
Secondary treated effluent means *effluent* that at least 80% of the time meets the *effluent* quality parameters set out in Table 5.1.1.1 for *secondary treated effluent* Levels 2, 3 and 4.	Secondary treated effluent has a quality equal to or better than; BOD_5 25mg/L and TSS 30 mg/L 80% of the time. See Table 5.1.1.1 for additional secondary treatment levels.
Septic tank means a tank or chamber(s) within a tank used to provide *primary treatment* of *wastewater* through the process of settling and floating of solids and in which digestion of the accumulated sludge occurs.	See handbook Appendix B pg. Error! Bookmark not defined. Error! Bookmark not defined.for more detail on septic tanks.
Serial distribution means a *treatment field* design where discharged *effluent* is forced to travel through one *weeping lateral trench* to get to another *weeping lateral trench*.	

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Settling tank means a tank, or chamber within a tank, that typically has a limited detention time and is installed upstream of a *packaged sewage treatment plant* or other initial treatment system and is intended for the removal of larger items or inorganic material in the *wastewater* stream and may also provide some level of treatment and anaerobic digestion (sometimes referred to as a "trash tank").	
Sewage (see *Wastewater*).	
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.	See handbook Appendix B pg. **238** for more discussion of the importance of this definition for the purpose of identifying a watercourse with example pictures.
Single-pass sand filter means a system where the *effluent* is applied on an intermittent basis and flows through the filter only one time before being discharged for additional treatment or final dispersal.	
Size means, unless indicated otherwise, the nominal size by which a pipe, fitting, trap, or other item is commercially designated.	
Slope of land means a landscape form or feature demonstrating a change in elevation; typically described as a percentage (amount of rise divided by amount of run multiplied by 100).	On a drawing the direction of a slope is typically shown with an arrow pointing in the direction of the downhill slope, and includes a number indicating the % slope.
Smectitic or ***Smectitic soil*** means a *soil* that has characteristics significantly influenced by smectite *clays* which are a group of 2:1 layer silicates with a high cation exchange capacity, about 110 cmol/kg *soil* smectites, and variable interlayer spacing; formerly called the montmorillonite group. The group includes dioctahedral members montmorillonite, beidellite, and nontronite, and trioctahedral members saponite, hectorite, and sauconite. These *soils* can increase the risk of failure when *effluent* having a high *SAR* is applied. For test methods that can assist in identifying these *soils* and the *soil's* susceptibility to	These are swelling clays and are not well suited to onsite sewage systems. See pg. **293** for information about the potential for dispersion of these soils and how to test for dispersion potential.

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dispersion when applying *effluent* with a high *SAR* see http://www.soils.org. Information on the Emerson modified soil dispersion test is also helpful.	
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 *soil*. *Effluent* having a high *SAR* leads to a breakdown in the physical structure of the *soil* in *clay smectitic soils*.	See Handbook Appendix B pg. **297** for more information on what SAR means and the potential impact of a high SAR on soils and vegetation.
Soil means a naturally occurring, unconsolidated mineral or organic material at the earth's surface that is capable of supporting plant growth. Its properties usually vary with depth and are determined by climatic factors and organisms, as conditioned by relief and hence water regime, acting on geologic materials and producing genetic horizons that differ from the parent material.	
Soil colour means colour features of a *soil* that are indicative of *soil* formation processes and conditions. The colours are indicators of the level of aerobic conditions of the *soil* that is important to *wastewater* treatment in the *soil*. The Munsell Colour System is used as the method of defining and communicating the colours of the *soil*.	
Soil horizon means a layer of *soil* or *soil* material approximately parallel to the land surface; it differs from adjacent genetically related layers in properties such as *color*, *structure*, *texture*, *consistence*, and chemical, biological, and mineralogical composition.	The characteristics of a soil horizon will affect the design of an onsite sewage system.
Soil infiltration surface means the surface of *soil* receiving *effluent* for final treatment and does not include the *infiltration* surface of an engineered media or *soil* intended to improve the quality of the *effluent* prior to *infiltration* in to the *soil* for final treatment, such as the *sand layer* in a *treatment mound*.	This is the surface of the in situ soil (the existing soil) into which the effluent infiltrates. It does not include the surface of imported sand layers.

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Soil separates has the following 3 categories:

a) ***Sand*** means soil particles that have a size between 0.05–2 mm.

b) ***Silt*** means soil particles that have a size between 0.002–0.05 mm.

c) ***Clay*** means soil particles that have a size smaller than 0.002 mm.

Soil structure or ***Structure*** means the combination or arrangement of primary *soil* particles into secondary units or peds; secondary units are characterized on the basis of shape, size class, and grade (degree of distinctness expressed as grade 0, 1, 2, or 3) and also includes structureless soils described by the term massive.

Soil texture classification or ***Texture*** means the relative proportions of the various *soil separates* in a *soil* (*sand*, *silt*, *clay*) and is described with the following *soil* textural classes and sub-classes:

a) ***Sand*** means *soil* material that contains 85% or more *sand*; the percentage of *silt* plus 1.5 times the percentage of *clay* does not exceed 15; *sand* has the following sub-classes:

i) ***Coarse sand*** means 25% or more very coarse and coarse *sand*, and less than 50% any other one grade of *sand*. *Coarse sand* has a size limit that ranges between 1.0 to 0.5 mm. Very *coarse sand* has a size limit that ranges between 1.0 to 2.0 mm.

ii) ***Medium sand*** means 25% or more very coarse, coarse, and medium sand, and less than 50% fine or very fine sand. Medium Sand has a size limit that ranges between 0.5 and 0.25 mm.

iii) ***Fine sand*** means 50% or more fine *sand* or less than 25% very coarse, coarse, and medium *sand* and less than 50% very fine *sand*. Fine *sand* has a size limit that ranges between 0.25 and 0.10 mm.

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Sand particles are further broken down in to sub classes based on the size of the sand particle:

- Very Fine 0.05 – 0.10 mm
- Fine 0.10 – 0.25 mm
- Medium 0.25 – 0.50 mm
- Coarse 0.50 – 1.0 mm
- Very Coarse 1.0 – 2.0 mm

See Handbook Appendix B pg. **290** for more information of determining soil structure and graphic illustrations of soil structure.

See pg. **365** for a soil texture triangle that defines textural classes.

The hydraulic conductivity (infiltration rate) varies significantly depending on the amount of coarse to very fine sand in a soil sample.

The allowed effluent loading rate on each of these sand subclasses is different.

A sieve analysis of the sand fraction of a soil sample is needed to class the sand into one of these subclasses.

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iv) ***Very fine sand*** means 50% or more very fine *sand*. *Very fine sand* has a size limit that ranges between 0.10 to 0.05 mm.

b) ***Loamy sand*** means *soil* material that contains at the upper limit 85 to 90% *sand*, and the percentage of *silt* plus 1.5 times the percentage of *clay* is not less than 15, at the lower limit it contains not less than 70 to 85% *sand*, and the percentage of *silt* plus twice the percentage of *clay* does not exceed 30; *loamy sand* has the following sub-classes:

i) ***Loamy coarse sand*** means 25% or more very coarse and coarse *sand* and less than 50% any other one grade of *sand*.

ii) ***Loamy medium sand*** means 25% or more very coarse, coarse, and medium *sand* and less than 50% fine or very fine *sand*.

iii) ***Loamy fine sand*** means 50% or more fine *sand* or less than 25% very coarse, coarse, and medium *sand* and less than 50% very fine *sand*.

iv) ***Loamy very fine sand*** means 50% or more is very fine *sand*.

c) ***Sandy loam*** means *soil* material that contains either 20% or less *clay*, with a percentage of *silt* plus twice the percentage of *clay* that exceeds 30, and 52% or more *sand*; or less than 7% *clay*, less than 50% *silt*, and between 43% and 52% *sand*; *sandy loam* has the following sub-classes:

i) ***Coarse sandy loam*** means 25% or more very coarse and coarse *sand* and less than 50% any other one grade of *sand*.

ii) ***Medium sandy loam*** means 30% or more very coarse, coarse, and *medium sand*, but less than 25% very *coarse sand*, and less than 30% *very fine sand* or *fine sand*.

iii) ***Fine sandy loam*** means 30% or more *fine sand* and less than 30% *very fine*

The hydraulic conductivity (infiltration rate) varies significantly depending on the amount of coarse to very fine sand in a soil sample.

The allowed effluent loading rate on each of these sand subclasses is different.

A sieve analysis of the sand fraction of a soil sample is needed to class the sand into one of these subclasses.

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sand or between 15 and 30% very coarse, *coarse sand*, and *medium sand*.

iv) ***Very fine sandy loam*** means 30% or more *very fine sand* or more than 40% *fine sand* and *very fine sand*, at least half of which is *very fine sand*, and less than 15% very coarse, *coarse sand*, and *medium sand*.

d) ***Loam*** means *soil* material that contains 7 to 27% *clay*, 28 to 50% *silt*, and less than 52% *sand*.

e) ***Silt loam*** means soil material that contains 50% or more silt and 12 to 27% clay, or 50 to 80% silt and less than 12% clay.

f) ***Silt*** means soil material that contains 80% or more silt and less than 12% clay. Silt has a size limit that ranges from 0.05 to 0.002 mm.

g) ***Sandy clay loam*** means soil material that contains 20 to 35% clay, less than 28% silt, and 45% or more sand.

h) ***Clay loam*** means soil material that contains 27 to 40% clay and 20 to 45% sand.

i) ***Silty clay loam*** means soil material that contains 27 to 40% clay and less than 20% sand.

j) ***Sandy clay*** means soil material that contains 35% or more clay and 45% or more sand.

k) ***Silty clay*** means soil material that contains 40% or more clay and 40% or more silt.

l) ***Clay*** means soil material that contains 40% or more clay, less than 45% sand, and less than 40% silt. Clay has a size limit that is less than 0.002 mm.

m) ***Heavy clay*** means soil material that contains more than 60% clay.

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

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

Subsoil foundation drainage pipe means a piping system that is installed underground to intercept and convey subsurface water away from a foundation.

Total Suspended Solids (TSS) means the dispersed particulate matter in a *wastewater* sample that may be retained by a filter medium. Suspended solids may include both settleable and unsettleable solids of both inorganic and organic origin. This parameter is widely used to monitor the performance of the various stages of *wastewater* treatment, and is often used in conjunction with BOD_5 and $CBOD_5$ to describe *wastewater* strength.

Treatment boundary limits means the limits of the treatment zone in the *soil* as defined by this Standard and as used in a design, such as the *vertical separation* depth required below an infiltrative surface that *effluent* is applied over and at the point the design requires or expects treatment to be achieved.

Treatment field means a system of *effluent* dispersal and treatment by distributing *effluent* within trenches containing void spaces that are covered with *soil* and includes the following types:

a) a ***conventional treatment field*** means a system of *effluent* dispersal and treatment utilizing perforated piping laid in a bed of gravel in trenches for distributing *effluent* within the trenches,

b) a ***chamber system treatment field*** means a system of *effluent* dispersal and treatment using preformed structures to provide a void space for storage and movement of *effluent*, and an interface with the exposed infiltrative surface of the *soil*

c) a ***gravel substitute treatment field*** means a *conventional treatment field,* in which the gravel is replaced with an alternate media having characteristics that will provide void space and performance similar to gravel, and

d) a ***raised treatment field*** is any of the above variations of *treatment fields* where *soil* is imported to enable all or a portion of the *treatment field* trench to be located above the in situ *soil* surface.

Treatment mound or ***Mound*** means a system where the *effluent* is distributed onto a *sand layer* and is built above grade to overcome limits imposed by proximity to a *water table* or bedrock, or by highly permeable or impermeable *soils*.

Typical wastewater means *wastewater* that[1]

a) 80% of the time has
   i) BOD_5 of less than 220 mg/L,
   ii) *TSS* of less than 220 mg/L, and
   iii) oil and grease content of less than 50 mg/L, and

b) does not exceed
   i) BOD5 of 300 mg/L,
   ii) TSS of 350 mg/L, and
   iii) oil and grease content of 70 mg/L.

[1] *Note: Assumed design peak daily flow of 340 L per person per day.*

Underdrain media (as used in a *sand filter*) means that material placed under the *sand filter media* in a *sand filter* and is of a size to support the *sand*.

Underdrain piping means piping placed under a *sand filter* in the *underdrain media* or *drain media* to collect the *effluent* that has traveled through the *sand filter*.

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Uniformity coefficient (CU) means a numeric quantity that is calculated by dividing the size of the opening which will pass 60% of a sample by the size of the opening which will pass 10% of the sample (D60/D10=CU).

Vertical separation means the depth of unsaturated *soil* between the bottom of an *effluent* treatment component and a ~~*limiting condition*~~, *restrictive layer* such as a *water table* or an impervious layer of rock or *soil* that limits hydraulic conductivity such that it would cause a perched *water table* under the loading of the system.

Wastewater means the composite of liquid and water-carried wastes associated with the use of water for drinking, cooking, cleaning, washing, hygiene, sanitation, or other domestic purposes and includes *greywater* but does not include liquid waste from industrial processes.

Water course means

a) a river, stream, creek or lake,

b) swamp, marsh, or other natural body of water,

c) a canal, reservoir, or other man-made surface feature intended to contain water for a specified use, whether it contains or conveys water continuously or intermittently but does not include surface water run-off drainage ditches, such as those found at the side of roads,

d) an area that water flows through or stands in long enough to establish a definable change in or absence of vegetation (See definition of *shore*).

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See Article 8.1.1.4 for required depth of vertical separation and Appendix B pg. **238** for graphic illustration of vertical separation.

A change is shown in this definition to correct an editorial error. The term “limiting condition” was incorrectly used here. The correct term is “restrictive layer”. This is shown in the definition by the strikeout of limiting condition and the replacement of that term with restrictive layer as shown by the double underline.

Photos of what is considered a water course and what is not a water course can be found on pg. **239** in Appendix B.

The definition of *Shore* is critical to defining a water course as set out in clause (d) of this definition.

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Water re-use means a beneficial use of the treated *wastewater* directed to a specific purpose other than the general release to surface or subsurface environments.	
Water source means a man-made or natural source of *potable* water.[1]	
[1] *Note: A cistern is also considered to be a water source when buried in the earth. An above ground tank or a freestanding tank within a basement of a building would not have to meet minimum distance requirements from treatment components.*	A cistern is also considered a water source. See note in this definition.
Water table means the highest elevation in the *soil* at any given point in time where all voids are filled with water, as evidenced by the presence of water, *soil mottling*, or other *soil* characteristics that indicate intermittent saturated *soil* conditions.	
Weeping lateral pipe means the perforated pipe used to distribute *effluent* by gravity within a *treatment field* trench.	
Weeping lateral trench means a trench in a *treatment field* that receives *effluent* and provides a *soil infiltration surface*.	
Working capacity means the liquid volume of wastewater held in the septic chamber when the tank is properly installed and is in normal use, and does not include the air space, siphon chamber, pumping chamber, or effluent chamber of a tank	Not included in the Working Capacity volume is a chamber in a tank that is used for dosing of effluent. See pg. **272** for clarification and graphic illustration.

1.1.6. Abbreviations

1.1.6.1. General

1) Abbreviations in this Standard have the following meanings:

ABS	.... acrylonitrile-butadiene-Styrene
BOD_5	.... Biochemical Oxygen Demand
$CBOD_5$	.... Carbonaceous Biochemical Oxygen Demand
cm^2	.... square centimetre(s)
°	.... degree(s)
°C	.... degree(s) Celsius
CSA	.... Canadian Standards Association
dia.	.... diameter
DWV	.... drain, waste, and vent
ft.	.... foot (feet)
gpm	.... gallons per minute
gal.	.... gallons
Imp.	.... Imperial (gallons)
in.	.... inch(es)
kPa	.... kilopascal(s)
L	.... litre(s)
L/min	.... litres per minute
mL	.... millilitre
kg	.... kilogram(s)
lb	.... pound(s)
m	.... metre(s)
mm	.... millimetre(s)
µm	.... micrometre(s) or microns
m^2	.... square metre(s)
m^3	…… cubic metre(s)
min	.... minute(s)
mg/L	.... milligrams per litre
mm	.... millimetre(s)
No.	.... number(s)
NSF	.... National Sanitation Foundation
NPS	.... nominal pipe size
PE	.... polyethylene
PVC	.... poly (vinyl chloride)
psi	.... pounds per sq. inch (pressure)
sq.	.... square
temp.	.... temperature
TSS	.... Total Suspended Solids
US	.... United States (liquid gallon measure)

Part 2 General Requirements

Section 2.1. General System Requirements

2.1.1. General System Requirements — Objectives and Design Requirements

2.1.1.1. General

1) An *on-site wastewater treatment system* designed and installed to meet the objectives and requirements of this Standard shall

a) be capable of treating the volume and strength of *wastewater* generated by the *development* served,

b) be suitable for the location and *soil* conditions at the site,

c) achieve the performance objectives required by this Standard and anticipated for the design, and

d) accommodate maintenance and/or operational functions required by the system.

The design considerations set out in Design Considerations are applied to develop a system design that meets these objectives.

2.1.1.2. Objectives and Design Requirements Based on Peak Flow

1) Subsection 2.2.2. shall be referenced to determine the applicability of objectives or requirements based on flow volumes and class of treatment system.

Subsection 2.2.2 sets out methods of and requirements for determining flow from a development. Some design requirements are specific to large volume systems such as in Section 2.4.

2.1.1.3. Objectives Achieved Within Treatment Boundary Limits

1) *Wastewater* quality treatment objectives set out in this Standard shall be achieved prior to the *wastewater* meeting the intended *treatment boundary limits* applicable to the design and required by site conditions whether the *wastewater* is on the surface where intended by the design, or moving through the *soil* and subsoil.

2) A *treatment boundary limit* set for all systems, except for *lagoons* and *open discharge systems*, is established at the surface of the ground and to a depth of 75 mm (3 in.) below ground surface in which the following limits will not be exceeded:

a) fecal coliform < 10 cfu/100 mL above background levels, or

b) fecal coliform < 2 MPN/gram of dry *soil* above background levels.

The system design must ensure any effluent that may migrate toward the surface is treated to this quality before coming to within 3 inches of the surface to limit the risk of direct contact with wastewater pathogens at the surface of the ground.

2.1.1.4. Design Considerations

1) An *on-site wastewater treatment system* design shall consider[1]

a) the *soil* conditions determined by a complete site evaluation as required in Part 7,

b) the projected volume of *wastewater*, flow variation, and *wastewater* strength determined by an evaluation

i) as required in Section 2.2. of this Standard, and

ii) that considers any pertinent characteristics of the *development* not

Groundwater mounding is considered in a design by applying linear loading considerations, or by a detailed assessment of the site and modeling of groundwater mounding potential – See Article 8.1.1.9 pg. **136.**

Regarding clause (d), separation distances for tanks and soil based treatment areas is set out in the first article of Subsections ending with the number 2. For example, the separation distances for holding tanks is found in Article 3.1.2.1 of Subsection 3.1.2 Holding Tanks. Or, for Septic tanks it is Article 4.2.2.1., which is the first Article of Subsection 4.2.2. For treatment fields it is Article 8.2.2.1., which is the first Article of Subsection 8.2.2.

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specifically set out in this Standard,

c) the impact of potential *groundwater mounding* resulting from the addition of the *effluent*,

d) separation distances required by this Standard,

e) cold weather operation and other climatic conditions recorded by Environment Canada or another recognized source for the specific location where the system is installed,[2] and

f) other objectives and prescriptive requirements of this Standard that may impact system design and performance.

[1] *Note: Sentence (1) — The design may need to include consideration of cumulative impacts or loading limits established under other legislation.*

[2] *Note: Clause (1)(e) — Appendix A provides climatic data for various locations in Alberta and may be used to satisfy design criteria.*

2.1.1.5. Dosing of Effluent Required

1) An *on-site wastewater treatment system* that includes a *soil infiltration surface* shall be capable of delivering *effluent* to the *soil infiltration surface* in a volume dose adequate to achieve effective distribution of the *effluent* and minimize the risk a system freezing.[1]

[1] *Intent: Sentence (1)- — The system should discharge effluent intermittently with sufficient volume to encourage distribution of effluent throughout the system and to reduce the incidence of freezing problems common with "Trickle Type" systems. Trickle type systems are not allowed by this Standard. A dose tank must be included in the system. The dose*

All systems must be capable of dosing the effluent to the soil based treatment system as opposed to allowing effluent to trickle to the soil based system.

This requires that all systems include a pump or siphon.

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tank does not have to be integral to the septic tank. A separate tank is often better as it allows the designer to select a tank that has adequate volume to accomplish the desired dosing pattern.

2.1.1.6. Effluent Filters

1) All systems shall include an *effluent* filter in the treatment train prior to *effluent* being discharged to the *soil*-based *effluent* treatment component.

An effluent filter reduces the organic loading on the soil infiltration system.

2) *Effluent* filters shall be selected to accommodate the flow rate through the filter required by the system design over the period of time intended for system service intervals set out in the operations manual developed for the system.[1]

During events of high wastewater flow through the system when particulates may be carried through, the filters provide valuable protection.

This applies to Open Discharge systems as stated in the note to Sentence (2) of this Article.

[1] Note: Sentence (2) — The filter should be selected to provide an intended service interval appropriate for the system while considering other required service intervals for the system. It should be inspected yearly and serviced as required. To provide clarity this requirement applies to both pressure distribution lateral systems and to gravity systems that rely on the infiltration of effluent into the soil. As such it includes an open discharge system that relies on infiltration into the soil.

2.1.1.7. Groundwater Infiltration

1) An *on-site wastewater treatment system* shall be designed and installed to prevent the *infiltration* of groundwater into any component of the system.

Ground water infiltration into a system can quickly overload the system, causing a failure.

2.1.1.8. Surface Run-off Storm Water

1) The design and location of the *on-site wastewater treatment system* and finished landscaping shall minimize the

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impact of surface *storm water* run-off water on the performance and operation of the system.

2.1.1.9. Service Access

1) Components of an *on-site wastewater treatment system* that require regular maintenance shall be readily accessible such that servicing or required maintenance can be performed from the ground surface.

2) The location of tanks that need servicing by vacuum trucks shall be located such that reasonable access can be provided to the tank considering distance and vacuum lift limitations.

2.1.1.10. High-Strength Wastewater Considerations

1) If the *development* served by the *on-site wastewater treatment system* is expected to generate *wastewater* that includes constituents normally not found in *typical wastewater,* or if the concentrations exceed the values anticipated in *typical wastewater*, the system design shall[1]

a) include specific features that effectively treat the *wastewater*, or

b) have the *wastewater* directed to a *holding tank* for treatment at an appropriate facility.

[1] Note: Sentence (1) — If the wastewater source only includes an increased organic load, it may be treated by an on-site treatment system with appropriate design considerations, however, in some cases the wastewater may include hydrocarbons, metals, or other chemicals that require specialized treatment offsite.

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The set up of the system should be such that entry into any tank is not required for typical servicing such as changing a pump or servicing a filter.

See Appendix B pg. **273** for information on the limitation of lift into a vacuum truck.

The strength of wastewater is a key concern in the design of an onsite wastewater treatment system.

See Article 2.2.1.3 and Article 2.2.2.1 for information on identifying high strength wastewater and methods of projecting of wastewater strength.

See Table 2.2.2.1 for estimates of wastewater strength from some facilities.

2.1.1.11. Bypassing Treatment Phase Prohibited

1) *Wastewater* shall not bypass any treatment phase of the *on-site wastewater treatment system*.[1]

[1] *Intent: Sentence (1) — To ensure system effectiveness is not reduced due to ineffective flow management or treatment resulting from wastewater bypassing a component of the treatment system.*

2.1.2. General System Requirements — Prescriptive Requirements and Installation Standards

2.1.2.1. Site Suitability and Use of Holding Tanks

1) An *on-site wastewater treatment system* shall not be installed where there is

a) insufficient area to meet all minimum distance requirements of this Standard for the intended system, or

b) no available location that has the *soil* and site characteristics, as determined by an evaluation required by Part 7 and set out in Part 8, required to develop a sustainable *on-site wastewater treatment system* that can accept and treat the *wastewater* load generated by the *development.*

2) Notwithstanding Clause (1)(b) and subject to Sentence (3), a *holding tank* system may be installed.

Determining that a site has a location and conditions suitable for a soil based onsite wastewater treatment system is accomplished through an evaluation of the site as set out in Part 7.

If a public sewer is available, municipalities may require connection of the building to the public sewer. See Appendix B, Required Connections to Sewer, pg. **236**.

A municipality may require that only holding tanks be used for managing wastewater or alternatively that holding tanks cannot be used, requiring that a

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3) The suitability of using a *holding tank* system for a *development,* or a requirement that only a *holding tank* system be used, is subject to determination by the local municipal government, and if a *holding tank* system is used it shall conform with this Standard.[1]

[1] *Intent: Sentence (3) — Holding tanks are not a self-sustaining method of private wastewater management. The system relies on the availability of an approved wastewater treatment facility off the site creating a load on municipal infrastructure. Owners of holding tanks also incur ongoing costs for the removal and hauling of wastewater to approved treatment facilities. Municipalities have discretion regarding the acceptance of holding tanks as the wastewater management solution for a development.*

sustainable onsite system be installed. Such a decision relates to impact municipal infrastructure requirements and cumulative impact from high density developments, both of which are land use planning issues.

2.1.2.2. Owner's Responsibility

1) The owner of an *on-site wastewater treatment system* shall ensure that the system

a) is maintained,

b) is operated within the design parameters of the system, and

c) effectively treats the *wastewater*.

The owner of a system must maintain and operate the system for it to effectively treat the wastewater.

This standard does not set out requirements on how the system must be maintained.

Article 2.1.2.8 requires the designer or installer of a system provide a maintenance manual for the particular system.

2.1.2.3. Designer and Installer Responsibility

1) The system designer and system installer are responsible to ensure that

a) the site has been sufficiently investigated and the design has considered and addressed all pertinent factors to achieve a functional system, and

b) testing and commissioning of the system is undertaken to ensure it complies with this Standard and meets the objectives set out.

The designer and installer must ensure the site and soils investigation is adequate to develop a design. If that function was under taken by another party, it needs to be carefully assessed before using that information for a design.

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2.1.2.4. Separation from Specific Surface Waters

1) The *soil*-based treatment component of an *on-site wastewater treatment system* shall be located not less than 90 m (300 ft.) from the *shore* of a[1]

a) lake,

b) river,

c) stream, or

d) creek.

[1] *Intent: Sentence (1) — The terms "lake," "river," "stream," or "creek" are used specifically to separate them from other types of water courses to which this article does not apply. The purpose is to cause the location of the soil-based treatment component to be far enough from the body of water that upon a failure of surfacing effluent the effluent will not quickly and directly flow into the body of water. Alternatively, as set out in Sentence (2), the soil-based treatment component can be positioned on the lot, away from the body of water and in a location that will make a failure more easily noticed and upon failure will create an immediate inconvenience for the owner. This should result in a faster repair of the system. To achieve the intent of Sentence (2) the building does not have to be directly between the system and body of water. A water-tight septic tank or similar water tight initial treatment component does not need to meet the requirements of this Article.*

2) Notwithstanding the requirements of Sentence (1), where a principal *building* or other *development* feature is situated between the *soil*-based treatment component and a lake, river, stream, or creek, such that a failure of the system causing *effluent* on the ground surface will be obvious and create an undesirable impact on the owner, the distance may be reduced to the minimum distance requirements set out in this Standard for

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This article specifically refers to the soil based treatment component of the system and specifically references a lake, river, stream or creek. The 90m (300 ft.) set back does not apply to watercourses or water bodies that are not a lake, river, stream or creek. There are specific distances set out separately in the applicable sub-section from a water course.

The setback in this article also does not apply to separation from tanks.

The intent statement with this article and the exception set out in Sentence (2) is critical to its proper application.

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the particular type of treatment system being used.

2.1.2.5. Prohibited Discharge Locations

1) *Wastewater* or *effluent* shall not be discharged

a) into a well, abandoned well, *aquifer*, or water supply,

b) into any surface body of water such as, but not limited to a lake, river creek, stream, natural wetland or constructed aqua-scape/water feature,

c) onto any vegetable garden, or

d) into any other system or location not consistent with the designs provided under this Standard.

Discharge of any sewage or effluent into surface water is not allowed by this standard. Such a discharge is regulated by Alberta Environment.

2.1.2.6. Prohibited Wastes and Substances

1) O*n-site wastewater treatment systems* designed under the prescriptive requirements of this Standard shall not receive substances and *wastewater* that could adversely affect the operation of the system, which include, but are not limited to, the following:[1]

a) *storm water*,

b) surface water,

c) abattoir waste,

d) sub-surface seepage water from weeping tile systems, foundation drains, or *subsoil foundation drainage pipes*,

e) *clearwater waste* from a hot tub, spa or hydro massage bath that is not of the fill-and-drain design, unless the design of the system specifically includes capacity for the additional *wastewater* flow and instantaneous flow conditions

The volume of storm water, surface water, subsurface seepage water, etc. cannot be estimated, therefore, the disposal system cannot be sized to accommodate this type of waste.

The connection of a storm water drain or subsurface drain may cause the sewage system to back up into the building in the event of a power outage, pump failure or failure of the soil absorption system.

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the fixture will cause along with the potential disinfectants in the water,

f) *clearwater waste* from a swimming pool except the waste from the area drains around the pool area may discharge into a system,

g) commercial or industrial process wastes,

h) waste from a water filter or other water treatment device where the on-site design has not been designed to receive and treat the discharge from the filter or treatment device,2,3,4

i) wastes from an iron filter, and

j) other wastes not considered in the design of the system.

[1] *Intent: Sentence (1) — The wastewater treatment systems identified in this Standard are intended for treating wastewater. Substances, contaminants, and wastewater constituents not typically expected in domestic wastewater require special consideration.*

[2] *Warning: Clause (1)(h) — The use of water softeners and the discharge of regeneration wastes are not specifically prohibited from discharging to an on-site wastewater treatment system. The use of sodium salts in a water softener is generally more harmful to the soil-based treatment component of a treatment system than using potassium based salts. Increased sodium levels will be present in the domestic water used in the house from day to day and may be further increased by inefficient backwash functions of a water softener that does not have the regeneration controlled by flow volume. High levels of sodium can reduce the effectiveness of the on-site wastewater treatment system and reduce its life expectancy, particularly when it is located in fine textured clay soils. Sodium occurring naturally in the ground water or introduced to the water supply by a water softener using sodium salts may affect the ability of the soil to absorb the effluent. High sodium adsorption ratio effluent and the presence of expansive clays, such as montmorillonite clay (Refer to Appendix A.3.B.*

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It is possible to design an onsite wastewater system to receive some of the wastewater sources listed here where there is a specific reference saying not to enter the system unless it has been designed to receive the waste.

With regard to water treatment devices such as a water softener, both the chemical characteristics of the wastewater and the volume must be considered.

Alternate discharge locations other than the private sewage system may be acceptable for water treatment devices that do not carry a pathogen load.

See pg. **300** regarding the impact of the sodium from a water softener on the system and design considerations.

and Appendix A.3.C. for mapping of montmorillonite clays) in the soil may cause a soil-based treatment component to fail. Additional considerations from those set out in this Standard may be required.

[3] *Note: Clause (1)(h) — The use of potassium salts as a regeneration agent in a water softener is not expected to have the same negative effect on expansive clays as the use of sodium salts.*

[4] *Warning: Clause (1)(h) — The discharge of waste from water treatment devices can generate large volumes of water that are not included in flow estimates set out in this Standard. They may generate volumes that cannot be accurately predicted or include substances that are difficult to treat or can harm the system and cause a failure*

2.1.2.7. Construction Wastes Removed Prior to Commissioning a System

1) The installer of a system shall ensure that during construction of the *development*, substances that may harm or reduce the effectiveness of the system do not enter the system or are removed before the system is put into operation.

2.1.2.8. Owner's Manual

1) Prior to putting an *on-site wastewater treatment system* into operation, an operations and maintenance manual shall be made available to the owner detailing

a) the capacity of system design,

b) the principles of operation,

c) the construction details including a site plan showing the specific as-built location and area occupied by treatment components,

d) pump capacity requirements, control settings, float elevations and dosing volumes as applicable,

The owner's manual must be provided with the system. Maintenance of the system is important. To carry out the required maintenance, the owner must have a manual identifying what needs to be done for that particular system to continue operating effectively.

e) all operating and maintenance requirements, and

f) instructions to manage an alarm condition.

2) An operations and maintenance manual shall be affixed in close proximity to the electrical service panel or another clearly visible, accessible location of the *development*.

2.1.3. General System Requirements — Requirements for Materials

2.1.3.1. General

1) All materials, systems, and equipment used in an *on-site wastewater treatment system* shall be designed for and possess the necessary characteristics to perform their intended functions.

Components and equipment used in an onsite sewage system must be manufactured for that purpose and have the necessary quality to withstand contact with wastewater.

Section 2.2. Wastewater Flow and Strength

2.2.1. Wastewater Flow and Strength — Objectives and Design Requirements

2.2.1.1. General

1) The *on-site wastewater treatment system* shall achieve treatment of the *wastewater* within the range of volume and strength of *wastewater* generated by the *development*.

Some facilities produce a wide range of flow volumes and wastewater strength. The design needs to consider and address this fluctuation by employing a method of flow equalization.

2.2.1.2. Wastewater Strength Projected in Design

1) A system design shall include a projection of *wastewater* strength.

Wastewater strength is a key consideration in a system design. As such the projected wastewater strength the system is designed for is a critical design aspect.

2.2.1.3. Methods of Projecting Wastewater Strength

1) The mass or concentration of constituents of concern in the *wastewater* shall be estimated using

a) values set out in this Standard,

b) published guidelines acceptable to the *administrator*,

c) analytical results of *wastewater* samples taken following appropriate sampling and analytical protocols, or

d) *wastewater* quality data collected from similar establishments

Typical wastewater strength from some types of development where high strength wastewater is expected is provided in this standard in Article 2.2.2.1. This article also sets out additional methods of projecting wastewater strength.

2.2.1.4. Peak Wastewater Flow for Design

1) The system design flow shall be based on the daily peak flow expected from the *development*.

Onsite systems are significantly impacted by peak flows that occur. Because onsite systems serve individual developments, there is very little averaging of flows that are seen in larger municipal systems.

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2) The daily peak flow referred to in Sentence (1) shall be estimated using

a) the prescriptive requirements of this Standard,

b) metered flow to establish a daily peak flow design value based on applying a safety factor of 1.5 to the mean metered flow to provide the required safety in design or a larger factor to accommodate any potential increases in flow anticipated due to changes in use of the *development* over time and uncertainties in the metered flow data,

c) data collected from similar *developments* if an appropriate safety factor is included to accommodate peak flow, or

d) published guidelines or standards acceptable to the *administrator*.

3) The meter referred to in Clause (2)(b) must be recorded daily for at least 30 consecutive days during a typical peak flow period or as otherwise acceptable to the *administrator*.

4) If the daily water use of a *development* is expected to vary substantially between days of the week and a flow equalization and management method that effectively distributes the flow to the treatment components over a 7-day period is used, the system design may be based on the averaged 7-day peak flow calculated using the expected use frequency of the *development*.[1]

[1] Note: Sentence (4) — Examples of a development that can expect to see variations include churches, community halls, schools, and office buildings. Flow equalization and management can increase the effectiveness of the treatment system and reduce costs.

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Peak flow must be used in a design. Using average flow for design would mean many systems are undersized and prone to failure. It could be said that if average flow were used in design, many of the systems would be inadequately designed where flows exceed average.

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2.2.1.5. Consideration of High Flow Plumbing Fixtures

1) Where the *development* includes plumbing fixtures that

a) will generate large instantaneous flows, or

b) are likely to increase flow volumes above levels normally expected of that type of development,

the system design shall include a method to manage the additional volume and instantaneous flow rates created or have the capacity to treat the wastewater at the higher flow rate.

Large fill and drain hydro massage tubs are a typical example of a fixture used in some residences that will cause instantaneous high flow rates. These large tubs could release half the daily flow the system is designed for in 10 to 15 minutes and overwhelm the system.

2.2.1.6. Consideration of Water Conservation Plumbing Fixtures

1) Where the *development* includes low-flow or water conservation plumbing fixtures that will generate lower flow volumes, the system shall be designed to treat the increased *wastewater* strength that will result.

One method of design to address the higher strength is to not reduce the design capacity to less than the typical peak flow values anticipated without water saving fixtures. See Article 2.2.2.4 as an alternative to considering high strength waste caused by water saving fixtures.

2.2.1.7. Highly Variable Flow Volumes During the Day

1) A system serving a *development*, such as, but not limited to, a motel or other facility that will generate the majority of daily flow during a short period of the day or is subject to high instantaneous flow, shall include flow equalization to attenuate the high-flow periods.

Flow equalization tanks are needed for facilities that generate the majority of flow during a short time of the day.

See Appendix B pg. **246** for info on design for flow equalization and identifying variable flow situations.

See Article 2.2.2.5 for flow equalization requirements in the system.

See Article 2.2.2.3 for prescriptive requirements regarding instantaneous flow from residences.

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2.2.2. Wastewater Flow and Strength — Prescriptive Requirements and Installation Standards

2.2.2.1. Influent Wastewater Quality

1) Unless otherwise specified, the requirements of this Standard anticipate an influent raw *wastewater* strength that[1]

a) 80% of the time does not exceed
  i) *BOD*$_5$ of 220 mg/L,
  ii) *TSS* of 220 mg/L, and

b) oil and grease content of 50 mg/L, and does not exceed maximum values of
  i) *BOD*$_5$ of 300 mg/L,
  ii) *TSS* of 350 mg/L, and
  iii) oil and grease content of 70 mg/L.

[1] *Note: Sentence (1) — At daily flow volumes assumed in this Standard.*

Wastewater that exceeds this strength is considered high strength wastewater and must be adequately treated before reaching the soil based treatment system.

The wastewater strength set out here is what is anticipated from a residential development at the peak flow rates assigned in this standard.

2) If the *wastewater* strength is projected to exceed the values set out in Sentence (1), the system shall

a) include additional treatment capacity to achieve the *effluent* quality required for the downstream component,

b) have the downstream component include additional treatment capacity appropriate for the higher *wastewater* strength, or

c) have a combination of the requirements referred to in Clauses (a) and (b).

See Appendix B pg. 247 for more information on identifying wastewater strength and approaches to addressing the high strength wastewater in a design.

3) If the *development* is non-residential, the projection of *wastewater* strength shall not be less than highest strength determined

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by

a) the values estimated in Table 2.2.2.1. for the type of *development* listed,

b) *wastewater* strength projections set out in published information acceptable to the *administrator* that is more specific to the *development*, or

c) the measured *wastewater* strength from similar *developments*.

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This article requires that the highest strength determined by any of the 3 methods set out here is used for design. The values set out in Table 2.2.2.1 are minimum values and should be used cautiously by a designer. See the note in Table 2.2.2.1 below.

Table 2.2.2.1. Non-Residential Projected Wastewater Strength

Note: *These values are minimums. The designer must determine the correct wastewater strength to use in the design for the particular application. Actual values are often substantially higher than the values set out below.*

Non-Residential Development	Minimum Projected Wastewater Strength, mg/L
Restaurant	600 BOD_5; 400 TSS; 200 Oil & Grease
Work Camp	600 BOD_5; 400 TSS; 200 Oil & Grease
Camp ground with RV dump station	600 BOD_5; 400 TSS; 70 Oil & Grease

4) All systems, except for a *lagoon*, shall include an *effluent* testing port or readily accessible location that enables sampling of the *effluent* at a point downstream of any required *effluent* filter and prior to discharge to the *soil*-based treatment component.[1]

[1] *Note: Sentence (4) — Sampling from the effluent chamber may be acceptable if there is no filter required downstream of the pump.*

5) For a system where the anticipated *wastewater* strength exceeds that of *typical wastewater*, the *effluent* discharged to the *soil infiltration surface* area shall be tested once the system is commissioned to confirm the design has achieved the *effluent* quality intended by the initial treatment components.

In most private sewage systems a very appropriate and easily accessed location for sampling of effluent is in the dose tank.

If the system is designed for high strength wastewater, the effluent must be tested once the system is in operation to ensure the treatment system design is effective. This testing should go on at regular intervals during ongoing operation of the system.

See Appendix B pg. **248** for information on wastewater sampling.

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2.2.2.2. Peak Daily Wastewater Volume

1) The expected peak daily volume of *wastewater* used for system design shall not be less than the values provided in[1]

a) Table 2.2.2.2.A. for residential *developments*,

b) Table 2.2.2.2.B. for non-residential *developments*, or

c) accordance with Article 2.2.1.4.

[1] *Intent: Sentence (1) — The expected volumes of wastewater listed in Tables 2.2.2.2.A. and 2.2.2.2.B. are for uses typically expected in the corresponding type of occupancy. With regard to residential applications, additional fixtures, high capacity fixtures, or home designs that support entertaining events are expected to increase the load substantially. The designer and or installer must consider additional load factors when determining the expected sewage per day. The expected volume of sewage set out in these tables includes a volume that allows for a reasonable number of operational personnel.*

[1] *Note: Table 2.2.2.2.A. — Fixture units are a value assigned to plumbing fixtures related to their frequency of use, rate of discharge and anticipated volume. The following table lists fixture unit values for common fixtures. For a complete fixture unit loading list the National Plumbing Code should be referenced.*

These tables set out daily flow volumes for a typical development. Characteristics of the development that are not typical require consideration of the impact on daily flow volumes. See intent statement with this Article.

Article 2.2.1.4 can be applied in place of the values set in these referenced tables for alternate methods of projecting wastewater flow.

Table 2.2.2.2.A. Residential Peak and Mean Volumes of Wastewater Per Day			
Facility	**Peak expected daily wastewater volume**	**Additional capacity required**	**Mean daily wastewater volume**
Single-family dwelling and duplex	• 2 bedrooms or less: 2 people per bedroom X 340L (75 Imp.gal.) per person • 3 bedrooms or more: 1.5 persons per bedroom X 340L (75 Imp.gal.) per person	When the combined total of fixture units[1] exceeds 20, add 50L for each fixture unit over 20.	• 228L (50 Imp. G al.) per person
Residential Occupancy other than single family dwelling or duplex	• 340 L (75 Imp. gal.) X 2 persons per bedroom	When the combined total of fixture units exceeds 20 in an occupancy unit, add 50 L for fixture unit over 20.	228L (50 Imp. G al.) per person

[1] *Note: Table 2.2.2.2.A. – Fixture units are a value assigned to plumbing fixtures related to their frequency of use, rate of discharge and aniticipated volume. The following table list fixture unit values for common fixtures. For a complete fixture unit loading list the National Plumbing Code should be referenced.*

Fixture	***FU value***	***Fixture***	***FU value***
Basin	*1*	*Kitchen sink*	*1.5*
Bathtub	*1.5*	*Laundry stand pipe*	*1.5*
Single head shower *2 or 3 heads*	*1.5* *3*	*Laundry tray (one or two compartment)*	*1.5*
Water Closet (toilet) flush tank	*4*	*Floor drain* *4 inch* *3 inch* *2 inch*	 *3* *3* *2*
Bathroom group	*6*	*Bidet*	*1*

*****A bathroom group (the combined load from a tub/shower, toilet and basin) is rated at 6 fixture units. An emergency floor drain, such as in a bathroom, does not need to be counted in the fixture unit load from a building.

Handbook note: A floor drain that is not expected to receive wastewater flow regularly does not need to be included in the fixture unit loading. An example is a floor drain in a basement of a dwelling or residential mechanical room.

See Appendix B pg. **243** for an example of the application of this table for determining peak design flow.

Table 2.2.2.2.B. Peak Volumes of Wastewater Per Day

Facility	Peak daily *wastewater* volume in litres (Imp. gallons) per day
Assembly Hall	32 (7) per seat
Campground (full service) **Handbook note:** *A full service campground differs from an RV resort in that the campsites do not include wastewater connections for an RV but does have toilet and shower facilities in a common building. Some campgrounds may have a combination of campsites and RV sites which would be rated at different flows.*	80 (18) per campsite
Church without kitchen	23 (5) per seat
Church with kitchen	32 (7) per seat
Construction Camp	225 (50) per person
Day Care Centre	113 (25) per child
Golf Club Golf Club with bar and restaurant add	45 (10) per member 113 (25) per seat
Hospital (no resident personnel)	900 (200) per bed
Industrial and Commercial Building (does not include process water, showers or a cafeteria) Industrial and Commercial Building (with showers)	45 (10) per employee 90 (18) per employee
Institution (residential)	450 (100) per resident
Laundry (coin operated)	1800 (400) per machine
Liquor License Establishment	113 (25) per seat
Mobile Home Park	1350 (300) per space
Motel/Hotel	90 (18) per single bed
Nursing and Rest Homes	450 (100) per resident
Office Building	90 (18) per employee
Recreational Vehicle Park (special considerations are required for systems receiving waste from RV's as it may contain formaldehyde that could cause the system to fail) **Handbook note:** Most RV wastewater system additives used today do not use formaldehyde; however it may still be present in some products and other chemicals in the product may be harmful to the system. Wastewater from an RV park or any system an RV can dump into will be high strength waste and must be treated appropriately.	180 (40) per space
Restaurant (24-hour) Restaurant (not 24-hour)	225 (50) per seat 160 (35) per seat
School: Elementary Junior High High School Boarding	70 (15) per student 70 (15) per student 90 (18) per student 290 (64) per student
Service Station (not including café or restaurant)	560 (125) per fuel outlet
Swimming Pool (public) based on design bathing load	23 (5) per person

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2.2.2.3. Additional or High Capacity Fixtures

1) Where additional fixtures or high capacity fixtures are installed, the system shall have the capacity to manage the additional load, determined in accordance with Table 2.2.2.3. or by the application of Articles 2.2.1.4. and 2.2.1.5.[1]

[1] *Intent: Sentence (1) — This table provides a minimum estimate of the additional volume needed to accommodate both increased overall peak flow and instantaneous loading generated by the fixture.*

Also see Table 2.2.2.2.A for additional volume to be added based on the cumulative FU rating of fixtures installed in a residence.

See example in Appendix B pg. **246** for application of instantaneous flow from a large hydro massage tub.

Table 2.2.2.3. Fixtures that Require Additional Design Capacity	
Fixture	**Add to expected peak daily wastewater volume in litres (Imp. gallons) per day**
Hydro-massage and soaker tubs (fill and drain style) The design Peak Flow needs to increase to adequately handle the instantaneous flow from these fixtures. Flow equalization should be included in the system if these types of fixtures are present in the development as required by Article 2.2.1.7 ***Handbook note:*** *See also Article 2.2.1.5 for a more specific reference to instantaneous flow*	[Volume of tub in litres (minus 340 liters) x 2] [Volume of tub in Imp. gallons (minus 75 gal.) x 2]
Water Softener Discharge	15% increase in peak daily wastewater volume
Other High Capacity Fixture	A volume reasonably anticipated from the specific fixture shall be added to peak daily wastewater volume and will consider the impact on peak instantaneous flow.
High Flow Volume Showers (discharging in excess of 13 L (3 Imp. gal.) per minute)	Add 50 L (11 gallons) for every 6 L (1.5 gallons) per minute or portion thereof that exceeds a 13 L (3 Imp. gal.) per minute discharge (normal shower discharge)

2.2.2.4. Flow Estimates with Water-Saving Fixtures

1) Where a design is based on the prescriptive requirements of this Standard, the peak daily flow estimates shall not be reduced from the values set out in Subsection 2.2.2. when water saving fixtures or devices are used, unless adequate consideration of the increased *wastewater* strength is made.[1]

[1] Note: Sentence (1) — Reduced water usage resulting from the use of water conservation measures or fixtures will increase wastewater strength a corresponding amount so no reduction in treatment area should be applied.

This provides an alternative method to addressing higher strength of wastewater when water saving fixtures are used. Do not reduce peak flow design based on water saving fixtures unless the design specifically addresses the increase in wastewater strength.

See Appendix B pg. **245** for information on how water use reductions affect wastewater strength and design considerations that can be applied.

2.2.2.5. Flow Equalization

1) In systems that require flow equalization

a) the capacity of the tank providing flow equalization shall be not less than the peak daily flow or 1.5 times the average daily flow volume, and

b) be equipped with control systems needed to equally spread the dosing of the daily *wastewater* volume over a 24-hour period.

In systems where flow variability is high, flow equalization is critical to the long-term success of the system. In all systems it will provide treatment and sustainability benefits.

2.2.2.6. Garbage Grinders

1) Where a garbage grinder is installed in a residential *development*, there shall be a

a) 5 percent increase to the expected peak daily *wastewater* volume projection,

b) 30 percent increase to the *wastewater* strength projection, and

c) 50 percent increase in the projected volume of sludge storage required in a *septic tank*.

2) In all other *developments*, the specific increase in loading due to the garbage grinder shall be calculated in the design.

Kitchen sink garbage grinders add a significant organic load to the wastewater increasing the strength of the wastewater.

To address the increased strength from a garbage grinder a secondary treatment plant with an increased treatment capacity is likely the best design approach.

Section 2.3. System Controls: System Flow Less than 5.7 Cubic Metres Per Day

2.3.1. System Controls: System Flow Less than 5.7 Cubic Metres per Day — Objectives and Design Requirements

2.3.1.1. Application

1) Subsection 2.3.1.applies to all *on-site wastewater treatment systems* where the estimated peak *wastewater* flow from the *development* is less than 5.7 m^3 (1,250 Imp. gal.) per day.

5.7 cubic meters is equivalent to 1,250 imp or 1500 U.S gallons per day.

For comparison to determine when this applies, the volume of wastewater expected from an 11 bedroom residence is less than 5.7 cubic meters of wastewater per day.

2.3.1.2. Alarms Required

1) All *on-site wastewater treatment systems,* including *holding tank* systems but excluding *lagoons*, shall include a mechanism or process capable of visually and audibly warning the user of the system when high liquid level conditions above the normal operating specifications exist.

2) A control system for a timed dosing system shall include an alarm that visually or audibly indicates to the user that the *wastewater* flow is exceeding the design settings of the system.

3) The visual and auditory alarm signals shall continue to function in the event of an electrical, mechanical, or hydraulic malfunction of the system.

A high level alarm is required in all systems, excep noted for lagoons and for privies that do not receiv wastewater sources.

See Appendix B pg. 249 for timed dosing control and the importance of the alarm function when time dosing design volume is exceeded during operation.

Sentence 3 of this Article does not specifically require a battery backup of the alarm. It must continue to work in the event of an electrical failure of the treatment system which is why the alarm needs to be connected to a circuit that is not related to the treatment system or have a battery backup.

2.3.1.3. Control Systems Required

1) All treatment systems shall include the necessary system controls to achieve the level of functionality, operation, and monitoring of the system required to meet the objectives and requirements of this

Required controls may be simple or complex depending on the system design and operation. While this section sets out general requirements for controls a specific system design may require additional controls to be successful.

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Standard.[1]

[1] *Intent: Sentence (1) — Depending on the system design and treatment demands of the site, various control systems will be required. For example, if a sand filter design requires small volume time spaced dosing of effluent to achieve the expected level of treatment, the control required to achieve that must be provided.*

2.3.1.4. Mounting of Water Level Control Devices

1) Water level indicating devices shall be mounted in a manner that allows for the[1]

a) removal or adjustment of the devices without requiring the disconnection of other system components, and

b) re-installation of devices at a consistent reference elevation.

[1] *Note: Sentence (1) — To achieve this, water level control floats are mounted on a float mast that is independent of other piping and components. This enables the removal and replacement of the water control floats or other system components in a manner that ensures float settings remain at the level intended for the design. Mounting or securing these water level control devices to the effluent piping does not achieve the intent of this Article.*

Water level indicating devices are key to a successful control system.

Adjustment of the devices may be needed at the time of commissioning a system to meet design requirements regarding dose volumes or when changes in wastewater flow patterns occur due to changes in the occupancy of the development.

These control components must be mounted so they can be removed or adjusted without disconnection of other piping or components. See pg. **359** for an illustration of this in an effluent dosing chamber. See pg. **250** for further discussion on this article.

2.3.1.5. Detection and Data Recording for Secondary Treatment Systems

1) Treatment systems where a secondary treatment level is achieved prior to distribution of the *effluent* to a final *soil-*based treatment must include a component capable of

a) detecting electrical or mechanical failures that are critical to the treatment process,

Where a secondary treatment system is installed there is a high reliance on treatment of the wastewater to a higher quality. This is to ensure that it is ongoing and to be able to assess the performance of the system effective control as needed.

b) detecting high liquid level conditions above the normal operating specifications,

c) determining daily flow volumes, and

d) collecting and recording the operational data history as defined in Clauses (a), (b), and (c) for a minimum of the previous 30 days.

2) The collection of operational data history shall cover a sufficient period to provide information that can be used to develop a report on the system's operational performance that can be reviewed to

a) evaluate operational problems,

b) optimize system performance, and

c) evaluate the achievement of treatment objectives.

2.3.2. System Controls: System Flow Less than 5.7 Cubic Metres per Day — Prescriptive Requirements and Installation Standards

2.3.2.1. Application

1) Subsection 2.3.2. applies to all on-site wastewater treatment systems where the estimated peak wastewater flow from the development is less than 5.7 m3 (1,250 Imp. gal.) per day.

2.3.2.2. Location of Alarm and Warning Devices

1) Alarm and warning devices shall be located

The requirement to determine daily flow means it needs to record the flow over any given 24 hour period (a day) as opposed to a total cycle count or volume of many days which is averaged. Identifying daily flows through the system (particularly if it exceeds design capacity) is important for managing and optimizing the treatment effectiveness.

where

a) the visual alarm signal is reasonably conspicuous to the user(s) of the system, and

b) the audible alarm location and signal strength is reasonably conspicuous to the user(s) of the system.

2.3.2.3. Alarm Back-up

1) The alarm shall be connected to a separate electrical circuit that is not associated with the *wastewater* treatment system or have a battery back-up that provides a minimum of four hours' operation.

The circuit the alarm is connected to must be separate from the electrical circuit for the treatment system. This does not intend that the alarm be on a dedicated circuit. In fact that is not desirable as that circuit may fail and be unnoticed. It is best to tie it into a circuit that is used in the building that will be noticed if the circuit breaker is tripped.

2.3.2.4. Silencing Alarm Caused by Malfunction

1) An alarm or warning device may include the ability to silence an audible alarm, provided the visual signal continues to function until the condition is corrected and the alarm includes an automatic re-setting feature.

2.3.2.5. Pump Control Redundant Off

1) When control systems for the *on-site wastewater treatment system* include a pump "on-off-auto" switch, the control system shall be equipped with a redundant-off water level controller that prevents the pump from running in the event of inadvertent operation of the pump in the manual-on setting.

This is to protect against pump failure if the pump on manual switch is inadvertently left in the on position.

Most systems with the manual pump run switch are equipped with a switch that cannot be left in the on position; they utilize a spring loaded manual on switch.

2.3.2.6. Controls and Wiring Protected From Corrosive Environments

1) System controls, alarm devices, and electrical connections shall not be located in any space that communicates directly with

The atmosphere in the wastewater system is quite corrosive. The material used must be protected from that atmosphere and be made from materials that will withstand the environment. The atmosphere above the water line is corrosive to steel, brass and copper.

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the *wastewater*, gases, or vapours generated from the *wastewater*, unless the system control or alarm device is specifically designed for installation in the corrosive and high-moisture environment.

2.3.3. System Controls: System Flow Less than 5.7 Cubic Metres per Day — Requirements for Materials

2.3.3.1. Certification of System Controls and Alarm Devices

1) System controls and alarm devices shall be specifically designed for the use in *on-site wastewater treatment systems* and *certified* to the applicable electrical equipment standards and comply with the Canadian Electrical Code Part 1 and provincial electrical regulations.

All electrical components and systems of the wastewater treatment system are regulated under the electrical codes adopted in the province. The requirements of the electrical system are outside the scope of this standard.

Section 2.4. System Controls and Monitoring: System Flow Greater than 5.7 Cubic Metres per Day

2.4.1. System Controls: System Flow Greater than 5.7 Cubic Metres per Day — Objectives and Design Requirements

2.4.1.1. Application

1) Subsection 2.4.1. applies to all *on-site wastewater treatment systems* where the estimated peak *wastewater* flow from the *development* is greater than 5.7 m^3 (1,250 Imp. gal.) per day.

2.4.1.2. General

1) All treatment systems must include the necessary system controls to achieve the level of functionality, operation, and monitoring of the systems required to meet the objectives and requirements set out in this Standard.[1]

[1] *Note: Sentence (1) — Objectives and requirements related to a specific type of system and/or site conditions will vary and may be established in other sections of this Standard.*

2.4.1.3. High Liquid Level Warning

1) All treatment systems shall include a mechanism or process capable of visually and audibly warning the user of the system when liquid levels exceed the maximum design capacity.

5.7 cubic meters is equivalent to 1,250 imp or 1500 U.S gallons per day.

For comparison to determine when this applies, the volume of wastewater expected from an 11 bedroom residence is less than 5.7 cubic meters of wastewater per day. Systems that serve a development that generates more than 5.7 cubic meters per day require the involvement of a professional as set out in the Private Sewage Disposal Regulation in Section 4(4) which is shown on pg. **234**.

Required controls may be simple or complex depending on the system design and operation. While this section sets out general requirements for controls, a specific system design may require additional controls to be successful.

A high level alarm is required in all systems, except as noted for lagoons and for privies that do not receive wastewater sources.

See Appendix B pg. **249** for timed dosing control and the importance of the alarm function when time dosing design is exceeded.

Sentence (3) of this Article does not specifically require a battery backup of the alarm. It must continue to work in the event of an electrical failure of the treatment system, which is why the alarm needs to be connected to a circuit that is not related to the treatment system or have a

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2.4.1.4. Holding Tank High Liquid Level Warning

1) All *holding tank* systems must include a mechanism or process capable of visually and audibly warning the user of the *holding tank* system when liquid levels exceed the normal operating specifications.

2.4.1.5. Alarm Back-Up

1) The visual and auditory alarm signals shall continue to function in the event of an electrical, mechanical, or hydraulic malfunction of the system.

2.4.1.6. Detection and Data Recording

1) All treatment systems must include a component capable of

a) detecting electrical or mechanical failures that are critical to the treatment process,

b) detecting high liquid level conditions above the normal operating specifications,

c) determining daily flow volumes, and

d) collecting and recording an operational data history as defined in Clauses (a), (b), and (c) for a minimum of the previous 30 days.

2) The collection of operational data history shall cover a sufficient period to provide information that can be used to develop a report on the system's operational performance that can be reviewed to

a) evaluate operational problems,

b) optimize system performance, and

c) evaluate the achievement of treatment objectives.

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battery backup.

This does not require a battery backup in case of total power failure. The alarm must continue to work in the event of power supply to the sewage system being interrupted due to a breaker tripping. Having the alarm on a circuit separate for the overall sewage system or provided with battery back-up is acceptable.

Systems that treat the larger flow volumes addressed in this section are reliant on a consistent quality of wastewater being discharged to the soil dispersal component (field, mound, etc) as determined by the design.

Operational monitoring and control to ensure a consistent quality is important to reduce risk and ensure effective long term operation.

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2.4.1.7. Mounting of Water Level Control Devices

1) Water level indicating devices shall be mounted in a manner that allows for the[1]

a) removal or adjustment of the devices without requiring the disconnection of other system components, and

b) re-installation of devices at a consistent reference elevation.

[1] *Note: Sentence (1) — Water level control floats should be mounted on a float mast that is independent of other piping and components. This enables the removal and replacement of the water control floats or other system components in a manner that ensures float settings remain at the level intended for the design. Controls cannot be mounted on wastewater piping and accomplish the intent of this Article.*

Water level indicating devices are critical for a successful control system.

Adjustment of the devices may be needed at the time of commissioning a system, either to meet design requirements regarding dose volumes or when changes in wastewater flow volumes occur due to changes in the occupancy of the development.

These control components must be mounted so they can be removed or adjusted without disconnection of other piping or components. See pg. 359 for a graphic illustration.

2.4.1.8. Managing Flow Variation

1) The system design shall have features, including tanks and controls, that effectively manage daily or day-to-day flow variations to optimize system effectiveness and function.[1]

[1] *Intent: Sentence (1) — This would typically be accomplished with adequate tank volume and timed dosing controls.*

Large volume systems often have variable flow that must be managed effectively to ensure treatment effectiveness.

2.4.1.9. Monitoring Wells

1) The system design shall include monitoring wells that extend to a depth below grade sufficient to confirm that the required *vertical separation* from the *soil infiltration surface* to saturated *soil* conditions is maintained during operation and these monitoring wells shall be located within or immediately adjacent to the *soil treatment area*.

2) A system serving a *development* expected to generate more than 5.7 m^3 (1,250 Imp. gal.) in peak daily *wastewater* flow shall include

Vertical Separation Monitoring wells. These shallow monitoring wells are extended to a depth below the effluent infiltration surface that is slightly below the required vertical separation needed for the system design. These wells need to be monitored to ensure groundwater mounding does not compromise the required vertical separation needed for effective treatment. See pg. 252 for illustration.

These monitoring wells should be located where they will be most impacted by potential ground water mounding under the system.

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groundwater monitoring wells located to optimize the measurement of groundwater impact if the system is located over *GWUDI* which meets the criteria of a *domestic use aquifer*.

3) A system serving a *development* expected to generate more than 9 m^3 (1,980 Imp. gal.) in peak daily *wastewater* flow shall include groundwater monitoring wells located to optimize the measurement of groundwater impact where a system is located within 2 km (1.25 miles) of a

a) lake,

b) river,

c) creek, or

d) stream.

4) The design shall include monitoring ports that can be used to monitor *effluent* ponding on the *soil infiltration surface* of a *soil*-based treatment system or on the surface of the treatment medium used in a system to improve *effluent* quality such as, but not limited to, a *treatment mound* or *sand filter*.

5) *Effluent* sampling ports or access shall be provided in locations as required by the design to confirm that treatment and operational objectives are achieved prior to application to the *soil infiltration surface*.

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Groundwater Monitoring Well. A large volume system or multi lot development, located in an area where it may impact GWUDI, is of concern regarding potential impact on the groundwater quality. The impact must be measured.

See Definition of GWUDI in Article 1.1.5.2 on pg. 7. Essentially a GWUDI is an aquifer that is not protected from surface infiltration water or wastewater effluent by an impermeable layer in the geologic formations above the useable aquifer.

Large systems located near surface waters are likely to have an impact on the surface water quality. The monitoring wells enable testing of the ground water impact and subsequent impact on the nearby surface water from the effluent introduced into the near-surface groundwater.

Infiltration Surface Monitoring Ports. These monitoring ports provide the ability to assess the ponding depth that may occur on the soil infiltrative surface the effluent is applied over. It is information that can be critical to identifying arising problems with the capacity of the soil infiltration system so adjustments to the system can be made before large scale failure occurs. See pg. 364 for a graphic example of these ports

Effluent Sampling Ports. Effluent sampling in a large system should be an ongoing monitoring function of assessing the system performance and so a suitable sampling location needs to be provided.

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2.4.2. System Controls and Monitoring: System Flow Greater than 5.7 Cubic Metres per Day — Prescriptive Requirements and Installation Standards

2.4.2.1. Application

1) Subsection 2.4.2. applies to all *on-site wastewater treatment systems* where the estimated peak *wastewater* flow from the *development* is greater than 5.7 m^3 (1,250 Imp. gal.) per day.

5.7 cubic meters is equivalent to 1,250 imp or 1500 U.S gallons per day.

An 11 bedroom home is less than 5.7 cubic meters per day.

2.4.2.2. Installation

1) System controls and alarm devices shall be installed in compliance with the Canadian Electrical Code Part 1and provincial electrical regulations

All electrical components and systems of the wastewater treatment system are regulated under the electrical codes adopted in the province. The requirements of the electrical system are outside the scope of this standard.

2.4.2.3. Protection from Harmful Vapours

1) System controls, alarm devices, and electrical connections shall not be located in any space that communicates directly with the *wastewater*, gases, or vapours generated from the *wastewater*, unless the system control or alarm device is specifically designed for installation in the corrosive and high-moisture environment.

The atmosphere in the wastewater system is quite corrosive. The material used must be protected from that atmosphere and be made from materials that will withstand the environment. The atmosphere above the water line is corrosive to steel, brass and copper.

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2.4.2.4. Pump Control Redundant Off

1) The *on-site wastewater treatment system* shall be equipped with a redundant-off water level controller for the pump that prevents the pump from running in the event of a failure of the main-off water level control or inadvertent operation of the pump in the manual-on setting.

This is to protect against pump failure if the pump on manual switch is inadvertently left in the on position.

Most systems with the manual pump run switch are equipped with a switch that cannot be left in the on position; they utilize a spring loaded manual on switch.

2.4.3. System Controls and Monitoring: System Flow Greater than 5.7 Cubic Metres per Day — Requirements for Materials

2.4.3.1. Certification of System Controls and Alarm Devices

1) System controls and alarm devices shall be *certified* to the applicable electrical equipment standards and comply with the Canadian Electrical Code Part 1 and provincial electrical regulations.

In addition to using components certified to electrical standards, the component must be designed for the intended use in a sewage system as required in Article 2.1.3.1.

Section 2.5. Piping

2.5.1. Piping — Objectives and Design Standards

2.5.1.1. Leaking

1) Piping shall not leak except where intended in the design.

In some instances, e.g., weeping lateral piping or pressure effluent distribution laterals, piping is intentionally designed to enable effluent to discharge from the pipe. If not intended to discharge effluent such as in these intended circumstances, the piping shall not leak.

2.5.1.2. Freezing

1) The system design shall prevent the freezing of liquids in the piping.

Burial of the piping and grading to ensure drainage are the common ways to protect from freezing. In some cases a frost box may be required around the pipe to prevent freezing. See pg. **254** for examples of frost boxes. Frost boxes may be needed where there is a likely hood of a trickle flow or where water does not fully drain from the piping.

2.5.1.3. Grading and Sizing

1) Piping shall be graded and sized to accommodate the designed flow of *wastewater* or *effluent* and the drainage of piping when required to prevent freezing.[1]

[1] *Intent: Sentence (1) — Gravity piping must maintain a grade required for the flow volume and drain completely. Pressure piping must maintain sufficient grade to drain when required to prevent freezing. Pressure distribution piping shall be of sufficient size to deliver the required volume at the required pressure. Tables A.1.C.1., A.1.C.2., A.1.C.3., and A.1.C.4. in Appendix A may be used for sizing of pressure distribution piping, manifolds and supply piping at the required pressure head loss.*

The A.1.C series of tables on pg. **201** provides information on pipe sizing for various flow volumes.

2.5.1.4. Supports

1) Piping shall be sufficiently supported to

a) prevent sagging,

b) withstand expected mechanical forces, and

c) withstand forces resulting from the movement of liquid in the system.

Buried piping is to be supported continuously on compacted earth to prevent settling. Piping that is not buried typically requires support at not more than 1.2m (4 ft) intervals.

2.5.1.5. Design Pressure Rating

1) Piping shall be approved for a pressure rating of at least 1.5 times the maximum pressure it may be subjected to by the system design.

Sewer piping is not rated for pressure applications. Any pressure application must use piping certified for pressure applications. See Article 2.5.3.1.

2.5.2. Piping — Prescriptive Requirements and Installation Standards

2.5.2.1. Sewer Line Supports

1) *Effluent sewers* and *distribution header* piping shall be evenly and continuously supported.

These are buried gravity drainage pipes.

2.5.2.2. Distribution Header Supports

1) A d*istribution header* serving *weeping lateral trenches* at different elevations shall be evenly and continuously supported on a bed of undisturbed or tightly compacted earth between trenches to adequately support the piping and prevent migration of *effluent* to a lower lateral.[1]

[1] *Intent: Sentence (1) — The intent of this Sentence is to both support the pipe and to prevent the migration of effluent through the ground from a weeping lateral trench at a higher elevation into another weeping lateral trench at a lower elevation.*

It is important to ensure the piping of a sloped distribution header is on well compacted, in situ soil between trenches as opposed to using gravel. Gravel may allow the movement of the effluent along the pipe trench to lower weeping lateral trenches.

2.5.2.3. Protection from Freezing

1) A *building sewer* or *effluent sewer* having less than 1200 mm (4 ft.) of *soil* cover where it crosses under a ditch, driveway or path shall be protected from freezing by a

A building sewer or effluent sewer is subject to small trickling flows that are more likely to freeze. Piping must be adequately protected from freezing conditions. See Appendix B pg. **254** for illustrations of frost boxes.

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frost box, culvert, or other equivalent means.

2.5.2.4. Sizing

1) *Effluent sewer* piping shall not be smaller than 75 mm (3 in.) in pipe *size*.

2.5.2.5. Grading

1) A 100 mm (4 in.) *building sewer* or *effluent sewer* shall have a minimum *grade* of 1% (⅛ inch per foot).

2) A 75 mm (3 in.) *building sewer* or *effluent sewer* shall have a minimum *grade* of 2% (¼ inch per foot).

2.5.2.6. Backfill

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

[1] *Intent: Sentence (1) — To prevent damage to the pipe during and after backfill.*

2.5.2.7. Piping Connections to Tank

1) Piping connections to any tank or vessel used in the treatment systems shall be water-tight, flexible connections that will prevent *infiltration* and exfiltration and continue to provide a water-tight connection in the event the tank or piping shifts.

Piping connections to tanks are subject to movement and must be made with a connection that is flexible so any movement will not cause a leak in the joint.

2) Piping connected to any tank or vessel shall be supported to within 300 mm (1 ft.) of the tank outlet or inlet on a solid *soil* base, or equivalent bridging provided.[1]

[1] *Intent: Sentence (2) — The inlet and outlet piping connected to a tank must be protected from distortion caused by settling of the backfill material. The excavation for a tank should not be any longer than is necessary to install the tank. This provides undisturbed earth closer to the tank to support the inlet and outlet piping connected to the tank. A pipe with a greater*

Carefully planning the excavation for tanks can minimize the amount of piping not on undisturbed earth. Ensure the excavation is safe. Bridging to support the piping is often needed. See Appendix B pg. 358 for illustrations.

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wall thickness provides an added factor of safety.

2.5.2.8. Gravity Drainage Piping Connection

1) Gravity drainage piping connected to a tank shall be *DWV pipe* or piping of equivalent structural strength for at least 1800 mm (6 ft.) from the tank.[1]

[1] Intent: Sentence (1) — The inlet and outlet piping connected to a tank are subject to distortion caused by settling of the tank and the excavation around the tank. Heavy wall pipe and close excavation to minimize the distance to undisturbed earth provide an added element of safety.

DWV piping is the heavy walled sewer piping. It has much greater structural strength to resist bowing and crushing from the settling that occurs in the backfill around the tank. The DWV piping must be adequately supported and connected as described in Article 2.5.2.7.

2.5.3. Piping — Requirements for Materials

2.5.3.1. Piping in Pressure Applications

1) The piping used in a pressure application shall be *certified* to one of the following standards:[1]

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), or
- **ii)** CAN/CSA-B137.3, “Rigid Polyvinyl Chloride (PVC) Pipe for Pressure Applications,”

b) for pressure *effluent* distribution lateral pipe:
- **i)** CAN/CSA-B137.3, “Rigid Polyvinyl Chloride (PVC) Pipe for Pressure Applications,” or
- **ii)** CAN/CSA-B137.6, “CPVC Pipe, Tubing and Fittings for Hot and

A pressure application is any piping downstream of a pump. Piping used in a pressurized piping system must be certified for pressure applications.

DWV(Drain, Waste and Vent) ABS and PVC piping is not rated for pressure applications; it is rated for gravity applications only.

Rigid piping is required for pressure distribution laterals as it must be supported a minimum of 100 mm (4 in.) above the infiltration surface, and not have sags in the piping that hold effluent that would freeze between dosing events.

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Cold Water Distribution Systems," or

c) pipe deemed acceptable to the *administrator* for the intended application.

[1] Note: Sentence (1) — Table A.5.A. lists piping and its acceptable applications.

2.5.3.2. Piping in Gravity Applications

1) The piping used for an *effluent sewer*, or gravity *distribution header*, shall be *certified* to one of the following standards:

a) CAN/CSA-B181.1, "ABS Drain, Waste, and Vent Pipe and Pipe Fittings,"

b) CAN/CSA-B181.2, "PVC Drain, Waste, and Vent Pipe and Pipe Fittings,"

c) CAN/CSA-B182.1, "Plastic Drain and Sewer Pipe and Pipe Fittings," or

d) CAN/CSA-B182.2, "PVC Sewer Pipe and Fittings, (PSM Type)."

2) Where there is no existing standard for the intended use of a piping material, piping use shall comply with Table A.5.A., "Piping Materials."

The piping in (a) and (b) of this Article are DWV piping for gravity applications.

The piping in (c) and (d) of this Article are thin wall sewer pipe which cannot be used within 6 feet of a connection to a tank.

Table A.5.A pg. **220** provides a listing of suitable uses of various types of piping.

2.5.3.3. Joints

1) 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.

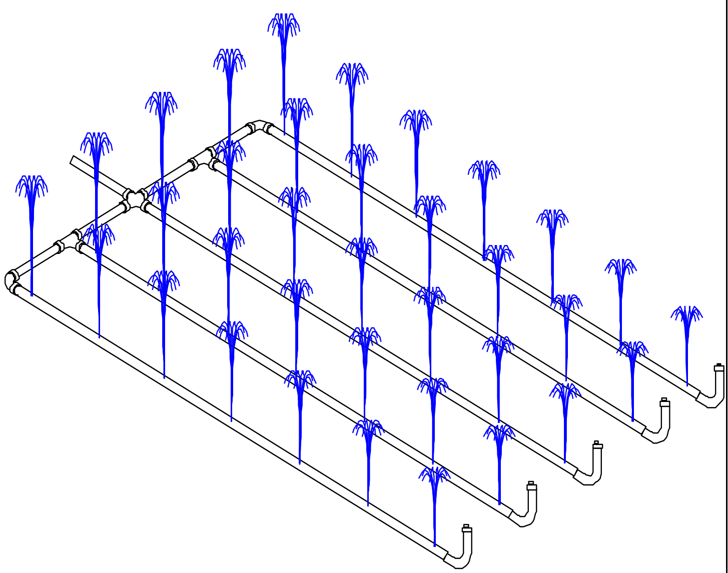
Piping and fittings should be of the same material for proper joints. In some cases, a transition from one material to another must be made. If materials are different, some suitable transition glues are available, a mechanical style joint may be used, or a threaded joint is used. Use fittings and joining materials intended for the piping.

Section 2.6. Pressure Distribution of Effluent

2.6.1. Pressure Distribution — Objectives and Design Requirements

2.6.1.1. General

1) A pressure distribution system shall be designed to provide positive control of the volume of *effluent* delivered to the treatment component as determined by the design loading rate.



Pressure distribution of the effluent over the infiltration surface ensures the entire available soil infiltration surface is used equally for the treatment and dispersal of the effluent into the soil.

Pressure effluent distribution systems include pressure piping along the entire length of the soil infiltration surface.

A system that uses pressure only to the start of a weeping lateral trench and then relies on gravity to move the effluent over the length of the trench is not considered an effluent pressure distribution system.

See Appendix B pg. **255** for more information on Pressure Distribution Lateral Systems and additional graphics.

Certain system designs set out in this standard require a pressure distribution system is used.

Pressure effluent distribution is required for:

- Application of secondary treated effluent – Article 8.1.1.8 pg. **135**.
- Raised Treatment fields – Article 8.2.2.11 sentence 1 clause c) pg. **154**.
- Treatment Mounds – Article 8.4.1.11 pg. **169**.

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2.6.1.2. Orifice Discharge Volume

1) The volume of *effluent* discharged through any orifice in the *distribution lateral pipe* system as measured over the duration of a single dosing cycle shall not vary by more than[1]

a) 10 percent along the length of a single distribution lateral pipe, and

b) 15 percent between all orifices in the system, unless specifically designed for in the system to accommodate variations in *soil* conditions.

[1] *Note: Sentence (1) — When using pressure distribution laterals, the volume discharged from each orifice should not differ by more than the percentage set out in Clauses (a) and (b) except where varying soil conditions dictate that the loading rate needs to differ within the system. This may occur where soil conditions vary over the soil infiltration area. When determining the volume discharged from a single orifice the differences in head pressure at the orifice and differences in the length of time effluent is discharged from each orifice requires consideration. In pressure delivery systems where the system supplies effluent to laterals of different lengths and relies on gravity to distribute effluent along the length of the trench it may be necessary to vary the volume discharged at the outlet to each trench to match the desired loading rate.*

This requirement focuses on the volume discharged during a dose event. Simply measuring evenness of the residual squirt height does not confirm this objective is met.

To confirm this objective is met, the squirt test should include collecting all the water discharged during a single dose event from the orifice that will get the water first and the orifice that the water squirts from last. The amount of water collected from each should not differ more than allowed by this Article.

The note with this Article includes important further information.

Long distribution laterals and distribution laterals at different elevations present difficulty to achieve even distribution. See pg. **270** for graphic illustration of problems created on sloped sites.

2.6.1.3. Effluent Pressure Distribution Lateral Objective

1) When *secondary treated effluent* is applied to the *soil* interface, the design and/or spacing of the orifices shall be such that the *effluent* is spread over the *soil* interface in a manner that results in a *soil* moisture content that does not vary by more than 20% over the entire *soil* interface area, as measured at a depth of 75–175 mm (3–7

An effective pressure distribution system will utilize the entire soil infiltration surface equally. Measuring the soil moisture in various locations of the infiltration surface can quantify the objective has been met. See Appendix B pg. **255** for more information on this objective.

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in.) below the *soil* interface.

2) The requirements of Sentence (1) do not apply when the pressure distribution system is designed as a pressure *distribution header* to supply gravity distribution *weeping lateral trenches* receiving *primary treated effluent level 1* doses.

2.6.1.4. Orifices Elevated Above Infiltration Surface

1) *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.

2.6.1.5. Pressure Distribution Lateral System Design

1) The design of a *pressure distribution lateral pipe* system shall

a) determine the *pressure head* and flow rate the pump supplying the system must be capable of by considering

i) static lift measured from the minimum *effluent* level in the dosing tank to the elevation of the perforated distribution piping,

ii) *pressure head* required at the orifices,

iii) volume discharged from orifices, and

iv) head loss resulting from piping at the calculated design flows using a Hazen Williams coefficient of smoothness determined for the type of piping used in the system,[1]

b) maintain a flow velocity in the piping of not less than 0.6 m/s (2 ft/s) except in

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A pressure distribution header without pressure effluent distribution laterals does not meet the requirements of a pressure distribution lateral system required for various system designs set out in this standard. See Appendix B pg. **320** for a description of a pressure distribution through the header only and benefit of this design over a total gravity system.

The elevated orifices help prevent the drain back of effluent in the trenches when periodic ponding occurs in the trench. Drain back of ponded effluent can cause rapid pump cycling and draw soil fines back into the piping and dose tank. Supports to elevate the piping should be spaced not more than 1.2m (4 ft.) apart to effectively prevent sagging of the pipe. A minimum elevation is specified above the infiltration surface in Article 2.6.2.6.

Appendix B pg. **257** provides direction on a design process that includes these design requirements and additional information on the purpose and intent of the requirements.

This standard includes numerous tables to help simplify some of the complicated friction loss calculations required. See the A.1.C series of tables, pg. **201**, for friction loss in piping.

The purpose of this minimum flow velocity is to minimize the buildup of biological growth in the piping. The A.1.C series of friction loss tables include two heavy black lines. The upper line indicating flow of 2 ft. per second and the lower line indicating 5 ft. per second flow rates.

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an *effluent distribution lateral pipe* this minimum velocity is required only at the supply end of the *effluent distribution lateral pipe*,[2]

c) maintain a flow velocity in the piping that does not exceed 1.5 m/s (5 ft/s) where the system includes any quick closing valves,

d) maintain a minimum *pressure head* of
   - **i)** 1.5 m (5 ft.) at all orifices that are 4.8 mm (3/16 in.) or less in diame*ter*, and
   - **ii)** 0.6 m (2 ft.) when orifices are larger than 4.8 mm (3/16 in.) in *diameter*,

e) use orifices in the lateral that are not smaller than 3.2 mm (1/8 in.) in *diameter*, and
   - **i)** spaced at a distance required to achieve the objectives of even distribution and in no case more than 1.5 m (5 ft.) apart,

f) be capable of delivering a dose volume that is equal to or less than the volume per dose required by the downstream system design,[3]

g) result in a *distribution lateral pipe* volume that is less than 20% of an individual dose volume,

h) include an *effluent* filter that prevents particles 3 mm (1/8 in.) in *diameter* or larger from being discharged into the *effluent* distribution system, and

i) include piping arrangements that result in components of the system being readily accessible from the ground surface to carry out the
   - **i)** flushing and cleaning of the individual laterals at the most downstream end of the lateral,
   - **ii)** checking of residual *pressure head* at both the supply end and most downstream end of the lateral, and

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High flow velocity in piping can result in extremely high pressures if it is suddenly stopped by a quick closing valve. If no quick closing valve is downstream of the pump the 5 ft. per second velocity can be exceeded.

Smaller orifices need more pressure at the orifice to minimize the chance of plugging from biological growth films that break loose from the piping and reach the orifice.

Maximum spacing of orifices is 1.5m (5 ft.) however for secondary treated effluent the maximum spacing is 0.9m (3 ft.). See Article 2.6.2.2 (1) (c) (ii)

Minimizing the pressure distribution lateral piping size will reduce the volume in the piping. The limit of 20% of the dose volume is to help ensure even distribution of the effluent.

The filter upstream of a pressure distribution lateral system must have an effective opening size of less than 3 mm (1/8 in.) to prevent orifice plugging.

The ends of the effluent pressure distribution laterals need to be accessible from ground surface for flushing and to check the head pressure at that point. See Appendix B pg. **369** for a drawing of this detail.

See pg. **359** for piping arrangements and control mounting to facilitate maintenance.

iii) regular maintenance and servicing of filters, pumps, and valves without requiring physical entry into a tank.

[1] Note: Subclause (1)(a)(iv) — Pipe friction loss tables can be found in Appendix A. These tables can be used to determine the size of main effluent supply piping and distribution headers. In large or complex systems where laterals are at different elevations, specific engineering of the system design may be required.

[2] Intent: Clause (1)(b) — the size of the effluent distribution pipe should be selected to maintain the required velocity while not exceeding pressure loss limits along the lateral.

[3] Intent: Clause (1)(f) — Numerous light applications of effluent provide better treatment conditions. The individual doses should be evenly spaced over a 24-hour day to further improve treatment.

2.6.2. Pressure Distribution — Prescriptive Requirements and Installation Standards

2.6.2.1. Design

1) A pressurized *distribution lateral pipe* system shall have

a) distribution lateral piping not smaller than 19 mm (3⁄4 in.) in diameter,

b) distribution lateral pipe of a size determined by Table A.1.A. for the required size and number of orifices or by using good engineering practice that achieves the objectives of a pressure distribution lateral pipe system design for achieving treatment goals, and

c) a distribution lateral pipe for each chamber assembly where chambers are used.

2.6.2.2. Orifices

1) Orifices in a *distribution lateral pipe* shall

a) point upwards and not form an angle greater than 45° with the vertical, except when[1]

i) required for pipe drainage, the number of orifices required for effective drainage may point downward if equipped with suitable orifice shields, or

ii) the lateral is encased in *drain media* all orifices may point downward,

b) be equipped with orifice shields to prevent blocking of the orifice when encased in *drain media*,

c) be spaced at a distance of not greater than

i) 1.5 m (5 ft.) when distributing *primary treated effluent level 1*,

ii) 900 mm (36 in.) when distributing *secondary treated effluent*, or

iii) the distance specified when using an approved distribution method that has been tested to meet the objectives of Article 2.6.1.3., and

d) not exceed the maximum number of orifices specified for the pipe *size* as set out in Table A.1.A.

[1] *Intent: Clause (1)(a) — Locating the orifice on the upper half of the pipe can help prevent clogging of the orifice from accumulated biological growths. Wherever the orifices are located, the orifices must be protected from rocks setting on the orifice and there must be room for the effluent to escape. The spraying effluent must not cause any erosion of the soil or sand around it.*

Table A.1.A. pg. **195** sets out the size of pressure distribution lateral required to minimize the difference in squirt height from the supply end of the lateral to the end furthest from the supply. Also see pg. **259** for a graphic of how to use these tables.

Orifices that are in the top of the pipe are not as likely to plug as one in the bottom of the pipe. When used in chambers, pointing the orifice up helps spread the spray and does not result in a concentrated spray on the soil interface. Any orifice that points down must be equipped with an orifice shield and all orifices encased in drain media (gravel) must be equipped with an orifice shield to ensure the orifice is not blocked by the drain media.

Closer spacing of orifices at 3 feet apart when applying secondary treated effluent is required, as compared to the maximum 1.5m (5 ft.) allowed for primary treated effluent, because secondary treated effluent results in very limited biomat formation as compared to the amount of biomat that forms when primary treated effluent is applied. The thicker biomat formed when primary treated effluent is applied limits the rate at which effluent enters the soil. This helps spread the effluent preventing localized saturated flow in the soil below.

The limited biomat formation occurring when secondary effluent is applied can allow saturated localized flow, if the orifices are not spaced close together.

Table A.1.A. on pg. **195** considers the friction loss in the pipe, the number of orifices along its length, and the diameter of the orifice to enable a distribution lateral selection resulting in a flow rate in L/minute (GPM) from each orifice does not vary by more than 10% along its length.

The head loss along a lateral may vary a maximum of 20% which results in not more that a 10% variation in the flow rate from the orifices.

2.6.2.3. Dose Volume 5 Times Pipe Volume

1) The volume of an individual dose to be distributed over the *soil infiltration surface* area using a pressure distribution lateral system shall be at least 5 times the volume of the *distribution lateral pipe* but shall not exceed the maximum individual dose volume needed to deliver the required number of doses per day.

2.6.2.4. Lateral Length

1) An individual pressure *distribution lateral pipe*, as measured from the pressure distribution supply header to the last orifice, shall not exceed 20 m (65 ft.) in length.

2.6.2.5. Pressure Head at Orifices

1) The system design shall ensure a *pressure head* of not less than

a) 1.5 m (5 ft.) at orifices that are 4.8 mm (3/16 in.) *diameter* or smaller, and

b) 600 mm (2 ft.) at orifices larger than 4.8 mm (3/16 in.) *diameter*.

2.6.2.6. Orifices Elevated Above Infiltration Surface

1) Where the *effluent* distribution system is designed to enable drain back of the *distribution lateral piping* to the dosing tank, the piping shall be installed so that each orifice opening is a minimum of 100 mm (4 in.) above the *soil infiltration surface*.[1]

[1] *Intent: Sentence (1) — The elevation above the infiltrative surface should be maximized. The orifices in the piping must be above the soil infiltration surface an adequate distance to prevent drain back into the system if intermittent ponding were to occur on the soil infiltration surface.*

Requiring the volume of the individual dose to be more than 5 times the volume of the pressure effluent distribution laterals minimizes the difference in the volume discharged per orifice across the system. A small dose volume that may only fill twice the volume of piping can result in a substantial difference between the volume discharge from the first orifice and last orifice to receive effluent. When the dose is larger, at least 5 times the volume of the piping, the delay in time between the discharge from orifices will still be the same but becomes less significant to the overall variation in the volume discharged during the entire dose event.

Minimizing the pipe size and thus the volume in the piping allows the system to meet this design requirement while maximizing the number of doses applied per day. More small doses per day as opposed to one large dose maximizes treatment. This design consideration enables the system to deliver an individual dose volume that is not more than 20% of the total daily flow so that the system provides a minimum of 5 doses per day over the entire infiltration surface such as required in Article 8.4.1.10.

Minimizing the length of pressure distribution lateral from supply point at the header to the far end helps minimize the delay in time between the first orifice squirting and the last orifice squirting and thus the difference in volume discharged from the first to last orifice which cannot exceed 10% as required in Article 2.6.1.2.(1)(a).

The pressure head at the orifice may be as little as 600mm (2 ft.) if larger orifices are used as specified in this article. However using larger orifices discharges more effluent and may substantially increase pump requirements and piping sizes needed.

To enable drain back of the effluent into the dose tank, which is often done to prevent

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2.6.2.7. Piping Supports

1) *Distribution lateral piping* that is not encased in media shall be supported at intervals of 1.2 m (4 ft.) or less, unless specified otherwise by the pipe manufacturer.

2.6.3. Pressure Distribution — Requirements for Materials

2.6.3.1. Piping

1) Piping used in a pressure *distribution lateral pipe* system shall meet the requirements of Section 2.5.

2.6.3.2. Effluent Filters and Service Access

1) Filters used in a pressure *distribution lateral pipe* system must

a) be suitable for *wastewater* applications,

b) provide filtration to less than 3.2 mm (1⁄8 in.) particle size,

c) be sized for the required flow rate of the system design and to provide a service interval frequency desired for the system, and

d) be located and installed so they are readily accessible from ground surface for servicing

2.6.3.3. Pumps

1) Pumps used in a pressure *distribution lateral pipe* system must be suitable for *wastewater* applications and able to produce the volume of *effluent* at the *pressure head* required by the system design.

freezing of water filled piping, a small 6.4 mm to 9.6 mm (1/4 to 3/8 in.) hole is often drilled in the lowest part of the effluent discharge pipe in the effluent dose tank. This will result in an additional volume discharging from the piping and may add 2 to 3 gallons per minute to the required pump capacity, depending on the head pressure put out by the pump. See pg. 261 for a table setting out discharge rates from orifices at high pressure heads.

Most pipe manufacturers require supports at no more than 4 foot spacing for the type of rigid pipe required for this pressure application.

Careful consideration of the filter selected for this purpose is needed. It must effectively remove particles to less than 3.2 mm in size, provide effective service intervals and, if located downstream of the pump, the head loss through the filter must be considered in pumping requirements.

Pumps should be selected so that they are working in the middle third of the pump curve to ensure long life of the pump.

The selected pump should also exceed the calculated pressure head and volume requirement to account for wear over the life of the pump and unanticipated friction loss in the calculations.

Part 3 Holding Tanks

Section 3.1. Holding Tanks

3.1.1. Holding Tanks — Objectives and Design Standards

3.1.1.1. Storage Capacity

1) A *holding tank* serving a detached single family *dwelling* shall have a storage capacity of not less than 4,500 L (1,000 Imp. gal).[1]

[1] *Intent: Sentence (1) - It is not the intent of this Standard to exclude the use of a septic tank as a holding tank provided the requirements of the Standard are met regarding holding tanks. The capacity of the holding tank should be large enough to make effective use of trucking service and provide a reserve volume for the owner*

2) A *holding tank* for *developments* other than a detached single family *dwelling* shall have a storage capacity suitable for the intended service.

This minimum capacity of a holding tank applies specifically, and only, to detached single family dwellings. This minimum capacity would be suitable only for very low occupancy homes. For other types of development see Sentence (2) of this article for sizing requirements. While this is a minimum, the appropriate capacity of the tank will consider water use, trucking capacity and frequency desired for pumping of the tank. Operational costs of a holding tank are a significant factor that determines the appropriate capacity.

3.1.1.2. Infiltration/ Exfiltration Prevention

1) *Holding tank* access openings, manhole extensions, and piping connections shall prevent *infiltration* and exfiltration.

2) Where the site evaluation identifies high ground water conditions at the location and elevation the tank is installed, the design of the system shall address

a) anti-flotation measures required,

b) the ability of the tank to withstand structural stresses caused by the hydrostatic pressure and buoyancy, and

Infiltration of groundwater into a tank can substantially increase the amount of sewage that needs to be hauled away. Even though the tank may not be installed in a water table, the excavation for the tank may act as a water collector and so cause infiltration into the tank if not properly installed.

It is particularly important to ensure a holding tank can withstand the pressures of water surrounding it as it is repeatedly filled and emptied. Special precautions are needed to prevent the stresses from fracturing or deforming the tank or causing it to pop out of the ground due to the buoyant forces on the tank.

c) maintaining the elevation of piping connections above the projected *water table* or include other specific additional measures to ensure *infiltration* does not occur through piping connections or manhole access risers.

The manufacturer of the tank needs to be consulted and confirm the tanks suitability to the condition it is installed in.

3.1.2. Holding Tanks — General — Prescriptive Requirements and Installation Standards

3.1.2.1. Separation Distances

1) *Holding tanks* shall not be located within

a) 10 m (33 ft.) from a *water source*,

b) 10 m (33 ft.) from a water course,

c) 1 m (3.25 ft.) from a property line, and

d) 1 m (3.25 ft.) from a building.

3.1.2.2. Service Access

1) *Holding tank* manhole access openings may be buried but access openings for waste removal shall be brought above ground and shall be located at a height above the surrounding landscape that ensures surface water will drain away from the access openings.[1]

[1] *Intent: Sentence (1) — Access openings above the ground provide readily available access to the tank as compared to buried access openings, particularly when the ground is frozen. The manhole access may be buried if wastewater removal pipes are provided for above ground access.*

2) A *holding tank* shall be located and installed to accommodate the regular removal of *wastewater* by vacuum truck or other approved means.[1]

In addition to openings for the removal of the sewage, a vent or other means that allows air into the tank when it is being pumped is needed.

It is advisable that the manhole access be brought above grade to enable periodic inspection of the tank condition and enable effective cleaning if difficult to remove solids collect in the tank.

[1] *Intent: Sentence (2) — Holding tanks are meant to hold a volume of wastewater and facilitate the removal of wastewater for treatment in a municipal lagoon or other suitable location.*

3.1.2.3. Access Opening Lid/ Cover

1) All access openings shall be equipped with a secure lid or cover.[1]

[1] *Intent: Sentence (1) — To increase safety by preventing unauthorized or accidental entry into the access opening of a septic tank or holding tank. Acceptable protective measures include, but are not limited to, a padlock, a cover that can only be removed with tools, or a cover having a minimum weight of 29.5 kg (65 lb).*

2) The opening of a manhole access that extends above ground shall be insulated to an equivalent R-8 insulation value to protect the tank contents from freezing.

It is imperative that the lid or cover of the manhole access opening be secure to prevent anyone from accidentally falling into a tank. Once fallen into a tank it is essentially impossible to get out without help. This securing of the access lid must be provided at time of installation and is an ongoing responsibility of the owner to ensure it remains secure.

During periods of time the occupants are away on a holiday for a number of days or in time of very low flow the tank is much more susceptible to freezing without this insulated lid.

3.1.2.4. Base for Holding Tank

1) The bottom of an excavation for a *holding tank* shall provide a uniform base to support the tank in a level position and meet the manufacturer's installation instructions.[1]

[1] *Intent: Sentence (1)- — A tank must have a stable base so it will not settle, shift, or crack after installation.*

A solid base for any tank is imperative for its effective operation and to maintain its integrity so it does not crack and leak. See Appendix B pg. **358** for illustrations on a solid base for the tank.

3.1.2.5. Insulation of Tank

1) A *holding tank* that has less than 1.2 m (4 ft.) of earth cover to protect it from freezing conditions shall be insulated to provide the equivalent of an R-8 insulation value at the top and sides of the tank to a minimum depth of 1.2 m (4 ft.) below grade or insulated in some other acceptable manner to achieve a level of protection from freezing that is equivalent to a tank that has a minimum 1.2 m (4 ft.) cover of the in situ *soil*.

The insulation used for this purpose must be suitable for underground use. Fiberglass batting types of insulation will hold water and freeze solid – providing no insulation value – and should not be used outdoors in an underground application. Insulation suitable for below ground use is required. Rigid Extruded Expanded Polystyrene (XEPS) Foam Board is rated at approx R5 – R6 per inch of thickness but this will vary by type and manufacturer.

This website provides additional information on rigid insulation: http://www.espenergy.com/foam_board_insulation.htm.

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3.1.3. Holding Tanks — General — Requirements for Materials

3.1.3.1. General

1) A *holding tank* shall be approved equipment that is *certified* by an accredited testing agency as meeting or exceeding the requirements of CAN/CSA-B66, "Design, Material, and Manufacturing Requirements for Prefabricated Septic Tanks and Sewage Holding Tanks."

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A certified holding tank will have a label permanently affixed to the tank showing the standard it was certified to and the name of the certifying body. It must indicate it was certified to the CAN/CSA-B66 standard. See Appendix B pg. **236** for more information on certification of products and expected labeling.

Part 4 Initial Treatment Components Primary

Section 4.1. Primary Treatment

4.1.1. Primary Treatment — Objectives and Design Standards

4.1.1.1. Effluent Treatment Quality

1) Except as permitted in Sentence (2), an initial treatment component intended to provide *primary treatment* of the *wastewater* prior to discharge to a *soil*-based final treatment component shall, 80% of the time, produce a *primary treated effluent level 1* having a strength that does not exceed any of the following concentrations:

a) $CBOD_5$: 150 mg/L,

b) *TSS*: 100 mg/L, and

c) oil and grease: 15 mg/L.

This is the effluent quality expected from a septic tank when the septic tank is operating effectively and the strength of the raw wastewater entering the septic tank does not exceed the limits set out in this standard. See Article 2.2.2.1 for the anticipated strength of raw wastewater.

2) The *effluent* discharged from a *primary treatment* component to a downstream *soil*-based component may be of a stronger *effluent* strength than set out in Sentence (1) if the design of downstream treatment component has been based on receiving that higher strength *effluent*.

Effluent loading rates set out in this standard for Primary treated level one effluent rely on this quality of effluent being applied. See Table 8.1.1.10 for effluent loading rates. Higher strength effluent may cause a premature failure of the soil based treatment and infiltration system due to excessive biomat formation on the infiltrative surface.

4.1.1.2. Sludge and Scum Accumulation

1) A *primary treatment* tank (*septic tank*) shall include the capacity to store accumulating sludge and scum for a minimum 3-year period without reducing the hydraulic retention capacity to less than the design daily peak flow.[1]

[1] *Note: Sentence (1) — This does not set the standard of tank pumping interval at three years. The tank must be regularly inspected (yearly is a good target) to determine sludge depth and pumped only when needed. Depending on actual use, the frequency may vary from one year to five. To minimize the amount of sludge trucked to outside treatment facilities the tank should only be pumped when needed.*

The capacity of the tank must be large enough to store sludge and scum as well as provide the desired retention time for settling and floating of particles in the wastewater.

Sludge and scum accumulation rates for residences are set out in Article 4.2.1.1.(1)(b)(i). For other types of development Table A.6.A on pg. **221** sets out sludge and scum accumulation rates.

Section 4.2. Septic Tanks

4.2.1. Septic Tanks — Objectives and Design Standards

4.2.1.1. Working Capacity

1) A *primary treatment* (septic) tank shall

a) have a minimum working capacity of not less than the expected daily peak wastewater volume determined under Section 2.2., and

b) include an additional capacity of not less than

i) 400 L (88 Imp. gal.) per expected occupant in a residential *development* to accommodate sludge and scum accumulation,[1] or

ii) an amount required for sludge accumulation following Table A.6.A. for other than residential occupancies.

[1] Note: Subclause (1)(b)(i) — The additional capacity of 400 L (88 Imp. gal.) per person to accommodate sludge and scum accumulation is based on the anticipated sludge and scum accumulation rate of 135 L (30 Imp. gal.) per person per year at a 95% confidence level for residential applications and a 3 year targeted pump out interval.

2) The amount of storage provided for sludge and scum accumulation shall be increased by 1.5 times when a garbage grinder is used unless that volume has already been included in the application of the requirements in Article 2.2.2.6.

4.2.1.2. Service Access

1) The system design shall consider the location and depth below grade of the *primary treatment* component (*septic tank*) to facilitate accessibility for septage removal, service, and maintenance.[1]

See Appendix B pg. **274** for more information on the required capacity of septic tanks. See pg. **274** and pg. **355** regarding types of septic tanks. See pg. **356** for illustration of septic tank configurations and inlet and outlet components.

Working capacity of the septic tank does not include the portion of the tank that is used for effluent dosing. See the definition of septic tank on pg. **15** for more clarity along with the graphic on pg. **272**.

In addition to having a capacity to store an amount of sewage equivalent to the peak daily flow, the tank must have the capacity to store the accumulating sludge and scum. The volume of sludge and scum set out in this Article is equivalent to 3 years accumulation.

The number of expected occupants used to determine sludge and scum storage capacity required of the tank is equal to the number of occupants expected per bedroom; that is also used to determine peak wastewater volume per day. The estimate of occupants for a residence is set out in Table 2.2.2.2.A pg. **44**.

The tank must be located where the vacuum truck can get reasonable access. The tank does not have to be right beside the building. See pg. **357** for illustration of locating the septic tank away from the building.

The available vacuum lift changes with the elevation above sea level. At Calgary's elevation, with 100 feet of hose attached, the limit is reached if the truck is parked about one story above the top of the tank. The vertical limit is about 27 feet when very little suction hose is needed. The lift distance is measured from the water level in the tank to the water level in the

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[1] *Intent: Sentence (1) — The tank should be located where it is unlikely a deck or other structure may be built over the tank or where access may be otherwise limited for removal of septage by a vacuum truck. The depth of the tank should not exceed the practical suction elevation of vacuum trucks in order to enable septage removal.*

4.2.1.3. Infiltration/ Exfiltration Prevention

1) Tank access openings, manhole extensions, and piping connections shall prevent *infiltration* and exfiltration of *wastewater* and groundwater.

2) Where the site evaluation identifies high ground water conditions at the location and elevation the tank is installed the design of the system shall address

a) anti-flotation measures required,

b) the ability of the tank to withstand structural stresses caused by the hydrostatic pressure and buoyancy, and

c) maintaining the elevation of piping connections above the projected *water table* or include other specific additional measures to ensure *infiltration* does not occur through piping connections or manhole access risers.

4.2.1.4. Insulation of Tank

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.

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truck's tank which rises as the truck fills.

Infiltration of groundwater into a septic tank can substantially increase the amount of water discharged to the soil based treatment system. Even though a septic tank may not be installed in a water table, the excavation for the tank may act as a water collector and so cause infiltration into the tank if not properly installed.

It is particularly important to ensure a septic tank can withstand the pressures of water surrounding it as the dose tank fills and empties or when the tank is pumped for cleaning. Special precautions are needed to prevent the stresses from fracturing or deforming the tank or causing it to pop out of the ground due to the buoyant forces on the tank.

The manufacturer of the tank needs to be consulted and confirm the tank's suitability to the condition it is installed in and acceptable anti-flotation methods suitable for the tank are used. In many cases a stronger tank must be used to withstand the structural forces encountered.

See Appendix B pg **273** for more information on the installation of tanks.

Article 4.2.2.6 provides specific direction regarding insulation of a septic tank.

4.2.2. Septic Tanks — Prescriptive Requirements and Installation Standards

4.2.2.1. Separation Distances

1) *Septic tanks* shall not be located within

a) 10 m (33 ft.) from a *water source*,

b) 10 m (33 ft.) from a *water course*,

c) 1 m (3.25 ft.) from a *property* line, and

d) 1 m (3.25 ft.) from a *building*.

4.2.2.2. Working Capacity

1) The *working capacity* of a *septic tank* shall not be less than

a) the volume set out in Table 4.2.2.2. for a single family dwelling or duplex, or

b) the volume required by Article 4.2.1.1.

Table 4.2.2.2. Working Capacity of Septic Tank

Number of Bedrooms	Working Capacity Volume
2 or 3 bedrooms	3,360 L (740 Imp. gal.)
4 bedrooms	4,260 L (940 Imp. gal.)
5 bedrooms	5,220 L (1,150 Imp. gal.)
6 bedrooms	6,130 L (1,350 Imp. gal.)

Note: Table 4.2.2.2. provides the working capacity volume required of the septic tank for residential applications where there are no conditions that require additional flow to be added to the peak daily volume.

The required volumes in Table 4.2.2.2 are slightly less than required by the calculation set out in Article 4.2.1.1 referenced in this article. This Article allows a choice of using Table 4.2.2.2 or applying the calculation set out in Article 4.2.1.1. This is made clear by using the word “or” between the clauses (a) and (b) of this article.

It is OK to use the lesser volume set out in Table 4.2.2.2 if the residence has no characteristics that required additional wastewater volume to be added as set out in Section 2.2 where wastewater volumes are determined.

See Appendix B pg. **274** for more information on required septic tank volume and types of septic tanks.

The effluent dose chamber volume is not included in the working capacity.

The required volume of the effluent dose chamber, whether integral to the septic tank or as a separate tank is determined based on the required effluent dose size.

More information on determining required working capacity of a septic tank and a larger image of the graphic displayed here is found in Appendix B pg. **271**.

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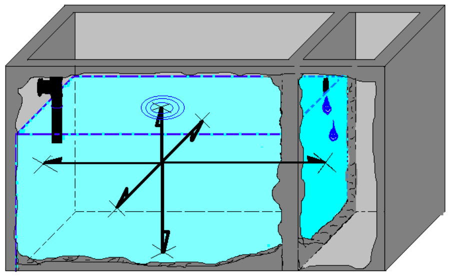

4.2.2.3. Septic Tank Manhole Access Not Buried

1) *Septic tank* access openings shall not be buried and shall be located at a height above the surrounding landscape that ensures surface water will drain away from the access opening.[1]

[1] *Intent: Sentence (1) — Access openings above the ground provide readily available access to the tank as compared to buried access openings, particularly when the ground is frozen. An above-ground access also encourages regular maintenance and provides a permanent and visible marker of the location of the tank.*

The manhole access opening to the septic tank must be at or above grade and the landscape must slope away from the access opening to prevent surface water runoff from entering the tank.

The intent set out in the note to this article is important. Lids must be secure at time of installation and at any time during operations as set out in Article 4.2.2.4.

4.2.2.4. Access Opening Lid/ Cover

1) All access openings shall be equipped with a secure, air-tight lid or cover.[1]

[1] *Intent: Sentence (1) — To increase safety by preventing unauthorized or accidental entry into the access opening of a septic tank or holding tank. Acceptable protective measures include, but are not limited to, a padlock, a cover that can only be removed with tools, or a cover having a minimum weight of 29.5 kg (65 lb). The lid or cover is air tight in order to contain the odour.*

2) All access openings shall be insulated to provide the equivalent of an R-8 insulation value.

Acceptable measures for ensuring a secure lid are described in the intent note to this article. The CSA certification standards for tanks require the lid be clearly marked with the word “Danger”.

Insulation of the access opening helps prevent freezing of the wastewater in the tank under no flow or very low flow conditions.

The requirement for an air tight lid does not require the lid to hold air pressure but needs to fit tight enough to minimize air movement into and out of the tank to minimize cold air entering the tank or odor from escaping.

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4.2.2.5. Access Opening Extensions Water-tight

1) Access opening extensions shall be installed to ensure a water-tight connection to the *septic tank* and at the joints between all sections of the extensions.

4.2.2.6. Insulation of Tank

1) A *septic tank* that has less than 1.2 m (4 ft.) of earth cover to protect it from freezing conditions shall be insulated to provide the equivalent of an 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 other acceptable manner to achieve a level of protection from freezing that is equivalent to a tank that has a minimum 1.2 m (4 ft.) cover of the in situ *soil*.

4.2.2.7. Base for Septic Tank

1) The bottom of an excavation for a *septic tank* shall provide a uniform base to support the tank in a level position and meet the manufacturer's installation instructions.[1]

[1] *Intent: Sentence (1) — A tank must have a stable base so it will not settle, shift, or crack after installation.*

Explanations & Related Articles

Access opening manhole extensions must be water tight to prevent water infiltration into the tank.

Installation strategies that help prevent a water tight manhole extension from being moved due to frost heave, causing leaks, include wrapping the manhole extension with a plastic; this prevents the ground from freezing directly to the manhole barrel, which would cause it to move as the ground heaves from frost.

The insulation used for this purpose must be suitable for underground use. Fiberglass batting types of insulation will hold water and freeze solid – providing no insulation value – and should not be used outdoors in an underground application. Insulation suitable for below ground use is required. Rigid Extruded Expanded Polystyrene (XEPS) Foam Board is rated at approx R5 – R6 per inch of thickness but this will vary by type and manufacturer.

This website provides additional information on rigid insulation: http://www.espenergy.com/foam_board_insulation.htm

A uniform stable base for the tank is critical to the long term success of the system.

See Appendix B pg. **358** for a graphic of tank excavations and support.

Standard of Practice | **Explanations & Related Articles**

4.2.3. Septic Tanks — Requirements for Materials

4.2.3.1. General

1) A *septic tank* shall be approved equipment that has been *certified* by an accredited testing agency as meeting or exceeding the requirements of CAN/CSA-B66, “Design, Material, and Manufacturing Requirements for Prefabricated Septic Tanks and Sewage Holding Tanks.”

A certified septic tank will have a label permanently affixed to the tank showing the standard it was certified to and the certifying body. It must indicate it was certified to the CAN/CSA-B66 standard. See Appendix B pg. 236 for more information on certification of products and expected labeling.

Part 5 Initial Treatment Components — Secondary Treatment

Section 5.1. Secondary Treatment

5.1.1. Secondary Treatment — Objectives and Design Standards

5.1.1.1. Secondary Effluent Treatment Qualities

1) Except as permitted in Sentence (2), an initial treatment component intended to produce *secondary treated effluent* shall, 80% of the time, produce an *effluent* quality that does not exceed the appropriate values set out in Table 5.1.1.1.[1]

[1] *Note: Sentence (1) — Level one treatment standard is equivalent to Primary Treatment. Thus, this table starts at Level 2.*

A treatment plant, sand filter or re-circulating gravel filter must treat the effluent to the quality set out for Secondary Treated Effluent level 2 or better to apply design criteria set out in this standard that requires level 2 treated effluent.

Additional treatment levels, such as Level 3, DII are required for drip dispersal systems when the drip dispersal piping is less than 200 mm (8 in.) below the surface. As table 5.1.1.1 sets out Level 3, DII effluent has maximum concentrations of:

- BOD_5 15 mg/L
- TSS 15 mg/L
- Fecal coliform 200 CFU/100 ML

Table 5.1.1.1. Secondary Treated Effluent

Treatment Type[2]	**Maximum Concentration**[1] **In Treated Effluent**				
	Basic Treatment Level		**Disinfection (D)**[3]	**Phosphorus Reduction (P)**	**Nitrogen Reductio n (N)**
	TSS, mg/l	CBOD5, mg/l	Fecal Coli, or *E. coli,* CFU/100 ml	Total Phosphorus, mg/l	Total Nitrogen
Level 2	30	25			
Level 3	15	15			
Level 4	10	10			
D-I			50 000		
D-II			200		
D-III			ND[4]		
P-I				1	
P-II				0.3	
N-I					50% Reduction
N-II					75% Reduction

[1] No tolerances apply to these requirements, because the given values take into consideration the inaccuracy of the measurement.

[2] A system's overall treatment classification is denoted by the applicable treatment types written in sequence, i.e. Level 2-DII-NI.

[3] Requirements for fecal coliform organisms or *E. coli* can be used for the purposes of Type D treatment. Reactivation after disinfection was not taken into consideration in establishing these requirements.

[4] ND = non-detectable (median < 10 CFU/100 ml).

2) The *effluent* produced by a secondary treatment component used in an *on-site wastewater treatment system* design may vary from the quality referred to in Sentence (1) if the design of the downstream treatment component is based on receiving *effluent* of a quality that the secondary treatment component will achieve 90 % of the time under the operating conditions.

In a high strength wastewater situation where the secondary effluent treatment levels may not be achieved, the capacity and sizing of the soil based treatment system can be increased to handle the quality of effluent applied. This will typically require the soil loading rates for primary treated effluent to be applied.

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Explanations & Related Articles

5.1.1.2. Wastewater Sampling Access

1) A secondary treatment component shall include sampling ports or a suitable location to obtain *wastewater* and *effluent* samples to confirm treatment performance and assess operation of the component.[1]

[1] *Intent: Sentence (1) — The system should include at least a sampling port to determine effluent quality and a sampling port for influent wastewater to assess system operation and facilitate trouble shooting of the treatment component.*

As the wastewater must be dosed to the soil based treatment and infiltration system a suitable location of the effluent sampling may be the effluent dose tank. However in some system designs the final disinfection for example may be in the pressure dosing pipe leaving the dose tank. In such a case a valved opening or other point of sampling will be required.

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Section 5.2. Packaged Sewage Treatment Plants

5.2.1. Packaged Sewage Treatment Plants — Objectives and Design Standards

5.2.1.1. General

1) The *effluent* from a *packaged sewage treatment plant* used in an *on-site wastewater treatment system* shall meet the *wastewater* quality parameters required by the downstream final treatment components.

5.2.1.2. Treatment Capacity

1) The required treatment capacity of a *packaged sewage treatment plant* used in an *on-site wastewater treatment system* shall consider the

a) expected peak hydraulic load,

b) expected strength of the *wastewater* from the *development*,

c) extent of wastewater flow variation throughout a day, and

d) variations in wastewater flow from day to day.

5.2.1.3. Accessible Location

1) The location of a *packaged sewage treatment plant* shall be selected with consideration to[1]

a) accessibility for regular servicing,

b) accessibility for periodic removal of sludge, and

c) minimizing concerns with periodic odour problems that may occur.

[1] *Intent: Sentence (1) — The plant should be located where it is unlikely a deck or other structure may be built over the tank or where access may be otherwise limited for removal of sludge by a vacuum truck. The depth of the*

This standard requires that a packaged treatment plant is certified to the ANSI/NSF40 – Class 1 Treatment Plant Standard. These plants are certified to a treatment quality of:

- BOD5 25mg/L
- TSS 30mg/L

A packaged treatment plant, certified to the ANSI/NSF 40 standard, is rated for an effluent treatment level 2 under its certification, regardless of other data that may show better test results.

See pg. **282** for more information on the use of treatment plants in an onsite system.

See Appendix B pg. **236** for more information on required certification of treatment plants.

Certified treatment plants are tested and certified based on receiving residential strength wastewater at the rated peak loading treatment capacity.

Higher strength wastewater and significant variations in flow patterns must be specifically addressed in the system design to achieve the expected effluent quality.

The location of the treatment plant needs to consider the same access for vacuum trucks as septic tanks need. See Article 4.2.1.2 explanatory text and the intent note with this article.

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tank should not exceed the practical suction elevation of vacuum trucks at the truck access point.

5.2.1.4. Insulation of Tank

1) A *packaged sewage treatment plant* shall have adequate earth cover or other means to protect it from freezing while in operation and during periods of non-use.

5.2.1.5. Infiltration/ Exfiltration Prevention

1) Tank access openings, manhole extensions, and piping connections shall prevent *infiltration* and exfiltration of *wastewater* and groundwater.

2) Where the site evaluation identifies high ground water conditions at the location and elevation the tank is installed the design of the system shall address

a) anti-flotation measures required,

b) the ability of the tank to withstand structural stresses caused by the hydrostatic pressure and buoyancy, and

c) maintaining the elevation of piping connections above the projected *water table* or include other specific additional measures to ensure *infiltration* does not occur through piping connections or manhole access risers.

Explanations & Related Articles

Article 5.2.2.7 provides specific direction regarding insulation of a treatment plant.

Infiltration of groundwater into a treatment plant tank can substantially increase the amount of water discharged to the soil based treatment system. Even though a treatment plant tank may not be installed in a water table, the excavation for the tank may act as a water collector and so cause infiltration into the tank if not properly installed.

It is particularly important to ensure a treatment plant tank can withstand the pressures of water surrounding it as the dose tank fills and empties or when the tank is pumped for cleaning. Special precautions are needed to prevent the stresses from fracturing or deforming the tank or causing it to pop out of the ground due to the buoyant forces on the tank.

The manufacturer of the tank needs to be consulted and confirm the tank's suitability to the condition it is installed in and acceptable anti-flotation methods suitable for the tank are used. In many cases a stronger tank must be used to withstand the structural forces encountered.

See Appendix B pg. **358** for more information on the installation of tanks on a stable base.

5.2.2. Packaged Sewage Treatment Plants — Prescriptive Requirements and Installation Standards

5.2.2.1. Separation Distances

1) A *packaged sewage treatment plant* shall not be located within

a) 10 m (33 ft.) from a *water source*,

b) 10 m (33 ft.) from a *water course*,

c) 6 m (20 ft.) from a *property* line, and

d) 1 m (3.25 ft.) from a *building*.

Note that the packaged treatment plant must be at least 6m (20ft.) from a property line. However this may be reduced if the conditions of sentence (2) of this article are met.

2) Notwithstanding Sentence (1), a *packaged sewage treatment plant* may be located not less than 1 m (3.25 ft.) from a *property* line if

a) equipped with odour control mechanisms,1

b) the plant serves a *development* where the peak daily flow is less than 5.7 m3 (1,250 Imp. gal.) per day, and

c) the strength of the *wastewater* from the *development* does not exceed *typical wastewater* strength.

[1] *Note: Clause (2)(a) — Odour control mechanisms may include the relocation of the vent from the treatment unit to a suitable location.*

If all of the conditions of this Sentence (2) are met the separation distance to the property line may be reduced.

Consult the manufacturer of the treatment plant for suitable odour control equipment and methods.

Using inappropriate methods can reduce the effectiveness of the treatment plant. The effectiveness of a particular method of odour control must be justified by the designer/installer of the system.

3) Notwithstanding Sentences (1) and (2), a *packaged sewage treatment plant* serving a *development* generating more than 5.7 m^3 (1,250 Imp. gal.) but less than 25 m^3 (5,500 Imp. gal) per day shall be located

a) if not equipped with odour control devices, not less than

Treatment plants serving developments that generate more than 5.7 cubic meters per day must be 100 m from a property line and 25m from the development served.

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i) 100 m (325 ft.) from the *property* line of an unrelated *development*, and
ii) not less than 25 m (82 ft.) from the *development* served, or

b) when equipped with odour control devices, the distance may be less than set out in Clause (a) but not less than the distance away from the *development* served and the *property* line of unrelated *developments* needed to minimize odour impact on the *development* and at the *property* line of unrelated *developments*.

Clause (b) of this sentence allows a reduction in that distance but does not specify the amount of reduction allowed. The separation from a property line or the development must be justified by the designer or installer.

Consult the manufacturer of the treatment plant for suitable odour control equipment and methods. Using inappropriate methods can reduce the effectiveness of the treatment plant.

5.2.2.2. Wastewater Strength

1) A *packaged sewage treatment plant* shall not receive *wastewater* having a strength that exceeds *typical wastewater* unless it can be demonstrated the *packaged sewage treatment plant* has the capacity to treat the organic loading of the *wastewater* to achieve the *effluent* quality required by these standards.

A treatment plant certified to the ANSI/NSF 40 class 1 standard for treatment of residential strength wastewater may be able to treat wastewater exceeding the strength limits set out in Article 2.2.2.1 for residential wastewater if the wastewater volume treated per day is reduced. Determining this capacity must be justified by the designer or installer based on mass loading treatment capacity.

5.2.2.3. Treatment Capacity

1) A *packaged sewage treatment plant* used in an *on-site wastewater treatment system* shall have a rated treatment capacity

a) of not less than the expected peak volume of *wastewater* per day determined in accordance with Section 2.2., and

b) that meets the requirements of Article 5.2.1.2.

See Appendix B pg. **247** for more information regarding high strength wastewater considerations.

Section 2.2 sets out the methods and values used in determining peak daily wastewater flow volumes.

Article 5.2.1.2 requires consideration of the sewage strength and variation in flow during the day or from day to day.

5.2.2.4. Service Access Not Buried

1) *Packaged sewage treatment plant* access openings shall not be buried and shall be located at a height above the surrounding landscape that ensures surface water will drain away from the access opening.[1]

Treatment plants require regular inspection and servicing to ensure the expected effluent quality is achieved. For this reason it is critical that ready access not requiring excavation is provided.

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[1] *Intent: Sentence (1) — To ensure an access opening or required maintenance.*

5.2.2.5. Access Openings Equipped with Lid/Cover

1) *Packaged sewage treatment plant* access openings shall be equipped with a secure lid or cover.[1]

[1] *Intent: Sentence (1) — To increase safety by preventing unauthorized or accidental entry into the access opening. Acceptable protective measures include, but are not limited to, a padlock, a cover that can only be removed with tools, or a cover having a minimum weight of 29.5 kg (65 lb).*

See the intent note with this article for more direction on providing a secure lid or cover.

2) All man way access openings shall be insulated to provide the equivalent of an R-8 insulation value.

5.2.2.6. Base for Packaged Sewage Treatment Plant

1) The bottom of an excavation for a *packaged sewage treatment plant* shall provide a uniform base to support the tank in a level position and meet the manufacturer's installation instructions.[1]

[1] *Intent: Sentence (1) — A tank must have a stable base so it will not settle, shift, or crack after installation.*

A uniform stable base for the treatment plant tank is critical to the long term success of the system.

See Appendix B pg. **358** for more information on the installation of tanks.

5.2.2.7. Insulation of Tank

1) A *packaged sewage treatment plant* that has less than 1.2 m (4 ft.) of earth cover to protect it from freezing conditions shall be insulated to provide the equivalent of an 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 other acceptable manner to achieve a level of protection from freezing that is equivalent to

The insulation used for this purpose must be suitable for underground use. Fiberglass batting types of insulation will hold water and freeze solid – providing no insulation value – and should not be used outdoors in an underground application. Insulation suitable for below ground use is required. Rigid Extruded Expanded Polystyrene (XEPS) Foam Board is rated at approx R5 – R6 per inch of thickness but this will vary by type and manufacturer.

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a tank that has a minimum 1.2 m (4 ft.) cover of the in situ *soil*.

5.2.3. Packaged Sewage Treatment Plants — Requirements for Materials

5.2.3.1. Equipment Structural Requirements and Operational Certification

1) *Packaged sewage treatment plants* shall be *certified* as meeting the National Sanitation Foundation (NSF/ANSI) Standard 40, Class 1, for "Residential Wastewater Treatment Systems."

2) In addition to Sentence (1), tanks used for *packaged sewage treatment plants* shall be

a) *certified* as meeting the structural and material requirements of CAN/CSA-B66, "Design, Material, and Manufacturing Requirements for Prefabricated Septic Tanks and Sewage Holding Tanks," or

b) *certified* as meeting the structural and material requirements of the BNQ Standard NQ 3680-905/208, "Prefabricated Septic Tanks for Residential Use – Dimensional and Physical Characteristics."

Explanations & Related Articles

This website provides additional information on rigid insulation:
http://www.espenergy.com/foam_board_insulation.htm

A packaged treatment plant that is rated for a level 2, or better, effluent quality must be marked as being certified to the ANSI/NSF Standard 40 Class 1. The tank the treatment components are installed in must meet the configuration set out in the certification for the treatment plant, and the tank must be certified as meeting the structural and material requirements of the CAN/CSA B66 Standard or the BNQ Standard NQ 3680-905/208.

A variance issued by the Administrator of Private Sewage for the compliance of the tank to the structural and material requirements may replace the required tank certification.

See Appendix B pg. **236** for more information regarding certification.

Section 5.3. Secondary Treatment — Sand Filters

5.3.1. Sand Filters — Objectives and Design Standards

5.3.1.1. General

1) The treatment objective of an intermittent *sand filter* is to treat the *wastewater* to a *secondary treated effluent* Level 3 standard.

5.3.1.2. Effluent Treatment Quality

1) The *effluent* produced by an intermittent *sand filter* that receives *primary treated effluent level 1* shall, 80% of the time, be of a quality characterized by the following:

a) *CBOD5 of less than 15 mg/L,*

b) *TSS of less than 15 mg/L,*

c) *less than 50,000 CFU/100 mL, and*

d) *oil and grease content of less than 5 mg/L.*

5.3.1.3. Coarse-Sand Sand Filter

1) A coarse-sand intermittent *sand filter* shall

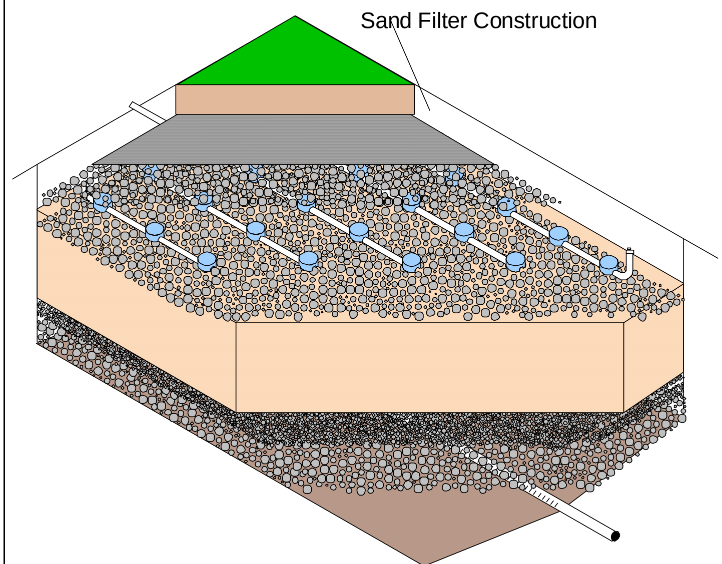
a) use filter media as specified in Sentence 5.3.3.4.(1), and

b) have a filter media infiltrative surface area that is sized based on

i) peak daily flow volumes,

ii) an *effluent hydraulic loading rate* of not more than 100 L per square metre (2 Imp. gal. per sq. ft.) per day, and

iii) an organic loading rate of not more than 0.015 kg *$CBOD_5$* per sq. metre per day based on peak daily flow volumes.



See pg. **370** and **371** for a larger graphic illustration of a sand filter. Treatment Level 3 quality parameters are set out in Table 5.1.1.1.

Pretreatment to an effluent Level 1 quality is required prior to treatment by the intermittent sand filter.

This section on intermittent sand filters applies to two types of sand filters; coarse sand sand filters and medium sand sand filters. The significant difference between the two is the specifications for the sand used in the treatment filters.

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5.3.1.4. Medium-Sand Sand Filter

1) A medium-sand intermittent *sand filter* shall

a) use filter media as specified in Sentence 5.3.3.4.(2), and

b) have a filter media infiltrative surface area based on

i) peak daily flow volumes,

ii) an *effluent hydraulic loading rate* of not more than 40 L per square metre (0.83 Imp. gal per sq. ft.) per day, and

iii) an average organic loading rate of not more than 0.0075 kg *CBOD*$_5$ per sq. metre per day based on peak daily flow volumes.

The loading rates allowed on a course-sand sand filter are higher than allowed on a medium-sand sand filter.

The definitions of coarse sand and medium sand as set out in this standard in the definitions does not apply to the particle size of the sand used in these sand filters.

See Article 5.3.3.4 sentences (1) and (2) for specification on the sand particle size required for the coarse-sand and medium-sand sand filter systems.

5.3.1.5. Application of Effluent

1) *Effluent* shall be evenly applied to the filter media infiltrative surface using a pressure distribution lateral system meeting the requirements of Section 2.6.

2) *Effluent* shall be applied to the filter media infiltrative surface in dose volumes that do not exceed[1]

a) 30% of the *field capacity* of the filter media per dose when using timed dosing, or

b) 20% of the *field capacity* of the filter media per dose when using demand dosing.

[1] Intent: Sentence (2) — Numerous light applications of effluent provide better treatment conditions. This requirement results in between approximately 12 and 24 doses per day to meet the percentage of field capacity per dose. The amount may vary depending on the filter media. A timing device to control the pump is desirable to provide a wait period between each volume per flush and also to provide volumes per flush evenly spaced over a 24-hour day.

This requires small frequent doses of the effluent to the sand filter media using a pressure distribution system.

Additional requirements for orifice spacing in the effluent distribution system for the sand filter are set out in Article 5.3.2.4.

5.3.1.6. Alarm Signals

1) A *sand filter* shall include a device capable of

a) detecting a high *effluent* level condition in the *sand filter*, and

b) delivering a visible and audible signal to alert the user of the system that the *effluent* level is above normal operating levels.

The requirements for a high level alarm within the sand filter is specific to the sand filter and is similar to requirements in Article 2.3.1.2 and the other Articles in Section 2.3. or 2.4. that set out requirements for control systems based on the volume of wastewater generated by the development served. The requirements of those Sections must be met in addition to this specific article.

5.3.1.7. Prevention of Infiltration/ Exfiltration

1) A *sand filter* container shall prevent the *infiltration* and exfiltration of water.[1]

[1] *Note: Sentence (1) — A suitable liner within which the sand filter is contained is required to prevent the infiltration and exfiltration of water. A berm may be required on the upslope side of the sand filter to prevent surface storm water runoff from entering the sand filter.*

Minimum specifications for the water tight liner are set out in Article 5.3.3.2.

5.3.1.8. Above Ground Filters

1) A *sand filter* constructed above ground or partially above ground shall

a) have a container that is capable of holding the filter media and withstanding hydraulic and mechanical forces that may be encountered, and

b) include additional insulation to minimize the effect of cold weather that is equivalent to the *soil* insulating factor of a buried *sand filter*.

5.3.1.9. Soil Cover

1) Where a *soil* cover is required, the *soil* cover over a *sand filter* and the area immediately around it shall be graded to shed precipitation and minimize the entrance of surface runoff water and precipitation into the *sand filter*.

2) Except as permitted in Sentence (3), the *soil* cover over the *sand filter* shall be a *soil*

The texture of the soil used to cover the sand filter should be the same textures as required for treatment mounds. The covering soil should be a coarse textured sand to allow sufficient air to enter the system and meet the oxygen demand needed to break down the organic loading to the sand filter.

texture that allows sufficient air to enter the *sand filter media* below the *soil* cover to satisfy the oxygen demand created by the treatment processes in the *sand filter*.

3) A piping system may be used to supply an adequate air supply to the *sand filter media* as an alternative to the permeable *soil* cover described in Sentence (2).

5.3.1.10. Open Bottom Sand Filter or Packed Bed Media Filter System Not Allowed

1) An open bottom *sand filter* design or other open bottom *packed bed filter* system shall not be used.

An open bottom sand filter or any other system that does not effectively distribute the effluent to avoid overloading of the soil in not acceptable.

5.3.2. Sand Filters — Prescriptive Requirements and Installation Standards

5.3.2.1. Separation Distances

1) A *sand filter* shall not be located within

a) 10 m (33 ft.) from a *water course*,

b) 10 m (33 ft.) from a *water source*,

c) 1 m (3.25 ft.) from a *property* line as measured from the foot of the *berm*, and

d) 1 m (3.25 ft.) from a *building*.

5.3.2.2. Base for Intermittent Sand Filter

1) An intermittent *sand filter* shall be on a stable and level base.

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5.3.2.3. Intermittent Sand Filter

1) An intermittent *sand filter* system shall have *underdrain piping* to collect treated *effluent* that shall

a) extend the full length of the *sand filter*,

b) be located at the bottom of the *sand filter*,

c) extend to the surface at both ends of the *underdrain piping*,

d) be located in *drain media* that has a minimum depth of 150 mm (6 in.), and

e) enable collection of the *effluent* at the bottom of the *sand filter* to ensure positive drainage to a depth of at least 200 mm (8 in.) below the *sand* layer.

See the graphic illustration of the sand filter construction in Appendix B pg. **370** to see the placement of the underdrain piping.

2) An intermittent *sand filter* system shall have a method of removing *effluent* collected at the bottom of the *sand filter* by the *underdrain piping*, and the following criteria shall be met:[1,2]

a) a pump housed in a corrosion resistant vault that will

- **i)** withstand the mechanical stresses that it will be subject to,
- **ii)** prevent the migration of *drain media*, *sand*, or *underdrain media* to its interior, and
- **iii)** provide water-tight access to finished landscape grade with a *diameter* equal to that of the vault,

b) piping that drains to an *effluent* dosing tank external to the *sand filter* where the *effluent* is removed by a pump, and

c) the depth of *underdrain media* and the upper operating limit of the associated *effluent* pump cycle and alarm shall not allow *effluent* to rise within 50 mm (2 in.) of the bottom of the filter media.

See the graphic illustration of the sand filter construction in Appendix B pg. **371** to see the construction of a sand filter.

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[1] *Note: Sentence (2) — The underdrain piping should be installed in a manner that ensures the load of the media above does not press the pipe into the bottom of the sand filter liner, effectively closing the openings in the piping; see applicable sections in the handbook for design and installation procedures.*

[2] *Note: Sentence (2) — An underdrain pipe laid in the centre of the sand filter along the long axis quickly collects effluent. If the underdrain pipe extends beyond the sand filter to a dose tank, care must be taken to prevent freezing of the pipe, as the trickling effluent will readily freeze. The pump vault may be used as the dosing tank for the downstream soil-based final treatment component if the capacity of the pump vault provides sufficient volume for the dosing of the system.*

3) Above the *drain media*, a layer of *underdrain media* having a minimum depth of 50 mm (2 in.) shall be placed over the layer of *drain media* that supports the *sand filter media*.[1]

[1] *Intent: Sentence (3) — The media immediately under the filter media (underdrain media, which is pea gravel as specified in Sentence 5.3.3.6.(1)) should be small enough to support the filter media. Below this supporting layer, the underdrain piping should be enveloped in a coarse drain media (larger sized rock, Article 5.3.3.5.) to provide less restriction of effluent flow into the underdrain piping. The layers below the filter media must provide effective drainage to ensure aerobic conditions.*

4) Above the *underdrain media*, a minimum depth of 600 mm (2 ft.) of *sand filter media* shall be placed in a manner that ensures a uniform density and a top surface which is level.[1]

[1] *Note: Sentence (4) — The moisture content of the sand media may cause different placement techniques to ensure uniform density of the sand media.*

Explanations & Related Articles

See the graphic illustration of the sand filter construction in Appendix B pg. **371** to see the construction of a sand filter.

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5) A pressurized distribution lateral system shall be included that

a) meets the requirements of Section 2.6.,

b) is situated above the filter media layer, and

c) is placed in

i) clean *drain media* that has a minimum depth of 75 mm (3 in.) below the distribution laterals, and that covers the orifice shields protecting the distribution pipe orifices, or

ii) a chamber system that is installed in accordance with the manufacturer's instructions, covers a minimum of 90% of the filter media area, and is set on a minimum of 50 mm (2 in.) of *drain media* covering the *sand filter media* layer.

The effluent may be distributed into a gravel layer or chambers using a pressure distribution system to achieve effective use of the entire sand layer area required for treatment.

6) A geo-textile fabric shall cover the top of the *drain media* or chamber system in which the pressure distribution lateral system is installed.

7) A *soil* shall cover the intermittent *sand filter* area that

a) has a depth of not less than 150 mm (6 in.) and not more than 300 mm (12 in.),

b) is of a *texture* of *fine sand*, *loamy coarse sand*, *loamy medium sand* or *coarse sandy loam*,1 and

c) has been seeded to grass or covered with sod.2

[1] *Intent: Clause (7)(b) — The soil covering the sand filter must be a coarse soil texture to allow a free flow of air into the sand filter.*

[2] *Note: Clause (7)(c) — Grass cover must be established as soon as possible to prevent erosion of the soil cover and promote run off of precipitation.*

8) There shall be a minimum of two monitoring ports that

Monitoring ports are needed to enable assessment of the system effectiveness during

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a) are located so that there is not less than 1 per each 3 m by 3 m (10 ft. by 10 ft.) area of *sand layer* and located in each chamber, if chambers are used,

b) have a minimum *diameter* of 100 mm (4 in.),

c) have horizontal or vertical saw cuts from the bottom of the pipe to a height of 100 mm (4 in.) to allow the entry of *effluent*,

d) are accessible from the surface,

e) are equipped with removable caps, and

f) extend from finished grade down to the top of the filter media layer.

operation. Identifying a problem early may allow action to be taken to correct the potential failure of the system, such as supplying air to the sand layer through the air piping described in Article 5.3.1.9. (3).

5.3.2.4. Distribution Laterals

1) The distribution lateral system that meets the requirements of Section 2.6. shall be designed so that

a) there is not less than one orifice for
   i) each 0.55 m^2 (6 ft^2) of filter media surface infiltration area in a medium-sand *sand filter*, or
   ii) each 0.18 m^2 (2 ft^2) of filter media surface infiltration area in a coarse-sand *sand filter*,

b) each orifice serves an area, the length of which does not exceed its width by more than 1.5 times, and

c) the orifices in adjacent laterals create an offset pattern to maximize distribution.

This article includes specific requirements regarding orifice spacing in addition to the general requirements for pressure effluent distribution system requirements set out in Section 2.6.

The top of the sandfilter cannot be insulated as that would restrict the required air flow to the sandfilter. Only the sides are insulated.

5.3.2.5. Above Ground

1) A *sand filter* constructed above ground or partially above ground shall be insulated with polystyrene that provides a minimum R-8 insulation value and provided with a surrounding *soil* berm having a slope not steeper than 1 vertical to 3 horizontal or a concrete enclosure having the structural capacity to carry the loads placed on walls.

The insulation used for this purpose must be suitable for underground use. Fiberglass batting types of insulation will hold water and freeze solid – providing no insulation value – and should not be used outdoors in an underground application. Insulation suitable for below ground use is required. Rigid Extruded Expanded Polystyrene (XEPS) Foam Board is rated at approx R5 – R6 per inch of thickness but this will vary by type and manufacturer.

This website provides additional information on rigid insulation: http://www.espenergy.com/foam_board_insulation.htm

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5.3.3. Sand Filters — Requirements for Materials

5.3.3.1. Underdrain Piping

1) *Underdrain piping* shall

a) not be smaller than NPS 4 in. pipe with saw cuts halfway through the piping at approximately 50 mm (2 in.) spacing, or

b) be an alternative product that will effectively collect *effluent* from below the filter media without clogging.

5.3.3.2. Sand Filter Container

1) A *sand filter* container shall be

a) a reinforced concrete container,

b) constructed of other materials that will provide an equivalent performance in which water tightness is expected, or

c) a flexible membrane liner having properties that are at least equivalent to 0.76 mm or 760 µm thick (0.03 in.) unreinforced polyvinyl chloride (PVC), protected by a 75 mm (3 in.) thick *sand* layer beneath the liner.

The container must be water tight.

5.3.3.3. Test for Media

1) The *sand filter media*, *drain media*, and *underdrain media* specified in Articles 5.3.3.4., 5.3.3.5., and 5.3.3.6., respectively, shall be tested to determine conformance

a) in accordance with ASTM C-136, “Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates,” and in conjunction and accordance with ASTM C-117, “Standard Test Method for Materials Finer than No. 200 Sieve in Mineral Aggregates by Washing,” and

b) by a qualified third party.

The media used in a sand filter needs to be tested to confirm conformance with the design specifications.

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5.3.3.4. Filter Media

1) Except as permitted in Sentence (3), the *sand* used as filter media in a coarse-sand *sand filter* shall be well-washed and consist of the following particle size:

a) 100 percent passing the 9.51 mm (3⁄8 in.) sieve,

b) 77 to 100 percent passing the 4.76 mm (0.187 in.), No. 4 sieve,

c) 53 to 100 percent passing the 2.36 mm (0.0937 in.), No. 8 sieve,

d) 15 to 80 percent passing the 1.18 mm (0.0469 in.), No. 16 sieve,

e) 3 to 50 percent passing the 0.6 mm (0.0234 in.), No. 30 sieve,

f) 0 to 2 percent passing the 0.3 mm (0.0117 in.), No. 50 sieve,

g) a uniformity coefficient (CU) of between 1 and 4, and

h) effective particle size (D10) of 0.4 to 0.9 mm.

2) Except as permitted in Sentence (3), the *sand* used as filter media in a medium-sand *sand filter* shall be well-washed and have a *particle size* that meets the following criteria:

a) 100 percent passing the 9.51 mm, (3⁄8 in.) sieve,

b) 95 to 100 percent passing the 4.76 mm (0.187 in.), No. 4 sieve,

c) 80 to 100 percent passing the 2.36 mm (0.0937 in.), No. 8 sieve,

d) 45 to 85 percent passing the 1.18 mm (0.0469 in.), No. 16 sieve,

e) 15 to 60 percent passing the 0.6 mm (0.0234 in.), No. 30 sieve,

f) 3 to 10 percent passing the 0.3 mm (0.0117 in.), No. 50 sieve,

g) 0 to 4 percent passing the 0.15 mm (0.0059 in.), No. 100 sieve,

The sand used in the sand filter set out in this standard have different loading rates depending on the particle size distribution of the sand media used.

The success of the sand filter depends on quality material being used.

h) a *uniformity coefficient (CU)* of between 1 and 4, and

i) eff*ective particle size (D10)* of 0.3 to 0.5 mm, or

3) An alternative media to what is provided in Sentences (1) and (2) may be used as the filter media provided it

a) is of equivalent durability,

b) has a particle size consistent with the size required for use in a *coarse-sand sand filter* or *medium-sand sand filter*,

c) is inert so that it will maintain its integrity and not collapse or disintegrate with time, and

d) is not detrimental to the performance of the intermittent *sand filter*.

5.3.3.5. Drain Media

1) Except as permitted in Sentence (2), *drain media* shall be clean, washed gravel; clean, crushed rock; or other equivalent media for distributing *effluent*, with particle size of the following consistency:

a) 100 percent passing the 38.1 mm, (1 1⁄2 in.) sieve,

b) 50 to 100 percent passing the 9.51 mm, (3⁄8 in.) sieve,

c) 6 to 84 percent passing the 4.76 mm (0.187 in.), No. 4 sieve,

d) 0 to 24 percent passing the 2.36 mm (0.0937 in.), No. 8 sieve,

e) 0 to 1 percent passing the 1.18 mm (0.0469 in.), No. 16 sieve,

f) 0 to 1 percent passing the 0.6 mm (0.0234 in.), No. 30 sieve, and

g) 0 to 1 percent passing the 0.15 mm (0.0059 in.), No. 100 sieve.

2) An alternative media to what is provided in Sentence (1) may be used provided it

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a) is of equivalent durability,

b) has a particle size consistent with the size set out in Sentence (1),

c) is inert so that it will maintain its integrity and not collapse or disintegrate with time, and

d) is not detrimental to the treatment performance of the system.

5.3.3.6. Underdrain Media

1) *Underdrain media* shall be clean, washed pea gravel, or equivalent material with a particle size of the following consistency:

a) 100 percent passing the 12.7 mm, (1⁄2 in.) sieve,

b) 50 to 100 percent passing the 9.51 mm, (3⁄8 in.) sieve,

c) 6 to 84 percent passing the 4.76 mm (0.187 in.), No. 4 sieve,

d) 0 to 24 percent passing the 2.36 mm (0.0937 in.), No. 8 sieve,

e) 0 to 1 percent passing the 1.18 mm (0.0469 in.), No. 16 sieve,

f) 0 to 1 percent passing the 0.6 mm (0.0234 in.), No. 30 sieve, and

g) 0 to 1 percent passing the 0.15 mm (0.0059 in.), No. 100 sieve.

Section 5.4. Secondary Treatment — Re-circulating Gravel Filters

5.4.1. Re-circulating Gravel Filters — Objectives and Design Standards

5.4.1.1. General

1) The treatment objective of a *re-circulating gravel filter* shall be to treat the *wastewater* to a *secondary treated effluent* Level 2 standard.

5.4.1.2. Infiltration Surface Area

1) A re-c*irculating gravel filter* using a minimum 600 mm (2 ft.) depth of filter media, as specified in Article 5.4.3.4., shall be designed to have a filter media infiltrative surface area based on

a) peak daily flow volumes,

b) an effluent hydraulic loading rate of not more than 200 L/m2 (4 Imp. gal./ft2) per day, and

c) an organic loading rate of not more than 0.04 kg CBOD5 /m2 per day.

Re-circulating gravel filters differ from intermittent sand filters in that the re-circulating gravel filter has the effluent passed over the filter media several times before being discharged from the effluent dose tank, as compared to an intermittent sand filter where the effluent only passes through the sand filter media once before going to the effluent dose tank.

The filter media in a re-circulating gravel filter is much coarser than in a sand filter.

Gravel filters are often used to treat high strength sewage. To do that attention must be given to the mass organic loading the filter receives. Loading rates set out in this standard anticipate Primary treated effluent Level 1 being applied to the re-circulation gravel filter.

5.4.1.3. Application of Effluent

1) *Effluent* shall be evenly applied to the filter media layer infiltrative surface using a pressure distribution lateral system meeting the requirements of Section 2.6. and Article 5.3.2.4.

2) *Effluent* shall be applied to the filter media infiltrative surface in doses that[1]

a) occur not less than 48 times per day,

b) occur at intervals of not more than 30 minutes, and

c) provide an orifice discharge volume per dose that does not exceed 8 L (1.76 Imp.

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gal.).

[1] *Intent: Sentence (2) — Numerous light applications of effluent provide better treatment conditions. A timing device to control the pump is desirable to provide a wait period between each volume per flush and also to provide volumes per flush evenly spaced over a 24-hour day.*

5.4.1.4. Effluent Tank

1) A *re-circulating gravel filter* design shall include a mixing/re-circulation *effluent tank* that

a) has a capacity of 150 percent of peak daily flow volume for residential applications,

b) has a capacity of 100 percent peak daily flow volume for commercial applications,

c) receives *effluent* from the upstream *primary treatment* component,

d) receives treated *effluent* from the *re-circulating gravel filter*, and

e) includes components required to achieve a 4 to 1 re-circulation ratio.

The mixing tank enables the re-circulating function needed for the success of the filter.

5.4.1.5. Minimum of One Pass Before Discharge

1) The *re-circulating gravel filter* design shall ensure *effluent* has passed through the gravel filter at least once prior to discharge to a downstream treatment system component.

This control requirement is in addition to those set out in Section 2.3 and 2.4 which must also be met.

5.4.1.6. Detection/Alarm

1) A *re-circulating gravel filter* shall include a device capable of

a) detecting a high *effluent* level condition, and

b) delivering a visible and audible signal to alert the user(s) of the system that the *effluent* level is above normal operating levels.

5.4.1.7. Infiltration/ Exfiltration Prevention

1) A *re-circulating gravel filter* container shall prevent the *infiltration* and exfiltration of water.

5.4.1.8. Above Ground

1) A *re-circulating gravel filter* constructed above ground or partially above ground shall

a) have a container that is capable of holding the filter media and withstanding hydraulic and mechanical forces that may be encountered, and

b) provide insulation from cold weather equivalent to the *soil* insulating factor of a buried gravel filter.

5.4.1.9. Open Bottom Re-circulating Gravel Filter Not Allowed

1) An open bottom *re-circulating gravel filter* design shall not be used.

5.4.1.10. Soil Cover

1) Where a *soil* cover is required, the *soil* cover over a *re-circulating gravel filter* and the area immediately around it shall be graded to shed precipitation and prevent surface water run-off from entering the *re-circulating gravel filter*.

5.4.2. Re-circulating Gravel Filters — Prescriptive Requirements and Installation Standards

5.4.2.1. Separation Distances

1) A *re-circulating gravel filter* shall not be located within

a) 10 m (33 ft.) from a *water course*,

b) 10 m (33 ft.) from a *water source*,

c) 3 m (10 ft.) from a *property* line measured from the foot of the *berm*, and

d) 1 m (3.25 ft.) from a *building*.

2) Notwithstanding Sentence (1), a *re-circulating gravel filter* designed to treat in excess of 5.7 m^3 (1,250 Imp. gal.) per day shall be located a sufficient additional distance away from *buildings* and *property* lines to ensure odour impact is minimized.

The construction of a Gravel Filter is very similar to a sand filter.

See pg. **371** for a graphic illustration of the construction of a sand filter.

5.4.2.2. Base for Filter

1) A *re-circulating gravel filter* shall be on a stable and level base.

5.4.2.3. Re-Circulating Gravel Filter System

1) A *re-circulating gravel filter* system shall contain *underdrain piping* to collect *effluent* that shall[1]

a) be located at the bottom of the *re-circulating gravel filter*,

b) extend the full length of the *re-circulating gravel filter*,

c) extend to the surface at both ends of the *underdrain pipe*,

d) provide positive drainage to a depth of at least 200 mm (8 in.) below the filter media layer, and

e) connect to a pump vault within the *re-circulating gravel filter* or extend beyond the edge of the *re-circulating gravel filter* to provide gravity drainage to the mixing/re-circulation tank.

[1] Note: Sentence (1) — An underdrain pipe laid in the centre of the re-circulating gravel filter along the long axis quickly collects effluent.

2) A *re-circulating gravel filter* system shall contain pumps and control systems that shall ensure the *effluent* collected in the bottom on the gravel filter does not come to within 50 mm (2 in.) of the bottom of the filter media.

3) The layer of *drain media*, containing the *underdrain piping*, shall have a minimum depth of 150 mm (6 in.).

4) The layer of *drain media* referred to in Sentence (3) shall be covered with a layer of *underdrain media* specified in Article 5.3.3.6. having a minimum depth of 50 mm (2 in.).[1]

[1] Intent: Sentence (4) — The media immediately under the filter media (underdrain media, which is pea gravel as specified in Sentence 5.3.3.6.(1)) should be small enough to support the filter media. Below this supporting layer, the underdrain piping should be enveloped in a coarse drain media (larger sized rock, Article 5.3.3.5.) to provide less restriction of effluent flow into the underdrain piping. The layers below the filter media must provide effective drainage to ensure aerobic conditions.

5) A minimum of 600 mm (2 ft.) of filter media above the *underdrain media* shall have a level surface and be placed in a manner to ensure uniform density.

6) A pressurized *distribution lateral pipe* system shall be installed that

a) is situated above the filter media layer,

b) is placed in clean *drain media* that has a minimum depth of 75 mm (3 in.) below the distribution laterals, and that covers the orifice shields, or

c) when placed in a chamber system, the chambers shall

d) be installed in accordance with the manufacturer's instructions,

e) cover a minimum of 90% of the gravel area, and

f) be set on a minimum of 50 mm (2 in.) of *drain media* covering the filter media layer.

7) A geo-textile fabric shall cover the top of the *drain media* or chamber system in which the pressure distribution lateral system is installed.

8) The *re-circulating gravel filter* area shall by covered by a layer of *soil* that

a) has a depth of not less than 150 mm (6 in.) and not more than 300 mm (12 in.),

b) is of a *soil texture classification* no finer than *loamy coarse sand*,1 and

c) has been seeded to grass or covered with sod.[2]

[1] *Intent: Clause (8)(b) — The soil covering the re-circulating gravel filter must be very coarse to allow a free flow of air into the gravel filter.*

[2] *Note: Clause (8)(c) — Grass cover must be established as soon as possible to prevent erosion of the soil cover.*

9) There shall be two monitoring ports with a minimum *diameter* of 100 mm (4 in.) that are accessible from the surface and extend down to the top of the filter media layer.

5.4.2.4. Orifice Spacing

1) The *distribution lateral pipe* system shall be designed so that

a) there is not less than one orifice for each 0.18 m2 (2 ft2) of filter media surface

This article includes specific requirements regarding orifice spacing in the pressure distribution laterals in addition to the general requirements for pressure effluent distribution lateral systems set out in Section 2.6.

infiltration area,

b) each orifice serves an area in which the area's length does not exceed its width by more than 1.5 times, and

c) the orifices in adjacent laterals create an offset pattern to maximize distribution.

5.4.2.5. Pumps

1) Where collected *effluent* is removed from the *re-circulating gravel filter* using a pump located within the gravel filter,

a) the pump and related apparatus shall be housed in a corrosion resistant vault designed to
   i) withstand the stresses placed upon it,
   ii) prevent the migration of *drain media*, gravel, or *underdrain media* to its interior, and
   iii) provide water-tight access to finished landscape grade with a *diameter* equal to that of the vault, and

b) the depth of *underdrain media* and the operating level of the pump cycle and alarm shall not allow *effluent* to rise within 50 mm (2 in.) of the bottom of the filter media.

5.4.2.6. Above Ground Containment

1) A *re-circulating gravel filter* constructed above ground or partially above ground shall be

a) provided with a
   i) surrounding *soil berm* having a slope not steeper than 1 vertical to 3 horizontal, or
   ii) concrete enclosure having the structural capacity to carry the loads placed on walls, and

b) insulated with polystyrene or equivalent on the walls of the enclosure that

The top of the gravel filter cannot be insulated as that would restrict the required aeration to the gravel filter.

The insulation used for this purpose must be suitable for underground use. Fiberglass batting style insulation will hold water and freeze solid – providing no insulation value – and should not be used outdoors in an underground application. Insulation suitable for below ground use is required. Rigid Extruded Expanded Polystyrene (XEPS) Foam Board is rated at approx R5 – R6 per inch of thickness but vary by type and brand.

provides a minimum R-8 insulation value.

This website provides additional information on rigid insulation: http://www.espenergy.com/foam_board_insulation.htm

5.4.3. Re-circulating Gravel Filters — Requirements for Materials

5.4.3.1. Underdrain Piping

1) *Underdrain piping* shall not be smaller than NPS 4 inch pipe with saw cuts halfway through the pipe at approximately 50 mm (2 in.) spacing.

5.4.3.2. Re-Circulating Gravel Filter Container

1) A *re-circulating gravel filter* container shall be constructed of

a) reinforced concrete or materials that will provide performance and water tightness equivalent to a reinforced concrete container, or

b) a flexible membrane liner

i) having properties that are at least equivalent to 0.762 mm or 762 µm thick (0.03 in.) unreinforced polyvinyl chloride (PVC), and

ii) protected by a 75 mm (3 in.) layer of *sand* beneath the liner that is adequately supported by structurally sufficient sidewall supports provided by void forms when further supported by surrounding earth *berms* or concrete walls.

The construction and material requirements for a re-circulating gravel filter are very similar to intermittent sand filters. See Appendix B pg. **370** for illustration of a constructed sand filter or gravel filter.

The main difference between the two filters is the particle size of the filter media and the recirculation of the effluent required in the gravel filter.

5.4.3.3. Test Requirements for Gravel Filter Media

1) The *re-circulating gravel filter* media shall be tested to determine conformance with the criteria outlined in Article 5.4.3.4. by a sieve analysis test

a) in accordance with ASTM C-136, "Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates," and in conjunction with ASTM C-117, "Standard Test Method for Materials Finer than No. 200 Sieve in Mineral Aggregates by Washing," and

b) performed by a qualified third party.

5.4.3.4. Gravel Filter Media

1) The gravel used as filter media shall

a) have a *uniformity coefficient* of less than or equal to 2,

b) have an *effective particle size (D10)* of 3–4 mm, and

c) be washed gravel consisting of the following particle size:

- **i)** 100 percent passing the 9.50 mm (3⁄8 in.) sieve,
- **ii)** 0 to 95 percent passing the 4.76 mm (0.187 in.), No. 4 sieve,
- **iii)** 0 to 2 percent passing the 2.36 mm (0.0937 in.), No. 8 sieve, and
- **iv)** 0 to 1 percent passing the 0.6 mm (0.0234 in.), No. 30 sieve.

2) An alternative media to what is provided in Sentence (1) may be used as filter media if it

a) is of equivalent durability,

b) has a particle size distribution consistent with the size required for use in a *re-circulating gravel filter*,

c) is inert so that it will maintain its integrity and not collapse or disintegrate with time, and

d) is not detrimental to the performance of the *re-circulating gravel filter*.

The filter treatment media for the re-circulating gravel filter is very specific. The media required is a much coarser media than required in a sand filter. Some of the main filter media particle size fall above the range of sand particle classification and is classed as gravel given its size. Thus the name re-circulating gravel filter.

Part 6 Initial Treatment Components — Effluent and Pre-treatment Tanks

Section 6.1. Effluent Tanks

6.1.1. Effluent Tanks — Objectives and Design Standards

6.1.1.1. General

1) The objective of an *effluent tank* is to retain *effluent* to enable the effective delivery of *effluent* in dosed volumes to a downstream component.

6.1.1.2. Tank Capacity

1) *Effluent tanks* shall have a capacity to manage the *wastewater* flow as required by design of the downstream component.

6.1.1.3. Prevention of Infiltration/ Exfiltration

1) *Effluent tank* access openings and manhole extensions and piping connections shall prevent *infiltration* and exfiltration.

2) Where the site evaluation identifies high ground water conditions at the location and elevation the tank is installed the design of the system shall address

a) anti-flotation measures required,

b) the ability of the tank to withstand structural stresses caused by the hydrostatic pressure and buoyancy, and

c) maintaining the elevation of piping connections above the projected *water table* or include other specific additional measures to ensure *infiltration* does not occur through piping connections or manhole access risers.

Effluent tanks provide the ability to dose the soil based treatment system with a dosed volume as opposed to a trickle flow. This enables better control and distribution of the effluent; the tanks may also be used to equalize flow during the day or from day to day.

The dosing capability provided by an effluent dosing tank, or effluent dosing chamber that is integral to a septic tank, is very important to the success of a system.

The dosing tank may also be used for flow equalization. See Article 2.2.2.5 for capacity requirements when used for daily flow equalization.

See pg. **246** for more information on flow equalization, and pg. **275** for more information on effluent dosing tanks.

Infiltration of groundwater into an effluent tank can substantially increase the amount of water discharged to the soil based treatment system. Even though an effluent tank may not be installed in a water table, the excavation for the tank may act as a water collector and so cause infiltration into the tank if not properly installed.

It is particularly important to ensure an effluent dose tank can withstand the pressures of water surrounding it as the dose tank fills and empties or when the tank is pumped for cleaning. Special precautions are needed to prevent the stresses from fracturing or deforming the tank or causing it to pop out of the ground due to the buoyant

6.1.1.4. Insulation of Tank

1) An *effluent tank* shall have adequate earth cover or other means to protect it from freezing while in operation and during periods of non-use.

6.1.2. Effluent Tanks — Prescriptive Requirements and Installation Standards

6.1.2.1. Separation Distances

1) *Effluent tanks* shall not be located within

a) 10 m (33 ft.) from a *water source*,

b) 10 m (33 ft.) from a *water course*,

c) 1 m (3.25 ft.) from a *property* line, and

d) 1 m (3.25 ft.) from a *building*.

6.1.2.2. Service Access

1) Effluent tank *access openings shall not be buried and shall be located at a height above the surrounding landscape that ensures surface water will drain away from the access opening.*[1]

[1] *Intent: Sentence (1) — Access openings above the ground provide readily available access to the tank as compared to buried access openings, particularly when the ground is frozen. An above-ground access also encourages regular maintenance and provides a permanent and visible marker of the location of the tank.*

2) All access openings shall be insulated to provide the equivalent of an R-8 insulation value

forces on the tank.

The manufacturer of the tank needs to be consulted and confirm the tank's suitability to the condition it is installed in and acceptable anti-flotation methods suitable for the tank are used. In many cases a stronger tank must be used to withstand the structural forces encountered.

See Appendix B pg. **358** for more information on excavations for tanks and the installation of tanks.

See Article 6.1.2.5 for specific requirements regarding insulation of effluent tanks.

Access to the effluent dosing tank is very important for servicing. The dose tank will contain a pump or siphon which needs to be checked for operation and may require replacement or repair.

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6.1.2.3. Access Openings Equipped with Lid/Cover

1) All access openings shall be equipped with a secure lid or cover.[1]

[1] Intent: Sentence (1) — To increase safety by preventing unauthorized or accidental entry into the access opening. Acceptable protective measures include, but are not limited to, a padlock, a cover that can only be removed with tools, or a cover having a minimum weight of 29.5 kg (65 lb).

6.1.2.4. Base for Effluent Tank

1) The bottom of an excavation for an *effluent tank* shall provide a uniform base to support the tank in a level position and meet the manufacturer's installation instructions.[1]

[1] Intent: Sentence (1) — A tank must have a stable base so it will not settle, shift, or crack after installation.

6.1.2.5. Insulation of Tank

1) An *effluent tank* that has less than 1.2 m (4 ft.) of earth cover to protect it from freezing conditions shall be insulated to provide the equivalent of an R-8 insulation value at the top and sides of the tank to a minimum depth of 1.2 m (4 ft.) below grade or insulated in some other acceptable manner to achieve a level of protection from freezing that is equivalent to a tank that has a minimum 1.2 m (4 ft.) cover of the in situ *soil*.

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6.1.3. Effluent Tanks — Requirements for Materials

6.1.3.1. General

1) No person shall manufacture or install an *effluent tank* unless it meets or exceeds the requirements of CAN/CSA-B66, "Design, Material, and Manufacturing Requirements for Prefabricated Septic Tanks and Sewage Holding Tanks," and is *certified* by an accredited testing agency.

A certified tank will have a label permanently affixed to the tank showing the standard it was certified to and the certifying body. It must indicate it was certified to the CAN/CSA-B66 standard. See Appendix B pg. **236** for more information on certification of products and expected labeling.

Section 6.2. Settling Tanks (Pre-Treatment)

6.2.1. Settling Tanks — Objectives and Design Requirements

6.2.1.1. General

1) The objective of a *settling tank* is to reduce the strength of *wastewater* to a level that is suitable for the downstream component and it may also be used to enable flow equalization with or without the objective of reducing the *wastewater* strength.

6.2.1.2. Settling Tank Used as Pre-aeration Tank

1) A *settling tank* may be used as a pre-aeration tank where required by the system design.

6.2.1.3. Capacity

1) *Settling tanks* shall have the capacity to pre-treat and manage the *wastewater* flow as required by the downstream component and system design

6.2.1.4. Prevention of Infiltration/ Exfiltration

1) Se*ttling tank* access openings, manhole extensions, and piping connections shall prevent *infiltration* and exfiltration.

2) Where the site evaluation identifies high ground water conditions at the location and elevation the tank is installed the design of the system shall address

a) anti-flotation measures required,

b) the ability of the tank to withstand structural stresses caused by the hydrostatic pressure and buoyancy, and

c) maintaining the elevation of piping

Settling tanks are often installed upstream of wastewater treatment plants to reduce the organic load of the wastewater entering the treatment plant.

The settling tank may often also serve or primarily serve the function of equalizing flow coming from the development served.

This standard does not anticipate the quality of effluent discharged from the settling tank will meet the quality expected from a septic tank. The settling tank is simply used to reduce wastewater strength so it is suitable for a treatment plant or for the equalization of flows or both.

A settling tank upstream of a treatment plant is often also used as a pre-aeration tank to reduce organic loading and reducing the aeration loading required of the treatment plant and/or to reduce odour.

The capacity of the required settling tank is very specific to the system design and needs to be justified in the design.

See similar requirements and explanation in Article 4.2.1.3 (2) regarding septic tanks installed in high water table or seasonal high water table conditions.

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connections above the projected *water table* or include other specific additional measures to ensure *infiltration* does not occur through piping connections or manhole access risers.

6.2.1.5. Insulation of Tank

1) A *settling tank* shall have adequate earth cover or other means to protect it from freezing while in operation and during periods of non-use.

See Article 6.2.2.5 for specific requirements regarding insulation.

6.2.1.6. Service Access

1) The system design shall consider the location and depth below grade of the *primary treatment* component (*settling tank*) to facilitate accessibility for septage removal, service, and maintenance.[1]

[1] *Intent: Sentence (1) — The tank should be located where it is unlikely a deck or other structure may be built over the tank or where access may be otherwise limited for removal of septage by a vacuum truck. The depth of the tank should not exceed the practical suction elevation of vacuum trucks in order to enable septage removal.*

Settling tanks as with any other tank will require periodic pumping and cleaning by a vacuum truck.

See Article 4.2.1.2 explanations for more information.

6.2.2. Settling Tanks — Prescriptive Requirements and Installation Standards

6.2.2.1. Separation Distances

1) *Settling tanks* shall not be located within

a) 10 m (33 ft.) from a *water source*,

b) 10 m (33 ft.) from a *water course*,

c) 1 m (3.25 ft.) from a *property* line, and

d) 1 m (3.25 ft.) from a *building*.

Tanks that include pre-aeration need to be considered similar to wastewater treatment plants regarding separation distances as they introduce air to support aeration of the wastewater. As such, the air introduced must be expelled. Reduced clearances may be achieved as allowed by sentence (3) or (4) of this article as it applies to the volume of wastewater treated.

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2) Notwithstanding Sentence (1) a *settling tank* that includes pre-aeration in its function shall not be located within

a) 10 m (33 ft.) from a *water source*,

b) 10 m (33 ft.) from a *water course*,

c) 6 m (20 ft.) from a *property* line, and

d) 1 m (3.25 ft.) from a *building*.

3) Notwithstanding Sentences (1) and (2), a *settling tank* that includes pre-aeration in its function may be located not less than 1 m (3.25 ft.) from a *property* line if

a) equipped with odour control mechanisms,

b) the plant serves a *development* where the peak daily flow is less than 5.7 m3 (1,250 Imp. gal.) per day, and

c) the strength of the *wastewater* from the *development* does not exceed *typical wastewater* strength.

4) Notwithstanding Sentences (1), (2), and (3) a *settling tank* that includes pre-aeration in its function and serves a *development* generating more than 5.7 m^3 (1,250 Imp. gal.) but less than 25 m^3 (5,500 Imp. gal.) per day shall be located

a) if not equipped with odour control devices not less than

  i) 100 m (325 ft.) from the *property* line of an unrelated *development*, and

  ii) not less than 25 m (82 ft.) from the *development* served, or

b) when equipped with odour control devices, the distance may be less than set out in Clause (a) but not less than the distance away from the *development* served and the *property* line of unrelated *developments* needed to minimize odour impact on the *development* and at the *property* line of unrelated *developments*.

6.2.2.2. Access Openings Above Ground

1) *Settling tank* access openings shall not be buried and shall be located at a height above the surrounding landscape that ensures surface water will drain away from the access opening.[1]

[1] Intent: Sentence (1) — Access openings above the ground provide readily available access to the tank as compared to buried access openings, particularly when the ground is frozen. An above-ground access also encourages regular maintenance and provides a permanent and visible marker of the location of the tank.

2) All access openings shall be insulated to provide the equivalent of an R-8 insulation value

6.2.2.3. Access Openings Equipped with a Secure Lid/Cover

1) All access openings shall be equipped with a secure lid or cover.[1]

[1] Intent: Sentence (1) — To increase safety by preventing unauthorized or accidental entry into the access opening of a settling tank. Acceptable protective measures include, but are not limited to, a padlock, a cover that can only be removed with tools, or a cover having a minimum weight of 29.5 kg (65 lb).

6.2.2.4. Base for Settling Tank

1) The bottom of an excavation for a *settling tank* shall provide a uniform base to support the tank in a level position and meet the manufacturer's installation instructions.[1]

[1] Intent: Sentence (1) — A tank must have a stable base so it will not settle, shift or crack after installation.

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6.2.2.5. Protection from Freezing

1) A *settling tank* that has less than 1.2 m (4 ft.) of earth cover to protect it from freezing conditions shall be insulated to provide the equivalent of an 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 other acceptable manner to achieve a level of protection from freezing that is equivalent to a tank that has a minimum 1.2 m (4 ft.) cover of the in situ *soil*.

The insulation used for this purpose must be suitable for underground use. Fiberglass batting style insulation will hold water and freeze solid providing no insulation value. It should not be used outdoors in an underground application. Insulation suitable for below ground use is required. Rigid Extruded Expanded Polystyrene (XEPS) Foam Board is rated at approx R5 – R6 per inch of thickness but vary by type and brand.

This website provides additional information on rigid insulation: http://www.espenergy.com/foam_board_insulation.htm

6.2.3. Settling Tanks — Requirements for Materials

6.2.3.1. General

1) No person shall manufacture or install a *settling tank* unless it meets or exceeds the requirements of CAN/CSA-B66, “Design, Material, and Manufacturing Requirements for Prefabricated Septic Tanks and Sewage Holding Tanks,” and is *certified* by an accredited testing agency.

A certified tank will have a label permanently affixed to the tank showing the standard it was certified to and the certifying body. It must indicate it was certified to the CAN/CSA-B66 standard. See Appendix B pg. **236** for more information on certification of products and expected labeling.

Part 7 Site Evaluation

Section 7.1. Site Characteristics and Evaluation Procedures

7.1.1. Site Characteristics and Evaluation Procedures — Objectives and Design Standards

7.1.1.1. General

1) The objective of a site evaluation is to assess and quantify the capability of the site to infiltrate and disperse the *effluent* load into the *soil* in a manner that achieves the treatment objectives in the *soil* within the performance boundaries set for the *on-site wastewater treatment system*.[1]

[1] *Intent: Sentence (1) — The site's "capability" to treat wastewater is a combination of the site's ability to accept the wastewater load, meet separation distances to other features, and possess the depth of suitable soil needed to achieve treatment. For example, the soil may be able to accept the wastewater load without surfacing but a sufficient depth of unsaturated soil may or may not exist under the proposed hydraulic loading to provide final treatment of the wastewater. Together, all of the site characteristics will determine the suitability of a site for a particular treatment system design.*

The evaluation of the soil characteristics provides the basis of the system design. The treatment effectiveness and sustainability of the system is dependent on an effective evaluation of the site and soils.

The evaluation methods and description of the soil must be consistent with the Canadian System of Soil classification.

7.1.1.2. Site Evaluation

1) A site evaluation shall evaluate and note the

a) topography, landscape position of the system, vegetation, and surface drainage characteristics
   - **i)** the slope gradient and aspect of each landscape element shall be determined for each potential treatment site investigated,
   - **ii)** the landscape positions shall be described for each reported site investigated

Clause (1) (a) requires an evaluation of the surface landscape features.

Slope information and elevation changes are critical information needed to develop an effective design.

Vegetation that favors wet soil conditions indicate unfavorable conditions for on onsite sewage system.

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iii) any vegetation type that favours wet or saturated *soils* shall be identified using its popular name, if known, and have its location identified in relation to the proposed system,

iv) any vegetation that will impact selecting the location of the treatment system or will require removal prior to construction of the treatment system shall be noted, and

v) swales, depressions, and other drainage features that may impact system selection and design shall be located and described, and

b) surface waters, rock outcrops, and other natural features:

i) surface waters, including permanent or intermittent streams, lakes, wetlands, and other surface water within 100 m (330 ft.) of the proposed system, shall be located and described,

ii) rock outcrops within 50 m (165 ft.) of the *soil*-based treatment system shall be located and described, and

iii) any other natural features that could impact the application and/or design of a treatment system shall be located and described.

Rock outcrops in the area indicate a limited soil depth and a potential break out point of the effluent.

2) A sufficient number of suitably located *soil* profiles in the area of the *soil*-based treatment system shall be examined and described to adequately determine the variability of the *soils* on the proposed treatment site by

a) using excavated *soil* pits and intact cores of soil,[1] and

b) completing an investigation to a depth that achieves the objectives of the site evaluation and in no case shall the depth

This Article requires that the soil profile be investigated using excavated soil pits and intact cores of soil. Article 7.1.2.1, Sentence (1), further requires that a minimum of two soil test pit excavations shall be used to investigate and classify the soil. This clearly sets out that excavated test pits must be used as a minimum and soil cores may be used to supplement the investigation of the soils in the area. Soil cores be less than 300 mm (12 in.) deeper than the *vertical separation* distance required below the proposed *soil*-based treatment system.

[1] Note: Clause (2)(a) — A typical method of obtaining an intact core of soil is through the use of a Shelby tube.

3) The characteristics of each *soil* profile investigated shall be described using Canadian System of Soil Classification nomenclature and include the following in the *soil* profile description:[1]

a) *soil horizons:* the distance from ground surface to the top and bottom of each *soil horizon* observed shall be measured and the distinctness and topography of the horizon boundaries described,

b) *soil colour:* for each *soil horizon* identified, the matrix color and the quantity, size, contrast, and color of any redoximorphic features present shall be described,

c) *texture*:

i) for each horizon identified, the *soil texture classification* including any appropriate *texture* modifier shall be reflected in the evaluation report, and

ii) a *soil* sample of the most *restricting layer* affecting the design shall be collected and analyzed at a laboratory using a recognized *grain or particle size analysis* method to determine the *texture* of the sample,[2]

d) structure*: for each* soil horizon *identified, the grade of* soil structure *observed and the size and type of grades, 0-3 shall be described,*

e) consistence*: for each* structure *observed in the profile the consistence of the* soil *peds shall be described,*

f) *compaction: any zones of compaction in the* soil *profile shall be described to*

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estimate its effect on water movement, root penetration and aeration,

g) *saturated zones: for each* soil *profile described, the depth to any water or the depth to the estimated seasonally high zone of saturated* soil *based on redoximorphic or other appropriate features shall be measured,*

h) *bedrock and near impermeable* soil *layers: depth to bedrock and near impermeable* soil *layers observed shall be measured from the ground surface, and*

i) restricting horizons*: for each* soil *profile described, any horizon that is expected to significantly restrict downward water flow shall be identified and measured to determine its depth below ground surface.*[3]

[1] *Note: Sentence (3) — Refer to the Field Book for Describing and Sampling Soils or the Soil Survey Manual available on the web at: http://sis.agr.gc.ca/cansis/intro.html or as included in the Alberta Private Sewage Soils Description Manual.*

[2] *Note: Subclause (3)(c)(ii) — Where a sand fraction modifier such as coarse, medium, fine, or very fine sand is part of the soil texture classification description the laboratory analysis must include the determination of the sand fraction size distribution.*

[3] *Note: Clause (3)(i) — Such horizons may be discerned by evidence of episaturation above the horizon.*

4) Investigation of surface elevations in the area of the *soil*-based treatment system shall include

a) identifying or establishing a permanent benchmark on the *property* and shown on the plot plan of the *property*,

b) surface elevations and horizontal coordinates at each *soil* profile investigation location relative to the benchmark, and

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would typically be used on larger onsite systems or where the results of the test pit evaluations show soil conditions vary significantly over the site.

Handbook Note: The investigation and characterization of the soil profile must go deep enough below grade to show that suitable soil conditions exist at that location for the effluent treatment and dispersal system design. To characterize the soil profile, the soil must be visually and physically examined and sampled through its depth.

To make effective use of this Standard, the description of the soil must use terms that are set out in the Canadian System of Soil Classification as effluent loading rates and available vertical separation is determined by these characteristics. If other terms are used, for example those used in geotechnical evaluations, the terms can be properly applied to the requirements of this standard resulting in an incorrect design.

Soil is made up of three main horizons with sub-horizons within the main horizons. The horizons are distinguished by the different characteristics. Many of these characteristics are important to onsite sewage system design. Including sub-horizons within the three main horizons, many soils in Alberta have five horizons to describe.

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c) a topographic survey shall be performed at a scale sufficient to provide 300–600 mm (1–2 ft.) surface contours over the treatment site.

5) The degree of slope and slope aspect can be substituted for the topographic survey in Clause (4)(c) if the site topography is a simple planer slope.

6) *Property* land uses and *development* within 50 m (165 ft.), or where a *lagoon* is used to within 100 m (330 ft.), of the *on-site wastewater treatment system* shall be identified and described, including[1]

a) the land use of the *property* and adjacent *properties*, and

b) features such as *buildings*, wells, *on-site wastewater treatment systems*, roads, driveways, and other features that may impact treatment system location.

[1] Note: Sentence (6) — Property land uses and development within 50 m (165 ft.) of the treatment system applies to the main property itself, as well as adjacent properties.

7) An available area for construction of the *on-site wastewater treatment system* shall be determined considering relevant horizontal separation distances from features on the *property* or adjacent *properties* that may be required by this Standard and include

a) private, municipal, or other water supply wells,

b) *buildings* or other *property* improvements,

c) *property* boundaries,

d) surface waters and floodplains,

e) right-of-ways and easements, and

f) buried water supply piping, power lines, and other public or private utilities crossing the *property*.

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Sub clause (c) (ii) requires a sample of the soil be collected from the horizon that will impact the design effluent the loading rate most. This is referred to as the most *limiting condition* in the soil horizons that affect effluent loading rates selection. See definition of Limiting Condition – pg. **12**.

The identification of the restricting horizon or depth in the soil is critical to the correct selection and design of an onsite sewage system.

Redoximorphic features referenced in (g) are the soil features of mottled or gleyed soil; these indicate saturated soil conditions exist at times of the year. This is considered a restrictive layer.

See Appendix B pg. **283** for more information on the investigation and characterization of soils.

Surface elevations at critical points at the site are needed to develop a proper design. Elevation changes across the site between the tank and soil effluent treatment system and slope of land affect the selection of effluent distribution systems, pump demands, the selection of tanks, and linear loading capacity of the soil.

The investigation of the site must extend out a sufficient distance to ensure all required separation distances can be met. This often requires a review of adjacent properties to ensure such things as water well on the adjacent property are not too close to the onsite system.

The items identifies in sentence (7) require separation distances to be maintained and must be identified.

7.1.1.3. Site Evaluation Report

1) A site evaluation report documenting the results of the site evaluation shall include the following items or any other relevant design information and form part of the system design documentation:

a) description of the property:
   - **i)** address and legal description of the *property*, and
   - **ii)** parcel identification number,

b) date and time of day the evaluation was performed and weather conditions such as cloud cover, temperature, and precipitation,

c) plan of the *property,* to scale or dimensioned, including the following:
   - **i)** all *property* boundaries,
   - **ii)** *buildings*, roads, driveways, and other *property* improvements existing and proposed,
   - **iii)** existing easements,
   - **iv)** wells or proposed well locations on the *property* or adjacent *properties* within 50 m (165 ft.), or 100 m (330 ft.) if a *lagoon* is to be used, of the proposed system,
   - **v)** topography of the proposed treatment site(s),
   - **vi)** surface waters, rock outcrops, and drainage features,
   - **vii)** *soil* pit or boring locations with surface elevations,
   - **viii)** location of a permanent bench mark and its elevation, and
   - **ix)** outline of available treatment area(s),

d) descriptions of each *soil* profile investigated provided in an appropriate format,[1]

e) a statement regarding the treatment capability and dispersal capacity of the available site(s),

f) where the *soil* profile includes features

A report of the site investigation must be developed that clearly sets out what was investigated and the findings as described in this article. This information provides the basis of the system design. The resulting design is also to be documented to show the system design meets the characteristic of the site.

A key piece of the report is a plan of the property that includes the dimensions and shape of the property. The plan must show by dimensions or a scaled drawing the pertinent parts of the design and features that require separation distances in the standard to be maintained.

The location of the soil test pits need to be shown in relation to the selected site of the soil based onsite sewage system.

The report needs to summarize the main soil characteristics that affect design choices and requirements. Those characteristics are the limiting condition most affecting design.

Often where there are restrictive layers in the underlying soil, the effluent will need to move horizontally in the underlying soil. The capacity of the soil to allow the horizontal movement of the effluent must be determined.

Large systems, over 5.7 cubic meters per day, require additional investigation of the soil to predict potential groundwater mounding. See Appendix B pg. **308** for more information on this. Also see Article 8.1.1.9 (b) on ground water mounding.

Clause (i) of this Article requires the investigation include the determination of characteristic for the development that will affect the volume and strength of the wastewater generated. See Section 2.2 for additional requirements on determining flow volume and strength.

The volume and strength of the sewage is the other critical piece of information needed in that will require the lateral movement of water through the *soil* away from the dispersal system, identify constraints on the system design and allowable *effluent hydraulic loading rates* as it relates to *linear loading* rates,

g) a summary of the significant *limiting conditions* of the *soil* profile and site,

h) a justification of the locations and number of *soil* profiles investigated, and

i) a description of the *development* being served including
  - **i)** characteristics affecting the determination of peak and average *wastewater* flows to be used in the design,
  - **ii)** the peak daily *wastewater* flow volume to be used for the system design, and
  - **iii)** anticipated influent *wastewater* strength.

[1] *Note: Clause (1)(d) — Forms for reporting the soil profile descriptions are available in the Alberta Private Sewage Systems Standard of Practice Handbook; other equivalent forms may be used.*

addition to the soil characteristic required to develop an effective and sustainable onsite sewage system design.

7.1.2. Site Characteristics and Evaluation Procedures — Prescriptive Requirements and Installation Standards

7.1.2.1. Number of Soil Profiles Investigated

1) A minimum of two test pit excavations shall be investigated at the proposed location for

The required soil test pits may be supplemented with soil cores. Where site conditions are variable or the system requires a large area.

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the *soil*-based treatment component to classify and assess the treatment capacity of the *soil*.

7.1.2.2. Minimum Depth of Soil Investigation

1) The *soil* profiles shall be investigated to a

a) minimum depth below ground surface of

i) 1.2 m (4 ft.) for *treatment mounds*,

ii) 2.7 m (9 ft.) for *treatment fields* receiving *primary treated effluent level 1*,

iii) 2 m (6.5 ft.) for a *treatment field* receiving *secondary treated effluent* (Level 2 or better), or

iv) 1.8 m (6 ft.) for *open discharge systems*, or

b) depth at which *vertical separation* limiting features such as saturated *soil* indicators or limiting *soil* conditions are encountered.

7.1.2.3. Percolation Test

1) The results of a *percolation test* shall only be used in support of a design that is based on a *soil* profile investigation and site evaluation required by this standard.

7.1.2.4. Site Evaluation Report

1) A report as required by Article 7.1.1.3. shall be developed and included in the system design information.

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7.1.1.3 (1) (h) requires the number of test pits and locations be justified to show the characteristic have been adequately determined.

During the excavation of the test pit features will be revealed that begin to identify what type of system will be suited for the site.

The process is not to decide a specific system will be suitable prior to examination of the test pit and then excavate to a depth needed for that system. The excavation reveals the characteristics that affect design choices and limits. When a restrictive layer is encountered the excavation does not need to go deeper.

A percolation test is not acceptable for the design of a system. A designer may chose to do a test to gain further information but the results of the percolation test cannot be used for design.

The site evaluation report must form part of the entire system design report and specifications. Examples of system design that can also be used as a template for system design are available at the Municipal Affairs website at http://www.municipalaffairs.alberta.ca/CP_PSDS_DesignToolsAndForms.cfm

Part 8 General Soil-based Treatment

Section 8.1. Soil-based Treatment

8.1.1. Soil-based Treatment — Objectives and Design Standards

8.1.1.1. General

1) The design of any *soil*-based *effluent* treatment system shall meet the requirements of this Section.

8.1.1.2. Infiltration Area

1) In determining the *soil infiltration surface* area required for a *soil*-based *effluent* treatment system the following shall be considered in the design:

a) hydraulic loading capabilities of the *soil* profile,

b) *linear loading* rate limitations of the *soil* profile,

c) organic loading on the *soil infiltration surface* resulting from the *effluent* strength,

d) treatment capability of the *soil* profile,

e) depth of suitable *soil* required to achieve treatment objectives, and

f) achievement of treatment objectives at a depth that does not exceed 2.4 m (8 ft.), or a lesser depth as required by the site conditions and intended treatment boundary limits.

The objectives, design requirements and prescriptive requirements set out in this section apply to all soil based treatment systems. Continuous reference back to this section is required for a soil based treatment system design and installation.

This article lists 6 key items that are identified in the site evaluation. These characteristics must be applied to the selection of the suitable type of final soil based effluent treatment and dispersal system. The size of the system is a factor of these characteristics that indicate the capacity of soil to receive the effluent and the capability of the soil to treat the effluent, and the volume of wastewater generated by the development being served.

8.1.1.3. Effluent Loading Rates On Soil and Restrictions on Coarse Sand

1) The *effluent hydraulic loading rate* on the *soil infiltration surface* shall be based on the *soil texture* and *structure* as set out in Table 8.1.1.10. when the required *vertical separation* distance below the infiltrative surface is available.[1]

[1] *Intent: Sentence (1) — The soil texture classification and soil structure are key indicators of the hydraulic conductivity of the soil or the rate that the soil will accept and transmit water. The soil texture classification of samples taken from the most limiting design layer in the soil profile shall be determined by lab tests. Other field criteria must also be given consideration when sizing a system, such as type of clay, seasonal high water table and water quality; for example, the water's sodium adsorption ratio.*

Effluent loading rates set in Table 8.1.1.10 are related to the characteristics of the soil and the wastewater strength. See Appendix B pg. **304** for a graphic illustration of using this loading rate table.

Coarse sand textured soil has a very limited treatment capability as the field capacity of the soil is low and the mineral make up of the sand has limited cation exchange capacity (CEC) that helps hold and remove pathogens contained in the wastewater.

2) *Effluent* shall not be applied where the in-situ *soil* has the *soil texture classification* of *coarse sand* unless it can be demonstrated the *soil* profile includes horizons of other suitable *textures* that will result in effective treatment and protection of groundwater.

8.1.1.4. Vertical Separation

1) *Soil*-based treatment systems shall maintain a *vertical separation* between the point of *effluent* infiltration into the *soil* and a *water table* or an impervious layer of not less than

a) 1500 mm (5 ft.) when receiving *primary treated effluent level 1*,

b) 900 mm (3 ft.) when receiving *secondary treated effluent* (Level 2 or better),

c) 900 mm (3 ft.) below a *treatment mound* as measured from the bottom of the required 300 mm (1 ft.) depth of *sand layer* intended to provide secondary

The available vertical separation is the depth of suitable soil below the point of applying effluent to the soil infiltration surface and the saturated soil or impervious layer below which is the restrictive layer. This vertical separation is the aerobic treatment zone available in the soil to treat the sewage. A minimum depth of this treatment zone is needed to achieve treatment. Thus the purpose of requiring a minimum vertical separation between the point of effluent infiltration into the insitu soil and the restrictive layer.

The required depth for treatment changes depending on effluent quality as set out in clause

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treatment, or

d) the depth of *soil* required to achieve a 7-day *effluent* travel time to the design boundary depth, provided the *treatment boundary limit* depth does not exceed 2.4 m (8 ft.), as set out in Article 8.1.1.5.

2) Within the required *vertical separation* there shall be at least 300 mm (1 ft.) of in situ *soil* that is assigned a loading rate within this standard.

(a), (b) and (c) and effluent loading rate as set out in clause (d) in this Article.

See definition of vertical separation.

See Appendix B pg. **306** for additional information on vertical Separation and for graphic descriptions of vertical separation required for various systems.

8.1.1.5. Loading Rates and Vertical Separation Exceptions

1) *Effluent hydraulic loading rates* and/or *vertical separation* distances may vary from those set out in Table 8.1.1.10. and Article 8.1.1.4., respectively, and subject to Sentence (2) if

a) the hydraulic loading rate selected will result in a minimum 7-day *effluent* travel time to the *vertical separation* performance *treatment boundary limit* based on
   - **i)** the *mobile soil water* content at *field capacity*,
   - **ii)** a maximum *treatment boundary limit* depth that does not exceed 2.4 m (8 ft.), and
   - **iii)** peak design flow volumes as determined by applying the requirements of Section 2.2.,

b) a minimum *vertical separation* of 900 mm (3 ft.) to saturated *soils* or other limiting *soil* layer is maintained when the system is located within 2 km (1.25 miles) of a
   - **i)** lake,
   - **ii)** river,
   - **iii)** stream, or
   - **iv)** creek, and

c) the *effluent* is delivered to the *soil infiltration surface* using a pressure

The vertical separation distance and effluent loading rates may be varied if an adequate travel time through the available vertical separation is achieved and all requirements of this Article are met.

The effluent loading rate may be increased if addition vertical separation is available, the soil has the characteristics to be able to accept a higher long term effluent loading rate, the effluent travel time from the infiltration surface to the design vertical separation exceeds 7 days, and all the other requirements of this article are met.

See Appendix B pg. **308** for additional information on adjusting effluent loading rates and vertical separations.

Reducing the vertical separation creates risks that treatment will not be effectively achieved. As such a reduction in the prescribed minimum vertical separation of 900mm (3ft.) to not less than 600mm (2ft.) requires a higher quality of effluent being applied (Level 3-DIII). Due to the increased risk the reduction cannot be applied where the conditions set out in clause (b) and (c) are present.

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distribution lateral pipe system in all cases where the *vertical separation* distance is less than required in Clause 8.1.1.4.(1)(a).

2) *Vertical separation* distances may be reduced to a minimum of 600 mm (2 ft.) if the

a) *effluent* being applied will meet the qualities set out for *secondary treated effluent* Level 3-DII,

b) the system is not located within 2 km (1.25 miles) of a lake, river, stream or creek,

c) the system is not located over *GWUDI* which can be classified as a *domestic use aquifer*, and

d) the objective of a 7-day *effluent* travel time is achieved.

3) Where the *soil* profile includes coarse fragments the *effluent hydraulic loading rate* shall be reduced

a) to ensure a 7-day travel time is achieved, and

b) as required by Article 8.1.2.4.

8.1.1.6. Effluent Soil Infiltration Area Design

1) The design of the *soil*-based treatment system shall be based on peak daily flow volumes and the *effluent hydraulic loading rates* set out in this Standard for *primary* and *secondary treated effluent* when the *effluent* is

a) *primary treated effluent level 1* that 80% of the time has a strength of

  i) 150 mg/L *CBOD*$_5$ or less,
  ii) 100 mg/L *TSS* or less, and
  iii) 15 mg/L oil and grease or less, or

b) secondary treated effluent *(Level 2, 3, or 4) that 80% of the time has a strength of*

The effluent loading rates set out in this standard (Table 8.1.1.10 pg. **139**) are based on:

- the applied effluent meeting the qualities set out in this article, and
- the volume of effluent used to determine the required infiltration area is based on the peak flow anticipated from the development.

Primary treated effluent is the quality expected from a septic tank when the raw wastewater from the development does not exceed typical wastewater strength.

See definition of typical wastewater on pg. **22** for raw wastewater strength limit.

If the strength of the wastewater effluent exceeds the values set out for secondary treated effluent the loading rate selected should be based on primary treated effluent.

See Appendix B pg. **308** for more discussion on adjusting hydraulic loading rates to ensure the organic loading rate on the soil infiltration surface does not exceed expected loading.

Effluent applied to the soil will move downward through the soil but then often have to move

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i) 25 mg/L *$CBOD_5$* or less,
ii) 30 mg/L *TSS* or less, and
iii) 10 mg/L oil and grease or less.

2) When the *effluent* strength exceeds the values referred to in Sentence (1), the *effluent hydraulic loading rate* shall be reduced to achieve an organic loading rate on the *soil infiltration surface* that does not exceed the organic loading rate that would result from the anticipated *effluent* strength set out in Sentence (1).

8.1.1.7. System Geometry and Linear Loading Rate Design

1) The design and geometry of the *soil*-based treatment area shall result in an *effluent linear loading* rate that does not exceed the *soil* profile's capability to allow the horizontal movement of the *effluent* away from the treatment system when vertical flow will be restricted and shall consider

a) the values set out in Table 8.1.1.10. that relate horizontal movement of *effluent* through the *soil* to the characteristics of a *soil* profile and the slope of the landscape, or

b) a comprehensive and documented assessment and calculation of the *soil's* capacity to transmit the *effluent* horizontally as set out in Article 8.1.1.9.

8.1.1.8. Pressure Distribution Required

1) *Secondary treated effluent* shall be applied to any *soil*-based treatment system using a pressure *distribution lateral pipe* system that meets the requirements of Section 2.6.

2) A pressure *distribution lateral pipe* system that meets the requirements of Section 2.6. and having orifice spacing of not more than 900 mm (3 ft.) shall be used to apply *effluent* to *soils* having a *texture* of *medium*

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horizontally through the soil because the downward movement is restricted by more compact, fine textured, unstructured soil encountered at deeper depths. The amount of effluent that can move horizontally is limited by the soil conditions. The amount of effluent that must move horizontally is the linear loading rate. The shape (geometry) of the total soil infiltration surface affects the amount of effluent needing to go horizontally per meter or foot of the system length. An infiltration area that is long and narrow, with the longest dimension at a right angle to the slope of the ground, will reduce the amount of effluent at any given point along the system that must move horizontally in the soil below.

Table 8.1.1.10 sets out the volume of effluent that can move through a soil profile based on the characteristics of the soil. Exceeding these limits may create an excessive groundwater mound under the system which reduces the required vertical separation or, in worse cases, causes the effluent to surface on the ground.

Article 8.1.1.9 provides a method of predicting the capacity of the soil to move the effluent horizontally and select linear loading rates that will not cause excessive groundwater mounding. This method can be used as an alternate to applying the values set out in Table 8.1.1.10.

See pg. **302** for a graphic of the linear loading concept on fields and for a graphic representation of the linear loading concept on mounds.

Effluent treated to a secondary treatment Level 2 or better must be applied over the soil infiltration surface using an effluent pressure distribution lateral pipe system. Along with this Article requiring a pressure distribution lateral pipe system meet all the requirements of Section 2.6, Article 2.6.2.2 (1)(c) specifically requires the spacing of orifices is no more than 900mm (3 ft.) when applying secondary treated effluent.

Coarse textured soils as described in Sentence

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sandy loam or coarse sandy loam or any coarser–*textured soil.*

8.1.1.9. Groundwater Mounding Considerations Required

1) In the design of a *soil*-based *effluent* treatment system, the potential for *groundwater mounding* below the *soil*-based *effluent* treatment system shall be considered for all systems where the[1]

a) available *vertical separation* distance to a limiting *soil* layer does not exceed the required *vertical separation* depth by 300 mm (1 ft.) except where the prescriptive requirements of Article 8.1.2.3. are applied, and

b) daily peak flow exceeds 5.7 m3 (1,250 Imp. gal.) per day, in which case the site investigation shall include an investigation of the *soil* capability and capacity to disperse water from the site and the design documentation shall include a calculation of the potential *groundwater mounding* height to determine if the height will negatively impact the system's treatment effectiveness.

[1] *Note: Sentence (1) — Guidance on the intensity of the investigation based on related risk along with recognized methods are available from; Poeter E., J. McCray, G. Thyne, and R. Siegrist. 2005. Guidance for Evaluation of Potential Groundwater Mounding Associated with Cluster and High-Density Wastewater Soil Absorption Systems. Project No. WU-HT-02-45. Prepared for the National Decentralized Water Resources Capacity Development Project, Washington University, St. Louis, MO, by the International Groundwater Modeling Center, Colorado School of Mines, Golden, CO. It can be obtained online at www.ndwrcdp.org. or at National Small Flows Clearinghouse; P.O. Box*

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(2) of this Article can be easily overloaded causing saturated flow through the vertical separation required below the infiltration surface if effluent is not effectively distributed over the entire surface using an effluent pressure distribution lateral system. Gravity based weeping lateral trenches where the effluent enters the trench at one spot, overload the soil at that point and cause saturated flow through the coarse textured soil.

See Appendix B pg. **255** for discussion of the differences in effectiveness between pressure and gravity distribution of the effluent.

Article 8.1.2.3 requires the effluent linear loading of the system design to not exceed the values set out in Table 8.1.1.10. Using these limits will address concerns about excessive groundwater mounding below the infiltration system in smaller systems

However, for large systems the potential for groundwater mounding at the site must be carried out for systems where the peak daily volume of wastewater anticipated from the development served exceeds 5.7 cubic meters (1250 imp. Gal.) per day.

Sources for methods of predicting groundwater mounding are provided in the note to this Article.

See Appendix B pg. **308** for more discussion on groundwater mounding and a graphic illustration of groundwater mounding under an effluent infiltration system.

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8.1.1.10. Effluent Loading Rates on Soil Infiltration Surface

1) The *effluent hydraulic loading rates* and *linear loading* rates suitable for the *soil* profile identified at the site, as characterized by the *texture* and *structure* of the *soil*, shall be determined by using Table 8.1.1.10.

Handbook notes: Definitions of the abbreviations used for soil texture, structure and grade of structure shown in column 1, 2 and 3 of this table are provided on the page following Table 8.1.1.10 (pg **Error! Bookmark not defined.**) and Table A.1.E.1 giving imperial measures (pg 207).

Note references in the Table, such as note [1] for infiltration distance and note [2] related to COS textured soil are provided on the page following the table.

The infiltration loading rate columns provide effluent loading rates for primary treated effluent and secondary treated effluent. Column 4 (30 – 150 mg/L [$CBOD_5$]) of the table provides the allowed effluent loading rate for primary treated (septic tank) effluent. Column 5 (<30mg/L [$CBOD_5$]) of the table provides the allowed effluent loading rate for secondary or better treated effluent.

The allowable hydraulic linear loading rates are set out on the right hand side of the table. The appropriate value is selected by following the appropriate column for slope of the land at the site and the available infiltration distance down to where it intersects with the soil texture and structure characteristics of the soil at the site.

This table identifies that a pressure effluent distribution lateral system must be used to

Note: Table 8.1.1.10, and the Imperial Equivalent Table A.1.E.1 on pg. **206** include editorial updates from the table in the original 2009 Standard of Practice, Edition 1. The changes include the following:

1. Slopes in the second and third column under linear loading; slope of land is now >4-9% and >9%.
2. Unintended table row lines between the structure shapes PR/BK and GR have been removed.
3. A dash between the infiltration distances is replaced with a less than sign (<) to provide clarity.

This table showing equivalent imperial measures is provided in Appendix A Table A.1.E.1 pg. **206**.

See Appendix B pg. 304 for an illustration of how to use this table to select appropriate effluent loading rates in relation to the soil conditions at a site.

The loading rates set in this table may need to be reduced if the soil contains more than 35% coarse fragments (gravel particles that are larger than 2.0mm [approx 5/64 inch)). See Article 8.1.2.4 for the required reduction in loading rate due to increasing amounts of coarse fragments in the soil. The reduction in loading rates in soils that include coarse fragments is needed so the effluent retention time is still achieved in the soil. Coarse fragments reduce the water holding capacity of the soil.

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apply the effluent as required by Article 8.1.1.8 (2) on the coarse textured soils included in the first three rows of the table.

The loading rates in this table are to be applied based on peak daily flow volumes determined following the requirements set out in Section 2.2.

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See Appendix B pg. **292** for information on quantifying the percentage of coarse fragments in a soil.

Table 8.1.1.10. (Metric) Effluent Soil Loading Rates and Linear Loading Rates (Litres)

Soil Characteristics			Effluent loading rate: L/day/sq. metre		Hydraulic Linear Loading Rate, L/day/m								
					Slope of land								
					0 - 4%			>4 - 9%			>9%		
	Structure		Effluent Quality		Infiltration distance[1], m			Infiltration distance[1], m			Infiltration distance[1], m		
Texture	Shape	Grade	30-150 mg/L	<30 mg/L	0.2 <0.3	0.3 <0.6	0.6 <1.2	0.2 <0.3	0.3 <0.6	0.6 <1.2	0.2 <0.3	0.3 <0.6	0.6 <1.2
COS[2], MS, LCOS, LMS Requires pressure distribution	--	0SG	14.7	14.7	59.7	74.6	89.5	74.6	89.5	104.4	89.5	104.4	119.3
FS,VFS,LFS,LVFS Requires pressure distribution	--	0SG	19.6	24.5	52.2	67.1	82.0	59.7	74.6	89.5	74.6	89.5	104.4
COSL, MSL Requires pressure distribution	--	0M	9.8	29.4	44.7	52.2	59.7	53.7	61.2	68.6	74.6	89.5	104.4
	PL	1	9.8	24.5	44.7	52.2	59.7	53.7	61.2	68.6	59.7	74.6	89.5
		2,3	0.0	9.8	29.8	37.3	44.7	32.8	40.3	47.7	35.8	43.3	50.7
	PR/BK/GR	1	19.6	29.4	52.2	67.1	82.0	59.7	74.6	89.5	74.6	89.5	104.4
		2,3	29.4	29.4	52.2	67.1	82.0	59.7	74.6	89.5	74.6	89.5	104.4
FSL,VFSL	--	0M	8.8	17.6	29.8	34.3	38.8	35.8	40.3	44.7	40.3	47.7	55.2
	PL	1	8.8	17.6	29.8	34.3	38.8	35.8	40.3	44.7	40.3	47.7	55.2
		2,3	0.0	7.3	29.8	37.3	44.7	32.8	40.3	47.7	35.8	43.3	50.7
	PR/BK/GR	1	8.8	22.0	44.7	52.2	59.7	49.2	56.7	64.1	53.7	61.2	68.6
		2,3	15.7	30.8	49.2	56.7	64.1	53.7	61.2	68.6	58.2	65.6	73.1
L	--	0M	8.8	22.0	29.8	34.3	38.8	35.8	40.3	44.7	40.3	47.7	55.2
	PL	1	14.7	22.0	44.7	52.2	59.7	49.2	56.7	64.1	53.7	61.2	68.6
		2,3	0.0	7.3	29.8	37.3	44.7	32.8	40.3	47.7	35.8	43.3	50.7
	PR/BK/GR	1	14.7	22.0	44.7	52.2	59.7	49.2	56.7	64.1	53.7	61.2	68.6
		2,3	22.0	30.8	49.2	56.7	64.1	53.7	61.2	68.6	58.2	65.6	73.1
SIL	--	0M	0.0	8.8	29.8	37.3	44.7	32.8	40.3	47.7	35.8	43.3	50.7
	PL	1	0.0	7.3	29.8	37.3	44.7	32.8	40.3	47.7	35.8	43.3	50.7
		2,3	0.0	0.0	--	--	--	--	--	--	--	--	--
	PR/BK/GR	1	14.7	22.0	35.8	40.3	44.7	40.3	44.7	49.2	44.7	52.2	59.7
		2,3	22.0	30.8	40.3	47.7	55.2	44.7	52.2	59.7	49.2	56.7	64.1
SCL, CL, SICL, SI	--	0M	0.0	0.0	--	--	--	--	--	--	--	--	--
	PL	1	0.0	7.3	17.9	25.4	32.8	20.9	28.3	35.8	23.9	31.3	38.8
		2,3	0.0	0.0	--	--	--	--	--	--	--	--	--
	PR/BK/GR	1	8.8	13.2	29.8	37.3	44.7	32.8	40.3	47.7	35.8	43.3	50.7
		2,3	13.2	22.0	35.8	43.3	50.7	40.3	47.7	55.2	44.7	52.2	59.7
SC, C, SIC	--	0M	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	29.8	37.3	44.7	32.8	40.3	47.7	35.8	43.3	50.7
HC	--	0M	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	23.9	31.3	38.8	26.8	34.3	41.8	29.8	37.3	44.7

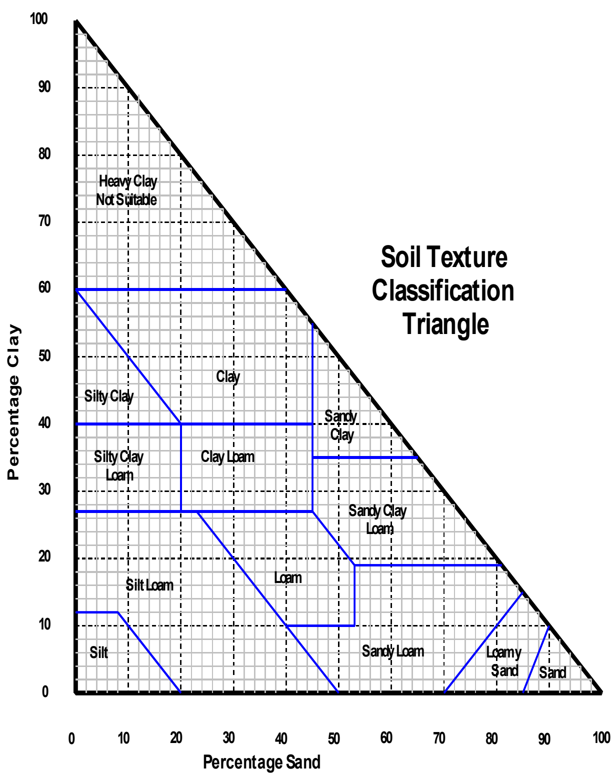
Soil Texture and Structure Abbreviations											
COS	Coarse Sand			**LVFS**	Loamy Very Fine Sand			**SI**	Silt		
MS	Medium Sand			**COSL**	Coarse Sandy Loam			**SCL**	Sandy Clay Loam		
LCOS	Loamy Coarse Sand			**MSL**	Medium Sandy Loam			**CL**	Clay Loam		
LMS -	Loamy Medium Sand			**FSL**	Fine Sandy Loam			**SICL**	Silty Clay Loam		
FS	Fine Sand			**VFSL**	Very Fine Sandy Loam			**SC**	Sandy Clay		
LFS	Loamy Fine Sand			**L**	Loam			**SIC**	Silty Clay		
VFS	Very Fine Sand			**SIL**	Silt Loam			**C**	Clay		
HC	Heavy Clay										
PL	Platy	**PR**	Prismatic	**BK**	Blocky	**GR**	Granular	**M**	Massive	**SG**	Single Grain
0	Structureless	**1**	Weak	**2**	Moderate	**3**	Strong				

[1] *Note: Infiltration distance is the depth of suitable soil below the in situ soil infiltration surface effluent is applied to.*

Table 8.1.1.10. *Infiltration rates in L/d/m^2 for wastewater of >30 mg/L BOD_5 or wastewater of <30 mg/L BOD_5 and hydraulic linear loading rates in L/d/m for soil characteristics of texture and structure and site conditions of slope and infiltration depth to limiting soil layers. Values assume daily wastewater volume estimates used in the design are based on the values set out in* Subsection 2.2.2*. or include the same factor of safety. If horizon consistence is stronger than firm or any cemented class or the clay mineralogy is smectitic, the horizon is limiting regardless of other soil characteristics {adapted from 2000 E. Jerry Tyler}.*

[2] *Note: The application of effluent to Coarse Sand is not allowed except where the requirements of Sentence* 8.1.1.3. (2) *are met.*

Figure 8.1.1.10. Soil Texture Classification Triangle



Note: Plotting the percentage of sand and clay provides the remaining percentage of silt.

8.1.2. Soil-based Treatment — Prescriptive Requirements and Installation Standards

8.1.2.1. Soil Evaluation

1) For the design of in situ *soil*-based treatment systems, the *soil* at the location of the system and required surrounding area shall be evaluated in accordance with Part 7 to determine

a) that the minimum *vertical separation* requirements of the system to be installed will be satisfied,

b) the *soil* characteristics required to determine the appropriate *soil infiltration surface effluent hydraulic loading rate*, and

c) the *soil* characteristics and groundwater conditions that are needed to determine acceptable *linear loading* rate design criteria.

Part 7 of this standard set out the characteristics of the site that need to be identified to select the appropriate soil based infiltration system for the site based on available vertical separation and the characteristics needed to select effluent loading rates on the soil infiltration surface and determine the linear loading capacity of the soil.

Note: If an effective site evaluation as required in Part 7 has not identified the critical characteristics of the site and soils, the requirements of all of Part 8 cannot be effectively applied.

8.1.2.2. Infiltration Loading Rate

1) The *soil infiltration surface loading* rate shall not exceed the amount set out in Table 8.1.1.10. based on the *soil* characteristics identified by the site evaluation.

2) Except where determined in accordance with the requirements of Article 8.1.1.5. the *effluent hydraulic loading rate* applied to a *soil infiltration surface* shall not exceed

a) 14.7 litres per sq. metre (0.3 Imp. gal per sq. ft.) per day on *coarse sand*, *medium sand*, *loamy coarse sand*, or

Sentence (2) sets out maximum effluent loading rates on the infiltration surface that cannot be exceeded. These limits are set to ensure the 7 day travel time of the effluent through the required vertical separation is achieved.

Soils having a texture classification of Coarse Sand have limited treatment capabilities related to pathogen removal but it is even more limited related to nutrient removal.

See Appendix B pg. **305** for more information on these maximum effluent rates on soils to ensure treatment capacity of the soil is not exceeded.

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loamy medium sand textured soils,

b) 29.4 litres per sq. metre (0.6 Imp. gal per sq. ft.) per day on *fine sand*, *very fine sand*, *loamy fine sand*, *loamy very fine sand*, *coarse sandy loam*, or [medium]*sandy loam textured soils*, and

c) 40.7 litres per sq. metre (0.83 Imp. gal. per sq. foot) per day on *loam*- to *clay-textured soils.*

3) *Effluent* shall not b*ture* of *coarse sand* except where conditions allow such a design in compliance with Sentence 8.1.1.3.(2).

8.1.2.3. Linear Loading Rates Not Exceeded

1) Except as provided for in Article 8.1.1.7., the geometry of the *soil infiltration surface* shall be designed to ensure the *linear loading* rates set out in Table 8.1.1.10. are not exceeded.

Table 8.1.1.10 sets out the volume of effluent that can move through a soil profile based on the characteristics of the soil. Exceeding these limits may create an excessive groundwater mound under the system which reduces the required vertical separation or in worse cases causes the effluent to surface on the ground. Also see Article 8.1.1.7 for more explanation; additional information on linear loading is provided in Appendix B, pg. **301**.

8.1.2.4. Infiltration Loading Rate Reduced, Coarse Fragments

1) The *effluent hydraulic loading rate* on *soils* that have a *soil texture classification* of *coarse sand*, *medium sand*, *loamy coarse sand*, or *loamy sand* and that have a coarse fragment content by volume exceeding 35% shall:

a) be reduced to 9.8 litres per sq. metre (0.2 Imp. gal. per sq. ft.) per day for both *primary* and *secondary treated effluent* where the coarse fragment content is from 35% to 60%,

b) be reduced to 7.4 litres per sq. metre (0.15 Imp. gal. per sq. ft.) per day for both *primary* and *secondary treated effluent* where the coarse fragment

c) content is more than 60% but less than

Coarse fragments are gravel particles that are larger than 2.0 mm (approximately 5/64 inch). As the coarse fragment content of a soil increases the water holding capacity decreases. Coarse fragments increase the rate at which the water will flow through these coarse textured soils and minimizes the particle surface area in the soil that is important to treatment of the wastewater.

See pg. **292** for information on identifying the coarse fragment content in soil.

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75%, and

d) not be applied at all on these *soil textures* where the coarse fragment content exceeds 75% by volume.

Section 8.2. Treatment Fields

8.2.1. Treatment Fields — Objectives and Design Standards

8.2.1.1. General

1) A *treatment field* shall meet the following objectives:

a) provide temporary storage of the *effluent* until it is able to infiltrate into the *soil*,

b) break down the organic loading contained in the *effluent*,

c) provide an area of *soil* over which the *effluent* is spread to reduce the hydraulic and organic loading on each part of the *soil infiltration surface*,

d) spread the *effluent* over a suitably sized area to enable sufficient oxygen to be transferred through the *soil* to achieve treatment objectives and long term utilization, and

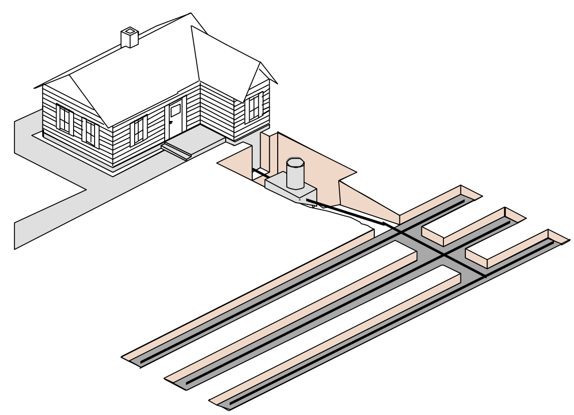
e) introduce the *effluent* into the *soil* and be constructed in a manner that minimizes the risk of *effluent* breakout through the material covering the *soil infiltration surface* area that provides a barrier against direct contact with the *effluent*.

2) The design of a treatment field shall meet all requirements set out in Section 8.1.

8.2.1.2. Effluent Treatment Quality in Soil

1) A *treatment field* is to treat the applied *effluent* as it migrates through the *soil*, as measured at the *vertical separation* boundary required for the design and *effluent* quality being applied to the following quality:

Treatment Field Installation
Deep Bury Pump Type Septic Tank
(Sample layout of field)



There are 5 key objectives of a treatment field design set out in this article:

- temporary storage of effluent
- sufficient area to break down organic loading
- sufficient area to accept the hydraulic loading
- maximize oxygen transfer capability to the infiltration surface and depth of vertical separation below the infiltration surface
- minimize risk of direct contact with the effluent applied by providing a cover over the infiltration surface

Achieving these objectives requires the application of many parts of this standard that set out in previous sections of this standard.

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a) fecal coliform < 10 cfu/100 mL above background levels, or

b) fecal coliform < 2 MPN/gram of dry *soil* above background levels.

8.2.1.3. Effluent Loading Rates

1) The *effluent hydraulic loading rates* for sub-surface *treatment fields* are set out in Article 8.1.1.10. and are based on *effluent* qualities that are equal to or better than *primary treated effluent level 1* or *secondary treated effluent.*

2) If the strength of the *effluent* is higher than

a) *secondary treated effluent*, the *effluent hydraulic loading rates* shall be based on *primary treated effluent level 1*, or

b) primary *treated effluent level 1,* the *effluent hydraulic loading rate* shall be reduced as required to result in a mass organic loading rate on the *soil infiltration surface* that does not exceed the calculated organic loading resulting from the application of *effluent* that meets the *primary treatment* standard.

8.2.1.4. Gravity Distribution

1) A *treatment field* utilizing gravity distribution over the *soil infiltration surface* shall receive a dose volume that

a) encourages spreading over the entire *soil infiltration surface*, and

b) is within the range of 3.4 and 12 L per square metre (0.07 to 0.25 Imp. gal. per sq. ft.) of *weeping lateral trench* per dose.

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The treatment field has the main objective of treating the effluent to these qualities while also being able to operate over a long term in an effective and sustainable manner. There is also a fecal coliform treatment objective set in Article 2.1.1.3. Sentence (2) that must be met by the design with regard to the surface layers of soil above the treatment field that are potentially impacted by the effluent. This clearly establishes that saturation of the soil above the trenches or any migration fecal coliform to the surface is not acceptable.

The effluent loading rates set out in this standard (Table 8.1.1.10) are based on:

- the applied effluent meeting the qualities set out in this article, and
- that the volume of effluent used to determine the required infiltration area is based on the peak flow anticipated from the development.

Primary treated effluent level 1 (definition on pg. **14**) is the quality expected from a septic tank when the raw wastewater from the development does not exceed typical wastewater strength.

See definition of typical wastewater (pg. **22**) for raw wastewater strength limit.

If the strength of the wastewater effluent exceeds the values set out for secondary treated effluent, the loading rate selected should be based on primary treated effluent.

The dosed volume of effluent can be provided by siphon or pump. The volume per dose should be large enough to encourage spreading over the entire treatment field.

The dosed effluent must be evenly split to each weeping lateral trench. See Article 8.2.1.10, 8.2.2.4, 8.2.2.5, 8.2.2.6. 8.2.2.7 and 8.2.2.8 for methods of splitting flow to weeping lateral trenches using a gravity distribution system or pumped supply to gravity weeping laterals.

8.2.1.5. Depth of Weeping Lateral Trench

1) The depth of the *weeping lateral trench* bottom shall be as shallow as possible, while considering the need for frost protection, to maximize the transfer of oxygen through the *soil* at the site to the *soil infiltration surface* and vadose zone below the trench bottom.

Shallow trenches provide the advantage of better aeration to the infiltration surface and take advantage of the higher permeability typically found in the near surface soil; however, some soil cover is needed to provide protection from freezing. The maximum depth of the weeping lateral trench infiltration surface (the trench bottom) is 900mm (3 ft.) see Article 8.2.2.3(1)(a). Shallow trenches help to maximize the available vertical separation below the trench.

8.2.1.6. Trench Width and Separation

1) The width of a trench used in a system design shall consider the organic loading on the *soil infiltration surface* and the ability of the *soil* to transmit the required oxygen demand to the trench bottom and vadose zone.

2) Adequate separation between trenches shall be provided to enable sufficient re-aeration of the subsurface *soil* receiving *effluent*.

The maximum width of a weeping lateral trench is 900mm (3 ft.). See Article 8.2.2.3(1)(b). Narrow trenches provide better aeration to the infiltration surface as well as reducing the amount of aeration needed per running foot of trench due to less organic loading.

Trenches must have a minimum of 3 feet of undisturbed earth between trenches as set out in Article 8.2.2.3(2). See Appendix B pg. **311** for further information and graphics on re-aeration to trenches and organic linear loading.

8.2.1.7. Effluent Loading Rate on Trench Bottom

1) The design *effluent* loading rate on the trench bottom area of a *treatment field* shall be based on Table 8.1.1.10. and comply with Article 8.1.2.2.

The effluent loading rate is determined by the soil characteristics and by applying the appropriate value in Table 8.1.1.0. Article 8.1.2.2 sets out absolute maximum loading rates to ensure the 7 day travel of effluent is achieved through the required vertical separation.

See Appendix B pg. **316** for a worksheet that assists in determining the total area of weeping lateral trench bottom required for a system and provides additional information.

8.2.1.8. Reduction in Trench Bottom Area Permitted

1) A *conventional treatment field* or *gravel substitute treatment field* supplied with *primary treated effluent level 1* may have a 20% reduction in the area of *weeping lateral trench* bottom required in Article 8.2.1.7. when pressure *distribution lateral piping* is used in accordance with Section 2.6. but in no case shall the resulting

Reduction for using pressure effluent distribution laterals. This reduction does not apply when secondary treated effluent is applied to the weeping lateral. A reduction in trench bottom area is allowed when an effluent pressure distribution lateral system is used to spread primary treated effluent. This reduction does not apply if the pressure supply of effluent is only to the start of the trench and the trench distribution is

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loading rate exceed the loading rate for *secondary treated effluent* on that same *soil* profile or limited elsewhere in this standard.[1]

[1] *Note: Sentence (1) — Notwithstanding the provisions in this Article, limits on loading rates need to also consider effluent loading limits established for course textured soils and/or coarse fragment content as set out in other articles. It must also consider limits to achieve 7-day travel times.*

8.2.1.9. Serial Distribution Prohibited

1) A *treatment field* shall not use *serial distribution* as a method to distribute *effluent* to *weeping lateral trenches*.[1]

[1] *Intent: Sentence (1) — The effluent should be distributed to each lateral evenly. The effluent should not be allowed to flow through one weeping lateral trench to reach another weeping lateral trench at a lower elevation.*

8.2.1.10. Equal Distribution to Gravity Weeping Laterals

1) When gravity distribution is used to supply *effluent* to the *treatment field weeping lateral trenches*, the *effluent* distribution system shall be designed to provide approximately equal *effluent* distribution to each *weeping lateral trench*.

8.2.1.11. Monitoring Effluent Ponding Depth

1) To facilitate monitoring of the *soil*-based treatment system, each *weeping lateral trench* shall be equipped with a method of evaluating the ponding depth within the length of the *weeping lateral trenches*.

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by gravity, such as shown on pg. **320** showing a graphic of a Pressure Header to Gravity Weeping Lateral Trenches.

Applying this reduction credit cannot result in the actual effluent loading rate exceeding the maximum effluent loading rate allowed under Article 8.1.2.2. This problem is most likely to occur in sandy textured soils so should be checked in those situations. **This credit does not apply to the application of secondary treated effluent.**

Applying this credit cannot result in a credited trench width exceeding 3 feet, as the soil's capacity to transfer oxygen through the soil to supply the 3 foot wide trench will be exceeded. This limit is consistent with the limits for credited width applied to chamber trenches to address organic linear loading rates resulting from the effluent loading as discussed in Appendix B pg. **312**.

Serial distribution of effluent is where the effluent must travel through one weeping lateral trench before entering another weeping lateral trench. This method is not allowed.

The delivery of effluent to the weeping lateral trenches must be designed to result in equal effluent loading to each trench so an individual trench is not overloaded. More specific direction is provided by Article 8.2.2.5 (gravity distribution header), Article 8.2.2.6 (laterals at different elevations), Article 8.2.2.7 (distribution boxes), and Article 8.2.2.8 (drop boxes).

See Appendix B pg. **318** to **322** for more discussion of equal distribution between gravity weeping laterals.

Ports into the weeping lateral trench allow and assessment of the system operation in regard to effluent ponding in the trench. Increasing ponding depth may indicate the system is beginning to fail. See Article 8.2.2.10 for specific requirements regarding the installation of these monitoring ports.

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8.2.1.12. Treatment Field Layout

1) The geometry of the *treatment field* layout shall consider the *linear loading* rates set out in this Standard or be determined by calculation of *groundwater mounding* impacts to ensure the cumulative loading from numerous trenches does not exceed the capacity of the *soil* to transmit the *effluent* away from the *weeping lateral trenches*.

A graphic illustration of these ports can be found on pg. **364**.

Treatment fields, as with treatment mounds, need to consider the linear loading capability of the soil. The shape of the treatment field area should be as long as possible. Where the soil conditions present a restrictive layer below the field, the linear loading rates set out in Table 8.1.1.10 need to be applied to determine the minimum length of the area covered by individual trenches in the treatment field.

See Appendix B pg. **302** for consideration of linear loading for treatment fields.

8.2.1.13. Fine Textured Soil Restriction

1) A *treatment field* shall not be installed on *soils* that have an *effluent hydraulic loading rate* of less than 9.80 L per square metre (0.2 Imp. gal. per sq. ft.) per day.

Fine textured soils have limited suitability for the use of weeping lateral trenches. A significant limitation in these soils is the ability of the soil to allow air and oxygen to the infiltration surface. In fine textured soils a treatment mound is an alternate to a treatment field. See Table 8.1.1.10 to determine the soil effluent loading rate allowed on fine textured soils.

8.2.2. Treatment Fields — Prescriptive Requirements and Installation Standards

8.2.2.1. Separation Distances

1) A *treatment field*, measured from any part of a *weeping lateral trench*, shall not be located within

a) 15 m (50 ft.) from a *water source*,

b) 15 m (50 ft.) from a *water course*, except as provided in Article 2.1.2.4.,

c) 1.5 m (5 ft.) from a *property* line,

d) 10 m (33 ft.) from a basement, cellar, or crawl space,1

e) 1 m (3.25 ft.) from a *building* that does not have a permanent foundation,

f) 5 m (17 ft.) from a *building* that has a

These separation distances must be considered in locating the system.

Article 2.1.2.4 requires a 90m (300 ft.) separation from a lake, river, stream, or creek in specific circumstances.

permanent foundation but does not have a basement, cellar, or crawl space, and

g) 5 m (17 ft.) from a *septic tank* or *packaged sewage treatment plant*.

[1] *Note: Clause (1)(d) — The 10 m (33 ft.) requirement to a basement, cellar, or crawl space is intended to protect excavations below grade from accumulating migrating effluent. A crawl space that is not below grade, or where the level of the ground surface at the treatment area is below the level of the crawl space, the separation required is 5 m (17 ft.) clearance as it can be treated as a building without a basement.*

See definition of building, page **7,** for clarity in applying this article. For example, farm buildings that do not fall under the requirements of the Building Code do not apply to this requirement. However consideration of the potential impact the added effluent will have on the building foundation must be considered by the system designer and building owner.

8.2.2.2. Coarse Textured Soil – Restrictions On Effluent Application

1) A *treatment field* shall not be installed in *soil* having a *texture* of *coarse sand*, medium *sand*, *fine sand*, *loamy medium sand* or *loamy coarse sand* unless

a) a pressure *effluent distribution lateral pipe* system having orifices spaced at not more than 900 mm (3 ft.) is used to distribute the *effluent* over the *soil infiltration surface*, or

b) sufficient *soil* profile information is provided indicating that within the design boundary *vertical separation* distance required for the system there is a layer of in situ *soil* throughout the entire area that[1]

i) has a *soil texture* of *loamy fine sand* or finer textured,

ii) has a minimum thickness of 300 mm (1 ft.), and

iii) a *effluent hydraulic loading rate* of 14.7 L per sq. metre (0.3 Imp. gal. per sq. ft.) per day is not exceeded.

[1] *Intent: Clause (1)(b) — The trenches cannot be lined with imported material to take the*

This article reflects the general requirements set out in Articles 8.1.1.3 (2) (restrictions on coarse sand), 8.1.1.8 (pressure distribution required on coarse textured soils), and 8.1.2.2 (2)(a) (limits on effluent loading on sandy soils).

Limits to effluent loading rates when there are more than 35% coarse fragments (gravel) set out in Article 8.1.2.4 may further restrict loading rates and must be considered.

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place of the in situ soil.

2) A t*reatment field* in *soil* having a *soil texture* referred to in Sentence (1) shall have the *effluent* distributed using a pressure *distribution lateral pipe* system meeting the requirements of Section 2.6. and have orifices in the laterals spaced at not more than 900 mm (36 in.).

8.2.2.3. Weeping Lateral Trench Construction

1) A *weeping lateral trench* shall

a) be not more than 900 mm (3 ft.) deep,1

b) be between 300 mm (12 in.) and 900 mm (3 ft.) in width,

c) have a *nominally level* bottom,

d) include a void space created by

- **i)** a chamber,
- **ii)** *weeping lateral trench* media meeting the requirements of Sentence 8.2.3.1.(1) placed at the bottom of the trench filling the entire width of the trench to a depth of 300 mm (1 ft.), or
- **iii)** *sand* meeting the requirements of Sentence 8.2.3.1.(2) placed in the bottom 150 mm (6 in.) of the trench, covered by 150 mm (6 in.) of *weeping lateral trench* media,

e) provide a minimum of 30% void volume under compression conditions equal to the weight of 1 m (3.25 ft.) of earth cover, and

f) be covered with a material to prevent migration of *soil* particles into the void space of the distribution media and allow the movement of air into the system that is either

- **i)** a geotechnical *filter fabric* that allows the movement of air and water through it,
- **ii)** 75 mm (3 in.) of a non-oil-seed

There is no minimum depth prescribed for a weeping lateral trench. The treatment objective set out in Article 2.1.1.3 (2) will require a soil, or other suitable media cover, of sufficient depth which may vary based on the design to achieve this objective in that article. This infers a minimum depth of 75mm (3in.) soil cover.

Article 2.1.1.4(1)(e) requires the consideration of cold weather operation and Article 8.2.1.5 "Depth of Weeping Lateral Trench" requires the trench be as shallow as possible to maximize oxygen transfer to the infiltration surface and vadose zone below the trench while considering the need for frost protection. Many designers and installers will maintain a minimum 300mm (1 ft.) cover over the treatment field trench gravel or chamber.

The trench bottom shall be level from end to end and not more than 900mm (3 ft.) deep.

The filter fabric to be used is a defined term. Refer to the definition of filter fabric, pg. **10** and Appendix B pg. **326** for more information on filter fabric and the purpose of filter fabric or straw referenced in this article.

The separation between trenches is needed to provide a re-aeration pathway to the soil infiltration surface at the bottom of the trench. See Appendix B page **311** for further discussion of this and a graphic illustration of the re-aeration pathways.

straw, or other equivalent fibrous material, or

iii) a material having equivalent properties.

[1] *Note: Clause (1)(a) — While no minimum depth is specified in this Standard, a cover of 300 mm (12 in.) of soil over the top of the gravel and effluent pipe has typically been maintained although there are many examples of weeping lateral trenches being placed at shallower depth throughout Alberta without encountering freezing problems. The burial depth required for adequate frost protection depends on a number of factors which include typical snow cover, type of soil at the site, and length of time the system may go without receiving effluent that adds heat to the soil.*

2) A *weeping lateral trench* shall be located so as to provide a minimum of 900 mm (3 ft.) of earth between the side wall of the trench and the sidewall of an adjacent *weeping lateral trench*.

8.2.2.4. Gravity Distribution Weeping Lateral Pipe

1) A gravity distribution *weeping lateral pipe* shall be

a) laid *nominally level* at a maximum depth of 600 mm (2 ft.) below the finished ground surface, as measured from the top of the pipe, and

b) installed with the top of the pipe at the top of the *drain media* used in the trench.

Effluent can be distributed through the trench using a gravity weeping lateral pipe as set out here or with a pressure effluent distribution lateral. The piping used shall meet the requirements for piping set out in Subsection 2.5.3. The diameter of the gravity weeping lateral pipe shall not be less than 3 inch as set out in Article 2.5.2.4.

8.2.2.5. Weeping Lateral Connected to Gravity Distribution Header

1) Where *weeping lateral pipes* connect to a gravity *distribution header* or *field header*, all piping in the *treatment field* shall be installed at the same elevation.

A gravity distribution header is somewhat effective in achieving relatively equal distribution only when all laterals are at the same level. This design should include an equalization header set at the trench bottom elevation to equalize effluent levels in all trenches. See Appendix B pg. **319** for a graphic illustration of this.

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8.2.2.6. Gravity Weeping Laterals at Different Elevations

1) Where *weeping lateral pipes* in the field are at different elevations either

a) pressure distribution supply to each *weeping lateral trench* shall be used, or

b) a distribution box shall be used to distribute the *effluent* evenly to each *weeping lateral pipe*.

When laterals are at different elevations a simple gravity distribution header is not effective. A distribution box (see Article 8.2.2.7 and Appendix B pg. **322**) or a pumped pressurized line to the start of each gravity distribution lateral (see Appendix B pg. **320**) is needed to achieve equal distribution to trenches.

8.2.2.7. Distribution Box

1) When used in a system, a distribution box shall[1]

a) have an internal dimension not exceeding 300 mm (12 in.),

b) provide relatively equal distribution to all outlets, and

c) be readily accessible for inspection and service and adequately protected from frost .

[1] *Intent: Sentence (1) — To ensure relatively equal distribution to all weeping laterals. The maximum internal dimension of the distribution box minimizes the impact soil movement or frost heaving that tips the box out of level will have on the even distribution of the effluent. Accessibility is required to confirm distribution during service.*

See graphic of distribution box on pg. **322**.
The limited dimensions of this distribution box help minimize the change in elevation that may occur if the box settles or is moved by frost heaving.

The box must be accessible from ground surface to inspect for even distribution and make adjustments if needed. This is a regular maintenance item. Insulation above the box is recommended to minimize the impact of frost.

8.2.2.8. Drop Boxes

1) Notwithstanding Sentence 8.2.1.10.(1), where drop boxes are used to distribute *effluent* to *weeping lateral trenches*[1]

a) the *treatment field* may be installed on sloping ground,

b) the invert of the outlet piping to the next drop box shall be

i) above the top of the *weeping lateral pipe* outlet, and

Drop boxes can also be used when laterals are not at the same elevation. However, they result in the sequential use of the laterals and cause overloading of the first latera, which can result in poorer treatment of the effluent due to saturated flow through the soil.

These are not a preferred method of distribution of effluent.

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ii) a minimum of 25 mm (1 in.) below the invert of the inlet piping to the drop box, and

c) the drop box serving each *weeping lateral pipe* shall have provisions for preventing *effluent* from entering the *weeping lateral pipe* to facilitate resting of the lateral.

[1] *Intent: Sentence (1) — A drop box system is a form of an anaerobic effluent treatment system. It is intended to be used primarily in very porous soil structures where the creation of a restricting layer of biomat is desired. This biomat reduces the infiltration rate of effluent into the soil. This design is used to reduce infiltration rates where desired. A drop box cannot be used as a "distribution box" for distributing effluent evenly to weeping lateral trenches.*

2) Where drop boxes are used, the operation manual shall specifically identify the requirement to periodically redirect *effluent* flow.

8.2.2.9. Location Restriction

1) A *treatment field* shall not be located under

a) a roadway or driveway,

b) a paved area,

c) a vehicle parking lot,

d) any structure, or

e) a vegetable garden.

8.2.2.10. Monitoring Pipes

1) There shall be a minimum of two monitoring pipes per *weeping lateral trench*, which extend from the surface of the ground to the depth of the *soil infiltration surface* and are located within 4.5 m (15 ft.) from each end of the *weeping lateral trench*.

These monitoring pipes installed into the trench achieve the objective of Article 8.2.1.11, which is to enable monitoring of the effluent ponding depth on the trench bottom infiltration surface. Excessive ponding in one trench indicates poor distribution. Excessive ponding in all trenches indicates a potential failure developing. See Appendix B pg. **364** for a graphic illustration of these monitoring pipes.

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8.2.2.11. Raised Treatment Field Contact with In Situ Soil

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 *soil* surface to the finished elevation of the *soil infiltration surface* area, shall meet the requirements of the sand specified in Article 8.4.3.1., and

c) *effluent* shall be distributed through the laterals using a pressure distribution lateral system meeting the requirements of Section 2.6.

This portion of the treatment field section sets out specific requirements for the construction of a raised treatment field. These raised treatment fields are fully or partially installed in imported fill material. Specifications for the fill material are set out in this portion of the section.

Any fill under trenches shall meet the specifications set out in Article 8.4.3.1 which is the specification for sand used in the sand layer of a treatment mound.

Pressure distribution must be used to spread the effluent effectively.

2) A raised *treatment field* shall not be used unless there is a minimum of 600 mm (2 ft.) of in situ soil that is assigned an *effluent hydraulic loading rate* in Table 8.1.1.10. below the raised *treatment field*.

There must be sufficient depth of soil below the raised field to complete treatment of the effluent and allow the movement of the effluent away from the field area. Linear loading rates set out in Table 8.1.1.10 must be applied.

8.2.2.12. Raised Treatment Field Fill Material

1) *Coarse sand*, *medium sand*, *fine sand*, *loamy medium sand* or *loamy coarse sand* fill material shall be used for the backfill material covering the area of the *raised treatment field* and it shall be[1]

a) placed over the gravel layer of the trenches or over the chambers to a depth of 300 mm (1 ft.), and

b) the finished grading of the fill material

Fill material imported that is between and over the weeping lateral trenches must be coarse textured soils as specified in this article. The imported soil will lose any structure it had in situ and thus reduce the capacity to allow air to the infiltration surface.

A capping soil as specified in Sentence (2) enables sufficient water holding capacity to

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shall ensure positive drainage of precipitation off the area of the *raised treatment field*.

[1] *Intent: Sentence (1) — To provide an adequate slope (1% or more) on the top of the field to prevent excessive infiltration and ponding of precipitation and snow melt on the area of the field.*

support grass growth over the raised treatment field which will help reduce the infiltration of precipitation (rain and snow melt) into the field area.

2) In addition to the requirements of Sentence (1), 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 a grass cover.

8.2.2.13. Grass Cover on Raised Treatment Field

1) A grass cover shall be established over the entire area of the *raised treatment field*.[1]

[1] *Intent: Sentence (1) — A contractor meets the requirement of this Sentence by seeding the area to grass, leaving the responsibility to the owner to water and maintain the grass cover. The grass cover is needed to prevent erosion of the area and limit infiltration under heavy precipitation events.*

The grass growth over the raised treatment field will reduce the infiltration of precipitation (rain and snow melt) into the field area and stabilize the imported fill.

8.2.2.14. Side Slopes of Raised Treatment Field Area

1) The side slopes on the area covering the *raised treatment field* shall not be steeper than 1:3 (one vertical to three horizontal).

This maximum slope is set out to avoid slumping of the sloped fill material.

8.2.3. Treatment Fields — Requirements for Materials

8.2.3.1. Weeping Lateral Trench Media

1) Except as provided in Sentence (3), *weeping lateral trench* media shall

a) consist of materials that maintain structural integrity and will not be degraded by the environment created in the *treatment field* trench,

b) consist of 12 mm (1⁄2 in.) to 50 mm (2 in.) particle size material,

c) be able to withstand vertical and horizontal loads from backfill equal to a minimum of 1 m (3.25 ft.) of earth cover, and

d) not contain more than 2% by weight fines, silt, or clay.

2) *Sand* used for the *sand layer* shall have

a) a particle size distribution that meets

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) the particle size distribution required for a medium-sand *sand filter* as set out in Sentence 5.3.3.4.(2),

b) an *effective particle size (D10)* of not less than 0.3 mm, and

The media typically used in a weeping lateral trench is gravel. This article set out the size limits of the gravel and requires it has a minimal amount of fines within the gravel. To meet the minimum required fines, the gravel must be washed gravel. Generally, gravel used to make concrete is suitable. A jar test on site can be used to help qualify the suitability of the gravel. Gravel used for weeping lateral trenches should be supported by an analysis by the supplier that it meets the minimum fines content.

Fines in the gravel will be washed off by the applied effluent and will have a tendency to fill any soil structure macro pores and so limit the infiltration capability of the soil.

If sand is used in the bottom half of the trench media, it can be effective in assisting in the removal of the organic load (BOD_5) prior to it infiltrating into the original soil surface. This can help increase the treatment efficiency of the field and provide protection in the case of periodic organic overloading.

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c) a *uniformity coefficient (CU)* of between 4 and 6.

3) When shredded tires are used as *weeping lateral trench* media, they shall be individual pieces

a) between 25 mm (1 in.) and 50 mm (2 in.) in *size*, and

b) washed free of particles, *fines*, and dust.

8.2.3.2. Piping

1) Piping used in a *treatment field* shall meet the requirements of Section 2.5.

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Piping must be certified to the required standard.

Section 8.3. Chamber System Treatment Fields

8.3.1. Chamber System Treatment Fields — Objectives and Design Standards

8.3.1.1. General

1) The objectives set out in Subsection [8.2.1.] apply to *chamber system treatment fields*.

2) The design of *chamber system treatment fields* shall meet requirements set out in this Standard except as provided in this Section.

Note: An editorial change has been made to this Article. The original reference was to Subsection 8.2.1, which is incorrect. The proper reference is to Subsection 8.2.1. Treatment Fields – Objectives and Design Standards. This sets out that all the requirements of Subsection 8.2.1 for typical gravel type treatment fields apply in this section except as specifically set out in this section. Subsection 8.2.1 also sets out that all of Section 8.1 applies and so it applies to this section.

8.3.1.2. Serial Distribution Prohibited

1) *Serial distribution* shall not be used as the method of distributing *effluent* to *weeping lateral trenches* that use chambers.

Serial distribution of effluent is where the effluent must travel through one weeping lateral trench before entering another weeping lateral trench. This method is not allowed.

8.3.1.3. Chamber Dimensions

1) Chambers shall be a minimum of 300 mm (1 ft.) wide and a maximum of 900 mm (3 ft.) wide.

8.3.1.4. Calculation of Infiltration Area

1) The effective *soil infiltration surface* area provided by chambers shall be calculated using the interior width at the base of the chamber where *effluent* contacts the *soil* and may be factored to determine loading rates as set out in Article 8.3.1.5.

The interior dimension that provides open contact with the soil may vary from the outside overall dimension of the chamber used. As well the chamber wall may have indents to improve strength. The actual open area must be determined and applied to infiltration area calculations.

Chambers receive a credit in the infiltration area calculated or required in comparison to gravel trenches.

8.3.1.5. Calculation of Trench Bottom Area

1) Notwithstanding Article 8.2.1.7., when receiving *primary treated effluent level 1*

Manufacturers of chambers may indicate in their literature that a certain reduction or credit can be used. Their claims do not apply above the

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the *effluent hydraulic loading rates* for a *treatment field* using chambers

a) may be calculated using 1.1 times the actual width of the chamber when *effluent* is distributed in the trench by gravity,[1]

b) may be calculated using 1.3 times the actual width of the chamber when the *effluent* is distributed using pressure distribution lateral *piping* and no reduction in area has been calculated for the use of pressure *distribution lateral piping* as provided in Article 8.2.1.8., and

c) shall in no case exceed the *effluent hydraulic loading rate* set out in Table 8.1.1.10. for *secondary treated effluent*.

[1] *Note: Clause (1)(a) — For example: A system requires 81 sq. metres (872 sq. ft.) of trench bottom absorption area:*

Gravel trenches: 81 sq. metres (872 sq. ft.) divided by 0.6 m (2 ft.) wide trench = 135 m (436 ft. of trench

Chamber system: 81 sq. metres (872 square ft.) divided by (0.6 m (2 ft.) wide actual width of chamber x 1.1 = 0.66 m (2.2 ft.) = 123 m (396 ft.) of trench.

2) Regardless of the width of the chamber used, the calculated chamber width in Sentence (1) shall not exceed 900 mm (3 ft.) when applying *primary treated effluent level 1*.

3) When receiving *secondary treated effluent* the *effluent hydraulic loading rate* and calculation of the *soil* infiltration surface required shall be based on

a) 1.1 times the actual width of the chamber, or

b) 1.2 times the actual width of the chamber if timed dosing is used in the system.

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requirements set out in this standard.

When effluent is distributed over the trench by gravity flow, a credit of 1.1 times the actual width of the chamber can be applied.

If the effluent is applied using pressure effluent distribution laterals, the credit may be 1.3 times the actual open area width of the chamber. Additional credit for pressure distribution allowed by Article 8.2.1.8 **cannot** be used to increase the credited infiltration width.

The credited width of the chamber shall not exceed 900mm (3 ft.) as a result of these allowed credits when applying primary treated effluent. This limit applies specifically to when primary treated (septic tank) effluent is applied. This limit does not apply if secondary treated effluent is applied. The difference is the secondary treated effluent has a lower oxygen supply demand. The limit of a 900mm (3 ft.) width is to avoid limiting oxygen supply to the infiltration surface, a consideration for both chamber systems and gravel trenches.

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8.3.1.6. Loading Rate Not to Exceed 7 Day Travel Time Limits

1) The actual trench bottom *effluent hydraulic loading rate* under the actual open area of the chambers shall not exceed the loading rates set out in Articles 8.1.1.2., 8.1.1.3., and 8.1.1.5., or that would result in the travel time of *effluent* to the *treatment boundary limit* to be less than 7 days, as provided in Clause 8.1.1.4.(1)(d).

When applying the credits for chamber widths the actual loading on the soil will increase.

Consideration of the maximum actual loading allowed on a soil to ensure adequate travel time to the treatment boundary must be made. These other limits that must be considered in the design are set out in the articles referenced in this article.

See Appendix B pg. **303** for further information on considering these ultimate loading rates.

8.3.2. Chamber System Treatment Fields — Prescriptive Requirements and Installation Standards

8.3.2.1. Separation Distances

1) The location of a sub-surface chamber system shall comply with the requirements of Article 8.2.2.1. that sets out the minimum separation distances for *treatment fields*.

Article 8.2.2.1 referenced sets out the distances to property lines buildings wells and water courses.

8.3.2.2. Manufacturer's Instructions

1) Chamber systems shall be installed in accordance with the manufacturer's instructions, except that in the event of a conflict with this Standard, the requirements of this Standard shall apply.

Chamber manufacturers will set out installation instructions. However, if those instructions conflict with the requirements of this standard, the standard must be followed instead of the instructions on the specific issue. For example, the manufacturer may claim their product receives certain credits on loading rates. The credits cannot exceed what is allowed in this standard. See pg. **327** for info on when a geotech fabric should be used despite manufacturer's instructions.

8.3.2.3. Prevention of Soil Disturbance and Erosion

1) Chamber system installations that do not include *effluent* distribution piping running the total length of the trench shall include a means to dissipate the hydraulic energy of the *effluent* delivered to the trench in order to minimize the disturbance and erosion of soil at the trench bottom where the *effluent* is delivered by using[1]

a) geotextile fabric covering the width of the trench under the chamber in the most upstream 1.5 m (5 ft.) portion of the *weeping lateral trench* or other area that receives *effluent*,

b) a minimum of 50 mm (2 in.) of gravel in the most upstream 1.5 m (5 ft.) portion of all *weeping lateral trenches* or other area that receives *effluent*, or

c) other suitable means to dissipate the hydraulic energy of the *effluent* it is receiving and prevent erosion or disturbance of the trench bottom.

[1] *Intent: Sentence (1) — To prevent erosion or disturbance of the trench bottom by the effluent that spills into the chamber rather than being piped the entire length of the chamber lateral.*

Chamber systems that rely on gravity distribution along their length result in the effluent dose being dumped into the chamber weeping lateral trench at one point. The energy of the effluent from the dose can disturb the soil at the point it enters if the soil is not protected.

Clauses (a), (b) and (c) set out methods of protecting the soil and allow other suitable means that will effectively dissipate the energy of the incoming effluent. A concrete block and layer of sand may be a suitable alternate to the gravel described in clause (b). The sand would need to cover the first 5 feet of the trench and the block placed to receive the impact of the incoming effluent.

This is not a typical requirement in installation instructions and is an example of a requirement in the standard that must be applied above the installation instructions.

8.3.3. Chamber System Treatment Fields — Requirements for Materials

8.3.3.1. Certification

1) All Chambers shall be *certified* as meeting or exceeding the requirements of the American Association of State Highway and Transportation Officials H -10 or H -20 ratings.

The H-10 and H-20 ratings referenced are a load bearing standard to evaluate structural strength. It is tested when a chamber or culvert is buried in a specific manner and depth of cover. Chambers in treatment fields are not buried in the manner specified so may not stand up to the given ratings in the field; however the rating provides a minimum structural strength evaluation. The amount of load bearing capacity lost when not buried as specified in this test may vary between chamber types. Installers should consider this when choosing chambers for a specific application.

Section 8.4. Treatment Mounds

8.4.1. Treatment Mounds — Objectives and Design Standards

8.4.1.1. General

1) The design of a *treatment mound* shall meet all requirements set out in Section 8.1.

8.4.1.2. Effluent Treatment Quality in Soil

1) At a depth of 900 mm (3 ft.) below the bottom of the required thickness of the *sand layer* and in the *effluent*/groundwater plume at the edge of the *berm*, the treated *effluent* shall meet the following criteria:

a) fecal coliform < 10 CFU/100 mL above background levels, or

b) fecal coliform < 2MPN/gram of dry *soil* above background levels.

2) The *effluent*/groundwater plume shall not exceed background levels of fecal organisms 8 m (25 ft.) horizontally from the *soil treatment area*, as measured from the edge of the *treatment mound berm*, including during typical periods of climatic stress and/or typical/maximum designed flow volumes.

8.4.1.3. Sand Layer — Orientation on Slopes

1) The geometry of the *sand layer* shall conform to the surface slope contour of the site it is placed on such that

a) the long axis of the *sand layer* (its longest dimension), including any 3 m (10 ft.) segment of the sand layer, shall be oriented at 90 degrees to the slope direction,

b) the downslope edge of the *sand layer*

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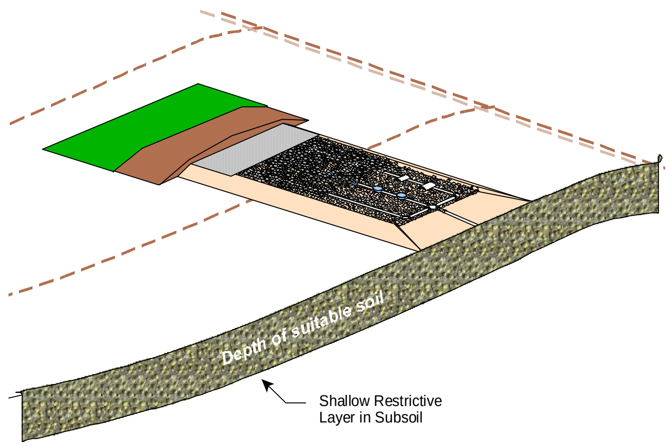

See pg. **328** for larger view.

The design of a treatment mound must include consideration and application of the requirements set out in Section 8.1 that sets effluent infiltration loading rates and other principles of treatment of the effluent in the soil.

The purpose of the treatment mound is to treat the sewage, preventing a negative impact on the near surface and deeper groundwater as to effectively disperse the effluent in the soil so there is no risk of direct contact with effluent.

Article 2.1.1.3 that sets out a quality limit for the soil from surface to a depth of 3 inches also applies to treatment mounds.

Treatment mounds are often used where there are limiting features in the soil below that reduce the available vertical separation. In these cases it will result in horizontal flow of the effluent in the soil below; this is why there is an effluent quality set for the 8m (25ft.) horizontal distance from the mound.

The design of a treatment mound results in a rectangular shaped treatment system. The longest dimension of the treatment mound must be placed

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where it makes contact with the in situ (original) *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 of the *sand layer*, and
- **ii)** be level within 100 mm (4 in.) as measured within any 600 mm (2 ft.) segment of its length, and

c) when placed on a convex slope, the deflection of curvature of the *sand layer* 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 *sand layer*.

2) If there is documentation that the direction of groundwater movement is different than the slope of the land, the direction of groundwater movement must be considered in determining the preferred orientatin of the *sand layer* as it relates to groundwater flow direction and soil characteristics for the purpose of managing *linear loading rates* and the impact of *groundwater mounding* below the system.

8.4.1.4. Sand Layer — Primary Treated Effluent

1) The *sand layer* of a *mound* receiving *primary treated effluent level 1* shall

a) have a surface area designed on the basis of an effluent hydraulic loading rate of not more than 40 L per square metre (0.83 Imp. gal per sq. ft.) per day,

b) regardless of whether primary treated effluent level 1 or secondary treated effluent is applied, have a sand layer surface area that does not exceed the effluent hydraulic loading rates

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so it is at 90 degrees (a right angle) to the direction of the land slope. It is anticipated the effluent will need to flow horizontally in the soil below the mound to be effectively dispersed in the soil. Putting the longest dimension of the mound at a right angle to the slope reduces the amount of effluent per meter or foot along its length that must move horizontally. See photo on pg. **329**.

This article sets out very important design considerations for a treatment mound. As mounds are typically used on sites that have restricting features in the soil below at shallow depths, the consideration of linear loading is required for effective design.

See Appendix B pg. **333** for additional information on the requirements of clause (c) of this article.

In some site conditions the underlying groundwater flow direction may not follow the direction of the ground surface slope at the site of the mound. This may result in the longest dimension of the mound not being at a right angle to the surface ground slope to more effectively minimize groundwater mounding below the treatment mound. Typically this article would be applied only on larger volume systems.

The surface area of the sand layer that first receives the effluent in the mound is determined by applying the maximum loading rate set out in clause (a). Peak Flow as determined in Section 2.2 divided by this effluent loading rate of 40L per sq. meter (0.83 gal./sq ft.) to determine the required sand layer area.

To ensure complete treatment of the effluent, the loading rate on the sand layer must be reduced if the underlying soils are coarse textured and have loading limits as set out in the Articles referenced in clause (b).

Note: An editorial change is reflected in sub-clause (1)(b)(x) clarifying the reference is to [medium]

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determined under Articles 8.1.1.2; 8.1.1.3; 8.1.1.4; 8.1.1.5; Sentences 8.1.2.2.(2) and (3) and Article 8.1.2.4. if the in situ *soil* is:

- **i)** *coarse sand,*
- **ii)** *medium sand*,
- **iii)** *fine sand*,
- **iv)** *very fine sand*,
- **v)** *loamy coarse sand*,
- **vi)** *loamy medium sand*,
- **vii)** *loamy fine sand*,
- **viii)** *loamy very fine sand*,
- **ix)** *coarse sandy loam*, or
- **x)** *[medium] sandy loam*,

c) not exceed 3 m (10 ft.) in width, measured at the top of the sand layer,

d) have a length that takes into account

effluent linear loading rate limits set out in Article 8.1.2.3. or as determined under Article 8.1.1.7. that are based on soil texture, structure, consistency, and distance to seasonal soil saturation and restrictive soil horizons at the site,[1]

e) be not less than 300 mm (1 ft.) thick, and

f) be on or above the existing *soil*.[2]

[1] Note: Clause (1)(d) — Article 8.1.2.3. provides a prescriptive solution for determining acceptable linear loading rates.

[2] Intent: Clause (1)(f) — This Clause requires the mound to be built on the existing grade of the soil. Soil should not be stripped away creating a depression in the ground or be stripped away and replaced by fill material.

8.4.1.5. Sand Layer — Secondary Treated Effluent

1) A *treatment mound* that receives *secondary treated effluent* shall be designed

a) using a *sand layer* that has a minimum average thickness of 75 mm (3 in.),

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sandy loam.

The sand layer should not exceed 3m (10ft) in order to ensure adequate air supply throughout the width of the sand layer. The sand layer is used to treat the organic load, the BOD5 (biochemical oxygen demand), in the applied effluent and the underlying soils need adequate air supply to achieve final treatment of the effluent.

The required length of the sand layer is based on the linear loading capacity of the underlying soil. Based on the required length the width of the sand layer is determined by dividing the required area by the length. The length, based on linear loading, cannot be reduced by using a wider sand layer

Determining the length of the sand layer to meet linear loading limits requires consideration of the following articles:

- Article 7.1.1.3 (f) Soil Evaluation
- Article 8.1.1.7.(1)(a) and (b) Site Geometry and Soil Evaluation and Groundwater Mounding
- Article 8.1.2.3. Linear Loading Rates not to exceed value set in Table 8.1.1.10
- Table 8.1.1.10 Effluent Loading and Linear Loading Rates
- Handbook discussion pg. 302 on linear loading considerations and pg. **304** on determination of Linear Loading Rates using Table 8.1.1.10

When receiving primary treated (septic tank) effluent, the sand layer must be at least 300mm (1 ft.) thick in order to achieve the level of effluent treatment anticipated at the bottom of the sand layer. The purpose of the sand layer is to improve the quality of the effluent prior to it infiltrating into the in situ soil. It is anticipated the effluent is treated to a secondary treatment standard after traveling through the sandlayer.

Excavating into the soil and placing the bottom of the sandlayer below the existing ground surface can create a bathtub effect, causing the sand layer to be saturated and resulting in ineffective treatment.

b) with a minimum distance of 900 mm (3 ft.) to a *vertical separation* boundary layer, as measured from the top surface of the 75 mm (3 in.) *sand layer*,

c) to have a *sand layer* surface area designed on the basis of an *effluent hydraulic loading rate* of not more than 40 L per square metre (0.83 Imp. gal per sq. ft.) per day, and

d) to have a *sand layer* surface area required to ensure the *effluent hydraulic loading* rate does not exceed the *effluent hydraulic loading* rates determined under Articles 8.1.1.2.; 8.1.1.3.; 8.1.1.4.; 8.1.1.5.; Sentences 8.1.2.2.(2) and (3) and Article 8.1.2.4. if the in-situ is:

i) *coarse sand*,
ii) *medium sand*,
iii) *fine sand*,
iv) *very fine sand*,
v) *loamy coarse sand*,
vi) *loamy medium sand*,
vii) *loamy fine sand*,
viii) *loamy very* fine sand,
ix) *coarse sandy loam*, or
x) *[medium] sandy loam*.

The depth of the sand layer required when applying secondary treated effluent is much less than when applying primary treated effluent as the sand layer is not being relied upon to achieve the treatment of the primary treated effluent to a secondary standard.

The purpose of the sand layer when applying secondary treated effluent is to ensure effective contact with the underlying in situ soil and to provide some capacity in the course textured sand to receive and store the effluent applied, until it infiltrates horizontally into the berm fill material and vertically into the in situ soil below.

See Appendix B pg. **329** for additional information on the importance of the sand layer.

If the underlying soils are coarse textured and have loading limits set out in the articles referenced in clause (1)(d), the loading rate on the sand layer must be reduced to ensure complete treatment of the effluent in the underlying soil to the treatment objectives set out.

Note: An editorial change is reflected in sub-clause (1)(d)(x) clarifying the reference is to [medium] sandy loam.

8.4.1.6. Suitability of In-Situ Soil and Vertical Separation

1) A *treatment mound* may be used as a final treatment component where

a) the in-situ (original) *soil* has an assigned loading rate as determined by Table 8.1.1.10. to a depth of at least 300 mm (1 ft.), and

b) a minimum *vertical separation* of 900 mm (3 ft.) is maintained between the bottom of the required depth of *sand layer* and any design boundary limiting *soil* layer below the *treatment mound*.[1]

The soil below the constructed treatment mound must have the capacity to receive and treat the applied effluent. A minimum of 1 foot of suitable soil is need at the site to enable a path for the effluent to flow horizontally in the subsoil, away from the treatment mound. The applied effluent will not disappear or just evaporate, it must be able to move through the soil at the site away from the mound without surfacing.

At a site where there is less than 900mm (3ft.) of suitable existing soil depth, the thickness of the sand layer can be increased to provide the needed vertical separation of 900mm (3 ft.). The 3 foot vertical separation is measured from the bottom of the minimum 300mm (1 ft.) sand layer to the restricting layer in the soil when primary treated effluent is applied. When secondary treated effluent

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[1] *Note: Clause (1)(b) — The sand layer receiving the effluent may be increased in thickness to provide the vertical separation required. Using the same sand as is required for the 300 mm (1 ft.) sand layer is advised. The fill must have a textural classification not finer than fine sand. Sand with any significant percentage of silt or clay content should not be used as it will cause excessive compaction and will be washed down over time through the fill material as the effluent is applied resulting in the development of a restrictive layer.*

8.4.1.7. Infiltration Into In Situ Soil

1) The area of contact with the in situ *soil* that is within the berm forming the mound, excluding the end slopes, shall provide a *soil infiltration surface* area into the in situ soil that[1]

a) is not less than the required *soil infiltration* surface area determined by Article 8.1.1.10. using loading rates for *secondary treated effluent* Level 2, and

b) when on a slope exceeding 1 percent, includes only the area downslope of the upslope side of the *sand layer* area receiving the *effluent* to the downslope edge of the *berm*.

[1] *Intent: Sentence (1) — To ensure that an adequate area of soil is available for the effluent to infiltrate into the in situ soil, and that the permeability of the berm fill material enables the effluent to readily distribute the effluent over the infiltration area and prevent mounding of the effluent in the sand layer.*

2) *The fill* soil *forming the* berm *covering the required* soil infiltration *area required by Sentence (1) shall be a* soil *that has a* soil texture classification *of* coarse sand, medium sand, fine sand, loamy medium sand *or* loamy coarse sand.

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is applied the vertical separation is measured from the top of the required 3 inch sand layer. There must be at least 300mm (1 ft.) of suitable in situ (existing) soil at the location.

The area covered by the mound of the berm must cover a sufficient area to ensure the effluent infiltrates into the underlying in situ soil prior to the effluent reaching the edge of the berm. The area the mound berm must cover is determined by applying the loading rate allowed on the in situ soil based on secondary treated effluent.

When the mound is on sloping ground, the effluent will move downslope of the sand layer. As such it is only the area of in situ soil under the sand layer and covered by the downslope berm that counts as effective infiltration area. See pg. **342** (equal to or less than 1% slope) and pg. **343** (greater than 1% slope) in Appendix B for a graphic illustration of the infiltration areas.

It is important to ensure effective contact of the sand layer and berm fill soil with the underlying soil to ensure effective infiltration into the existing soil. Scarifying the area needed for infiltration with a thin layer of the fill material in place is an effective way of doing this. Leaving a solid layer of grass thatch and roots under the mound in not desirable.

The fill soil covering the sand layer and forming the berm of the treatment mound must be a coarse textured soil; this enables air transfer to the sand layer and underlying soil, and allows the effluent applied to the sand layer a route away from the sand layer and spread out over the underlying in situ soil. This is needed to prevent saturated

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8.4.1.8. Distribution of Effluent

1) *The distribution of* effluent *to the* sand layer *shall be into*[1]

a) a 300 mm (12 in.) layer of gravel over the sand layer, or

b) chambers that provide an effective effluent infiltrative area within the internal opening area of the chambers over the sand layer that is not less than 80% of the required sand layer area determined by the design effluent hydraulic loading rate.

[1] Intent: Sentence (1) — The actual open area under the chambers providing direct effluent contact with the sand layer must be at least 80% of the required area. The internal dimensions of the chamber need to be measured as there is normally a significant foot print area of the chambers that covers a portion of the sand layer. The gravel layer or chambers must provide a void space for temporary storage of the effluent delivered during a dose event and during peak flow periods.

8.4.1.9. Using Chambers

1) Where chambers are used,

a) the *sand layer* shall be covered with a minimum thickness of 50 mm (2 in.) of gravel or other acceptable media to minimize the impact of the *effluent* spray, and

b) a pressure *effluent distribution lateral pipe* shall be provided for each of the chamber–*sand layer* contact areas provided by the chamber.

8.4.1.10. Maximum Dose Volume

1) The design of the treatment *mound* and pressure *distribution lateral pipe* system shall be based on achieving the ability to

conditions in the sandlayer.

See pg. **330** for further discussion on the importance of the fill material allowing horizontal movement of the effluent.

Distributing the effluent onto the sand layer requires an effluent receiving area that is capable of receiving the initial dose of effluent.

The effluent receiving area and layer can be provided by a gravel layer or chambers.

When chambers are used the actual open area provided by the chamber must cover at least 80% of the required sand layer. This is based on the actual open area provided, not the outside dimension of the chamber. As rows of chambers are set side by side the foot print of the chamber wall will cover some of the sand layer. It is anticipated the effluent can easily move through the sand to these covered parts of the sand layer.

Article 8.4.1.11 requires a pressure effluent distribution system be used for all types of mounds.

Each row of a chamber system, if used, must be provided with an effluent distribution lateral to ensure effective distribution of effluent.

Maximizing the number of doses applied to the sand layer is needed to ensure effective treatment. The sand used in the sand layer has very limited water holding capacity. Large doses will quickly flow through the sand layer, creating saturated

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deliver individual doses of *effluent* over the entire *sand layer* area that do not exceed 20% of the average daily *effluent* volume.[1]

[1] *Intent: Sentence (1) — Smaller doses provide better treatment conditions. Doses may be smaller than 20%. A 20% dose volume results in 5 doses per day. The entire sand layer does not have to be dosed during an individual dose event; however the design must ensure that each area of the sand layer served by an individual orifice receives not more than 20% of the average daily flow. For example, if a distribution system was designed with two alternating zones, the system needs to be designed on the basis of 10 doses per day in total — 5 doses for each zone.*

8.4.1.11. Pressure Distribution Required

1) Distribution of *effluent* shall be achieved using a pressure *distribution lateral pipe* system meeting the requirements of Section 2.6. and effectively distribute the *effluent* as set out in Article 8.4.2.6.

8.4.1.12. Effluent Ponding Monitoring Pipes

1) The *mound* design shall include access ports that enable monitoring the depth of *effluent* ponding at the *sand layer infiltration surface* and at the *sand layer*–in situ *soil* interface.

2) At a minimum there shall be two access ports, each one located at a quarter of the length of the *sand layer* but not more than 4.5 m (15 ft.) from each end of the *sand layer*.

3) Where chambers are used in place of a gravel distribution cell, monitoring pipes shall be provided for each continuous row of chambers.

4) The access ports shall

a) extend to finished grade,

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conditions and reduce treatment effectiveness. Eventually that overloading will cause a thicker biomat to form on the sand layer or at the sand layer soil interface reducing infiltration capacity.

To achieve an effective even dose requires that the volume of the individual dose volume is at least 5 times the volume of the distribution lateral piping as set out in Article 2.6.1.5 (f) and (g). This can create a competing balance in design and is a very important consideration.

Pressure distribution of the effluent is required. Effective control of the effluent volume applied and evenness of the applied effluent is critical.

Article 8.4.2.6 requires one orifice for every 0.5 sq. meters (5.5 sq.ft.) of sand layer in addition to the design requirements set out in Section 2.6 for pressure distribution laterals. This is important due to the coarse texture of the sand and to ensure the entire sand layer is effectively used to achieve the treatment intended by the sand layer.

Article 2.6.1.2 requires that the volume discharged per orifice per dose event does not vary by more than 15%.

The effluent monitoring pipes enable operational monitoring of the treatment mound. These monitoring pipes enable monitoring of the ponding that may occur on the sand layer, and indicate an organic overloading or limitation of the air supply to the sandlayer allowing action to be taken prior to entire failure of the mound. The monitoring ports also enable an assessment of the sandlayer soil interface to assess the ongoing capability of the underlying soil to receive the effluent and identify saturation of the sandlayer that will limit treatment effectiveness.

b) be fitted with a manufactured access box, and

c) be provided with perforations that
   i) allow entry of ponded *effluent* while excluding the *sand* or gravel media surrounding the access port, and
   ii) are located only within the vertical section of the *mound* they are intended to monitor depth of ponded *effluent*.

Monitoring intervals of these conditions using the monitoring pipe needs to be set out in the operation and maintenance manual required by Article 2.1.2.8. See pg. **364** for a graphic of a monitoring port.

8.4.2. Treatment Mounds — Prescriptive Requirements and Installation Standards

8.4.2.1. Separation Distances

1) A *treatment mound* shall not be located within

a) 15 m (50 ft.) of a *water source*,

b) 15 m (50 ft.) of a *water course*, except as provided in Article 2.1.2.4.,

c) 3 m (10 ft.) of a *property* line,

d) 3 m (10 ft.) of a *septic tank*,

e) 10 m (33 ft.) of a basement, cellar, or crawl space, and

f) 10 m (33 ft.) of a *building* that does not have a basement, cellar, or crawl space.

2) For the purposes of Sentence (1), all measurements are to be taken from the point where the side slope of the *mound berm* intersects with the natural *soil* contour.

These separation distances must be considered in locating the system.

Article 2.1.2.4 requires a 90m (300 ft.) separation from a lake, river, stream, or creek in specific circumstances.

See definition of building on page **7** for clarity in applying this article. For example, farm buildings that do not fall under the requirements of the Building Code do not apply to this requirement. However consideration of the potential impact the added effluent will have on the building foundation must be considered by the system designer and building owner.

8.4.2.2. Diverting Run-off Water

1) Whenever *treatment mounds* are located on slopes, a diversion shall be constructed immediately up slope of the upper side of the *mound berm* to intercept and direct run-off water away from the *mound*.

Surface water runoff coming down a slope from above the treatment mound needs to be diverted to avoid saturation of the mound from the runoff water. Contouring the surface of the slope above the mound is used to divert surface runoff water from negatively affecting the treatment mound.

8.4.2.3. Sand Layer Thickness

1) The *sand layer* that *primary treated effluent level 1* is distributed over shall be a minimum of 300 mm (1 ft.) thick, and the top of the *sand layer* shall be *nominally level*.

A minimum of 1 foot of sand of the quality specified in Article 8.4.3.1 to achieve the intended level of treatment at the maximum loading rates specified.

8.4.2.4. Placement of Sand Layer

1) The *sand layer* and 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 the *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*.

Do not work on the soil when it is wet to avoid compaction. Compaction of soils can be extreme when it is wet.

The placement of the sand layer requires machinery. The use of the machinery must not compact the underlying soil or cause it to be disturbed reducing the infiltration capacity of the available soil.

The effective integration of the sand layer and fill material with the in situ soil is very important.

Any vegetative layer, such as the grass and root mass, needs to be disturbed to prevent it from creating a limiting layer and reducing the rate effluent can move through the soil.

8.4.2.5. Use of Gravel

1) When gravel is used over the *sand layer*,

a) not less than 150 mm (6 in.) of gravel shall be placed over the contact area below the distribution laterals,

b) not less than 25 mm (1 in.) of gravel shall be placed over the distribution laterals, and

c) the gravel layer shall be covered with

i) straw or equivalent fibrous

When gravel is used over the sand layer to receive effluent it must be at least 150mm (6 in.) in depth below the pressure effluent distribution laterals.

The pressure effluent distribution laterals must also be covered by at least 25mm (1 in.) of gravel. Depending on the diameter of the pressure effluent distribution laterals the total depth of the gravel required will vary.

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material to an un-compacted depth of 75 mm to 100 mm (3 to 4 in.), or

ii) a geotechnical fabric suitable for the purpose of preventing the migration of the covering *soil* into the gravel while allowing the movement of air and water.

8.4.2.6. Orifice Spacing over Sand Layer

1) The pressure *effluent distribution lateral pipe* supplying *effluent* to the *sand layer* shall be spaced evenly over the *sand layer* with orifice spacing that provides one orifice for every 0.5 square metres (5.5 sq. ft.) or less of the *sand layer*.

8.4.2.7. Mound Berm Fill Material

1) *Coarse sand*, *medium sand*, *fine sand*, *loamy medium sand* or *loamy coarse sand* fill material shall be used to form the *berm* of the overall *mound* required to cover the *soil infiltration surface* area and it shall be[1]

a) placed to a minimum depth of 150 mm (6 in.) at the sides of the *sand layer*, and

b) provide a slope to ensure drainage of surface water from the mound.

[1] *Intent: Sentence (1) — To provide an adequate slope on the top of the treatment mound to prevent storm water from standing on the top of the mound. A minimum 4% slope (0.5 inch per foot) is recommended.*

2) In addition to the requirements of Sentence (1), 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 *mound* in order to support a grass cover.

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Although Article 8.4.1.8 generalizes that the gravel layer must be 300mm (12 in.) thick this article sets out in more detail the required depth of gravel over the sand layer and may allow a total gravel depth of small as 200mm (8 in.) if 18mm (3/4 in.) pressure effluent distribution laterals can be used in the design. See Appendix B pg. **255** for more information on the design of pressure effluent distribution lateral systems.

This Article requires one orifice for every 0.5 sq. meters (5.5 sq.ft.) of sand layer in addition to the design requirements set out in Section 2.6 for pressure distribution laterals. This is important due to the coarse texture of the sand and to ensure the entire sand layer is effectively used to achieve the treatment intended by the sand layer.

This Article specifies that the fill soil covering the sand layer and forming the berm of the treatment mound must be a coarse textured soil to enable air transfer to the sand layer and underlying soil. It also allows the effluent applied to the sand layer a route away from the sand layer and spread out over the underlying in situ soil covered by the berm fill material. This is needed to prevent saturated conditions in the sandlayer.

A capping soil as specified in sentence (2) enables sufficient water holding capacity to support grass growth over the raised treatment field, which will help reduce the infiltration of precipitation (rain and snow melt) into the field area.

8.4.2.8. Grass Cover

1) A grass cover shall be established over the entire area of the mound.[1]

[1] *Intent: Sentence (1) — A contractor meets the requirement of this Sentence by seeding the mound to grass, leaving the responsibility to the owner to water and maintain the grass cover. The grass cover is needed to prevent erosion of the mound and to assist in evaporating the effluent.*

The grass growth on the berm of the treatment mound is needed to reduce the infiltration of precipitation (rain and snow melt) into the mound and to stabilize the imported fill of the treatment mound berm.

8.4.2.9. Side Slopes of Mound

1) The side slopes on the *mound* shall not be steeper than 1:3 (one vertical to three horizontal).

This maximum slope is set out to avoid slumping of the sloped fill material.

8.4.3. Treatment Mounds — Requirements for Materials

8.4.3.1. Sand

1) *Sand* used for the *sand layer* shall have

a) a particle size distribution that meets

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) the particle size distribution required for a medium-sand *sand filter* as set out in Sentence 5.3.3.4.(2),

b) an *effective particle size (D10)* of not less than 0.3 mm, and

c) a *uniformity coefficient (CU)* of between 4 and 6.

The quality of the sand used in a treatment mound sand layer is critical to the success of the treatment mound.

The D10 size (see definition on pg. **9)** of the sand is an important characteristic of the sand related to hydraulic capacity and the movement of air through the sand layer.

See the definition of effective particle size for more explanation.

The uniformity coefficient ensures the sand is not made up of mostly finer or mostly larger particles. It ensures the proper particle size distribution from finer to coarse particles of sand. See the definition of uniformity coefficient, pg. **23,** for more explanation.

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8.4.3.2. Drain Media

1) *Drain media* shall be clean, washed gravel; clean, crushed rock; or other equivalent media for distributing *effluent*, with particle size of the following consistency:

a) 100 percent passing the 38.1 mm, (1½ in.) sieve,

b) 50 to 100 percent passing the 9.51 mm, (3⁄8 in.) sieve,

c) 6 to 84 percent passing the 4.76 mm (0.187 in.), No. 4 sieve,

d) 0 to 24 percent passing the 2.36 mm (0.0937 in.), No. 8 sieve,

e) 0 to 1 percent passing the 1.18 mm (0.0469 in.), No. 16 sieve,

f) 0 to 1 percent passing the 0.6 mm (0.0234 in.), No. 30 sieve, and

g) 0 to 1 percent passing the 0.15 mm (0.0059 in.), No. 100 sieve.

The gravel used over the sand layer must be clean gravel of a specific size. Dirty gravel will result in the fines being washed off the gravel by the effluent applied. The result is the fines accumulate on the sand layer below, reducing the infiltrative and treatment capacity of the sand. Fines on top of the sand layer will concentrate the biomat formation on the surface of the sand layer which further reduces the infiltrative capacity.

Section 8.5. Sub-surface Drip Dispersal and Irrigation

8.5.1. Sub-surface Drip Dispersal and Irrigation — Objectives and Design Standards

8.5.1.1. Effluent Treatment Quality in Soil

1) At a depth of 900 mm (3 ft.) below the drip dispersal lines and in the *wastewater effluent*/groundwater plume at a distance of not more than 900 mm (3 ft.) from the edge of the *soil treatment area*, the treated effluent shall meet the following criteria:

a) fecal coliform < 10 CFU/100 mL above background levels, or

b) fecal coliform < 2 MPN/gram of dry *soil* above background levels.

2) The *effluent*/groundwater plume shall contain no viable fecal organisms 8 m (27 ft.) horizontally from the *soil treatment area*, as measured from the edge of the *soil treatment area*, including during typical periods of climatic stress and/or typical maximum designed flow volumes.

The purpose of the drip dispersal system is to treat the sewage, preventing a negative impact on the near surface and deeper groundwater, and to effectively disperse the effluent in the soil so there is no risk of direct contact with effluent. See pg. **347** for further discussion on Drip Dispersal Systems.

Article 2.1.1.3 sets out a fecal quality limit in the soil from surface to a depth of 3 inches and also applies to drip dispersal systems. This can be a very important consideration as the drip dispersal piping is placed shallow in the soil to provide irrigation of vegetation.

Drip dispersal systems are often used where there are limiting features in the soil below that reduce the available vertical separation. In these cases it will result in horizontal flow of the effluent in the soil below; this is why there is an effluent quality set for the 8m (27ft.) horizontal distance from the system.

8.5.1.2. General

1) The design of a sub-surface drip dispersal system shall meet all requirements set out in Section 8.1.

The loading rate limits and general design requirements set out in Section 8.1 must be met.

8.5.1.3. Required Effluent Quality and SAR Limits

1) *Effluent* delivered to a drip dispersal system shall be treated to a

a) *secondary treated effluent* Level 2 standard or better, and

b) *secondary treated effluent* Level 3–D2 standard or better when the drip tubing

See Table 5.1.1.1 for specifics on the effluent quality referenced in the article. As the drip dispersal piping is placed shallower in the soil there is more tendency for the applied effluent to be drawn up toward the soil surface as plants use the moisture or to be pushed to the soil surface due to limited infiltration capacity. When the drip dispersal piping is placed shallow in the soil it requires a higher initial treatment level with regard to disinfection as set out in clause (b) of this article.

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is installed with less than 300 mm of cover.

2) *Effluent* shall have an *SAR* of less than 10 when the drip dispersal tubing is placed at a depth of less than 450 mm (18 in.) below ground surface and the *effluent hydraulic loading rates* are selected to meet typical irrigation needs as opposed to *effluent* dispersal at the rates set out in this Standard to prevent negative impact on vegetation at the ground surface due to the accumulation of sodium in the root zone of the vegetation.

8.5.1.4. Dispersal

1) The drip dispersal system shall be designed to prevent instantaneous loading resulting during a dose event from saturating the *soil* within 50 mm (2 in.) of the ground surface.

2) The geometry and orientation of the drip dispersal area shall not cause the *hydraulic loading* to exceed the *linear loading* capacity of the *soil* as determined in Article 8.1.1.7. or 8.1.2.3.

8.5.1.5. Winter Use Restrictions and Design

1) Where the system is used for a *development* that requires *wastewater* treatment during the period of November 30th to March 31st,

a) the system shall be protected from freezing and all piping sloped to ensure drainage of all piping back to the dose tank, and

b) an alternate system meeting the requirements of this Standard shall be provided for use in the event the drip distribution system freezes.

Explanations & Related Articles

The application of an effluent having a high SAR (sodium absorption ratio) will result in sodium salts accumulating in the soil as the vegetation uses and removes the water from the soil. The accumulating sodium salts will eventually limit the ability of the plant growth to take up moisture and nutrients, eventually being so limiting that the vegetation will die off. See further discussion of concerns with effluent SAR in Appendix B pg. **297**.

Any time drip dispersal is used for irrigation it must first be determined if the chemistry of the water supply to the development is suitable for continued irrigation.

The volume applied to the soil per dose can create instantaneous loading on the soil that exceeds the soil's capacity to allow the infiltration of the effluent, if the dose volume is not considered properly in relation to the soil characteristics. The drip dispersal system should be controlled to provide many small doses to prevent instantaneous overloading.

The layout of the drip dispersal system needs to consider the linear loading capacity of the soil to prevent surfacing of the effluent downslope of the system. This applies even when the system is used for irrigation; in the fall, winter, or early spring the uptake by the vegetation is minimal and so the effluent must effectively disperse in the soil.

The continued operation of drip dispersal systems may be limited in freezing conditions experienced in Alberta. To address this, an alternate system to ensure effective wastewater management can continue is required. This may include a traditional treatment mound, a treatment field, or a system as simple as a holding tank. As the drip dispersal system requires a large tank to enable equalization of the daily flow, this tank may adequately provide the alternate in terms of a holding tank. Consideration must be given to whether the municipality accepts holding tanks in a given area of the municipality.

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8.5.1.6. Effluent Loading Rates

1) The *effluent hydraulic loading rates* shall not exceed those set out in Table 8.1.1.10. or otherwise restricted by this Standard.

2) The *effluent soil infiltration surface* area supplied by a single drip dispersal tube shall be considered to be no more than 300 mm (12 in.) on either side of the drip dispersal tubing for a total calculated *soil infiltration surface* width of not more than 600 mm (2 ft.) per drip dispersal lateral.

Determining the area that must be covered by the drip dispersal system is based on the allowed loading rates set out in Table 8.1.1.10.

Sentence (2) of this article sets out how much area adjacent to the drip dispersal piping can be considered effective area. As the drip dispersal piping is raised in the soil to provide irrigation, the piping should be placed closer together while not exceeding allowed effluent loading rates. This provides more effective irrigation and prevents localized instantaneous loading on the soil that may result in the effluent surfacing and creating a direct contact risk.

8.5.1.7. Drip Dispersal Tubing Layout and Dosing Design

1) The drip dispersal tubing shall be equipped with pressure compensating orifices.

2) A means of preventing root intrusion into the emitters/orifices shall be provided in the system design.

3) The system shall have a means of inhibiting bacterial growth and the accumulation of slime in the emitters/orifices.

4) A minimum of one orifice shall be provided for each 0.37 square metres (4 sq. ft.) of soil infiltration surface area.

5) The system shall be dosed using timed dosing controls to ensure dosing events occur at evenly spaced intervals over a period of 24 hours.

6) Drip dispersal tubing shall have orifices that have a rated flow of not more than 2 L per hour (0.44 Imp. gal. per hour or 0.53 U.S. gal. per hour) when installed in *soil* that has a texture of

a) *sandy clay loam*,

b) *clay loam*,

c) *silty clay loam*,

Pressure compensating orifices provide more equal distribution of the effluent.

Drip dispersal systems used for sewage systems include both root intrusion and bacterial growth inhibitors. These inhibitors may be impregnated into the piping or injected into the effluent prior to the drip piping.

Achieving this objective set in clause (4) is accomplished by either closer spacing of the laterals or closer spacing of the orifices in the piping.

Timed dosing is needed to ensure instantaneous loading does not exceed the capacity of the soil to disperse the effluent.

The limitation of the flow rate from the orifice in fine textured soils is needed to limit the instantaneous loading on the soil during a dose event.

d) *sandy clay*,

e) *clay*,

f) *silty clay,* or

g) *heavy clay.*

7) Drip dispersal tubing shall be installed

a) following the slope contour,

b) as level as possible, and

c) at a depth of between 150 mm (6 in.) and 900 mm (36 in.) below finished grade.

8.5.1.8. Drip Dispersal Tubing Flushing Requirements

1) The system shall be capable of flushing all parts of the drip dispersal piping at a minimum flow velocity of 0.6 m/s (2 ft/s).[1]

[1] *Note: Sentence (1) — Backwashing/flushing with a return to a location set out in Sentence (3) may be done continuously or periodically based on a pre-set interval, the number of dosing cycles or the measurement of pressure difference across the filter (such as a 20% difference in pressure) or any combination of these criteria.*

Flushing of the piping at a high velocity flow is needed to scour the piping and remove any bacterial growth that may occur in the pipe and cause ineffective operation of the drip orifices.

2) The volume of a flushing dose shall be at least twice the volume of all pressurized piping.

3) The return line used to facilitate flushing shall return to the *building sewer* where it connects to an initial treatment component or into an initial treatment component in a manner that does not result in undesirable disturbance of the *settling tank* or *septic tank*.

8.5.1.9. Operational Control Required

1) The operation of a drip dispersal system of any size shall be managed using a control panel that can

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a) monitor the volume per flow event and per day applied to the *soil*,[1]

b) provide for automatic flushing of filters and drip laterals with filtered *effluent*, initiated by a timer and/or a preset pressure differential across the filters,

c) deliver designer-specified volumes of *effluent* to each field zone (adjustable and variable between zones) at designer-specified time intervals,

d) monitor alarm conditions (high water, power outage),

e) monitor flow variance and provide indication of when flow is ±20% of design indicating servicing is required,

f) monitor pump run times,

g) monitor numbers and times of filter and field flushing cycles,

h) record the operational events for a minimum of the previous 30 days, and

i) meet any additional requirements for system controls set out in Sections 2.3. and 2.4.

[1] *Note: Clause (1)(a) — This may be accomplished by the ability to count dose events, pump run times and calculated by the dose volume set out in the design documents and reflected in the operation and maintenance manual.*

Explanations & Related Articles

Effective operational control of the dosing and flushing of the drip dispersal system as set out in this Article is critical to successful long term operation.

The manufacturer may set out additional operational requirements that need to be followed provided they do not conflict with the requirements of this standard.

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8.5.2. Sub-surface Drip Dispersal and Irrigation — Prescriptive Requirements and Installation Standards

8.5.2.1. Separation Distances

1) An *effluent* drip dispersal system, measured from any part of the drip dispersal tubing, shall not be located within

a) 15 m (50 ft.) from a *water source*,

b) 15 m (50 ft.) from a *water course*, except as required by Article 2.1.2.4.,

c) 1.5 m (5 ft.) from a *property* line,

d) 10 m (33 ft.) from a basement, cellar, or crawl space, except this distance may be reduced to 1.5 m (5 ft) when the system is used specifically for irrigation and the *effluent hydraulic loading rates* do not exceed irrigation needs,1

e) 1 m (3.25 ft.) from a *building* that does not have a permanent foundation,

f) 5 m (17 ft.) from a *building* that has a permanent foundation but does not have a basement, cellar, or crawl space except this distance may be reduced to 1.5 m (5 ft.) when the system is used specifically for irrigation and the *effluent hydraulic loading* rates do not exceed irrigation needs, and

g) 5 m (17 ft.) from a *septic tank* or *packaged sewage treatment plant* except this distance may be reduced to 1.5 m (5 ft.) when the system is used specifically for irrigation and the *effluent hydraulic loading* rates do not exceed

These separation distances must be considered in locating the system.

Article 2.1.2.4 requires a 90m (300 ft.) separation from a lake, river, stream, or creek in specific circumstances.

See definition of building, page **7**, for clarity in applying this article. For example, farm buildings that do not fall under the requirements of the Building Code do not apply to this requirement. However consideration of the potential impact the added effluent will have on the building foundation must be considered by the system designer and building owner.

This article allows the drip dispersal piping to be located close to a building when used specifically for irrigation and when the effluent loading rates are limited to irrigation needs of the vegetation. Where this is applied, the sections of the drip dispersal piping close to the building should be shut off or limited when irrigation is not required or irrigation needs are limited.

irrigation needs.

[1] *Note: Clause (1)(d) — The 10 m (33 ft.) requirement to a cellar, basement or crawl space is intended to protect excavations below grade from accumulating migrating effluent. A crawl space that is not below grade, or where the level of the ground surface at the treatment area is below the level of the crawl space, would not require 10 m (33 ft.) clearance and could be treated as a building that has a permanent foundation without a basement.*

8.5.2.2. Prohibited Locations

1) An *effluent* drip dispersal system shall not be located under

a) a roadway or driveway,

b) a paved area,

c) a vehicle parking lot,

d) any structure, or

e) a vegetable garden.

8.5.2.3. Linear Loading Limits

1) The arrangement of the drip dispersal tubing shall ensure that the maximum *linear loading* as set out in Table 8.1.1.10. or determined in accordance with Article 8.1.1.7. is not exceeded.

Linear loading limitations of the soil must be applied in the design and layout of the system.

8.5.2.4. Clean-outs and Piping Access

1) Clean-outs shall be provided for the supply and return piping.

2) Access from the ground surface shall be provided to all valves, air release/intake valves, filters, and the two drip emitters located along the highest and lowest orifices.

Piping clean outs are needed to check the system and ensure continued effective operation. Use of these clean outs and frequency of checks need to be set out in the operation and maintenance manual required by Article 2.1.2.8.

8.5.2.5. Manufacturer's Recommended Practices

1) A drip dispersal system shall be installed following all of the manufacturer's recommendations except where there is a conflict with the manufacturer's recommendations, in which case the requirements of this Standard shall apply.

Manufacturers of drip dispersal piping and systems develop extensive installation and design documents. These instructions must be followed as required by this article, except where the instruction conflicts with this standard.

8.5.3. Sub-surface Drip Dispersal and Irrigation — Requirements for Materials

8.5.3.1. Piping

1) Piping other than sub-surface drip dispersal tubing used in a drip dispersal system shall comply with the requirements of Section 2.5.

2) Sub-surface drip dispersal tubing shall

a) have a warranty provided by the manufacturer for use with wastewater and for resistance to root intrusion,

b) incorporate emitters with a maximum nominal rated discharge of 3.64 L (0.8 Imp. gal.) per hour, except where required to be less as set out in Sentence 8.5.1.7.(6), and

c) be color-coded purple to identify that the pipe contains non-*potable* water from a *wastewater* source.

3) The emitter discharge rate referred to in Clause (2) (b) may be controlled by the use of pressure-compensating emitters.

4) Equipment used in a drip dispersal system must be specifically designed and intended for use in a drip dispersal system or recommended by the manufacturer for that use.

Most of the drip dispersal piping supplied by the major manufacturers complies with this article. However, when selecting available piping, the designer and installer need to ensure that the piping and orifice style and spacing comply with these requirements.

Section 8.6. Open Discharge

8.6.1. Open Discharge — Objectives and Design Standards

8.6.1.1. General

1) The design of an *open discharge system* shall meet all requirements set out in Section 8.1. *except* for the *effluent hydraulic loading rates*.

2) An *open discharge system* shall not be used on *soils* that have a soil texture classification of *coarse sand*, *medium sand*, *fine sand*, *loamy medium sand* or *loamy coar183se sand* within 1.5 m (5 ft.) of the ground surface.[1]

> [1] *Intent: Sentence (2) — The soil the effluent is discharged onto must have a textural class that will encourage the spreading of effluent, as opposed to allowing the effluent to quickly enter the soil in a concentrated area causing saturated flow.*

3) The design and location of an *open discharge system* that discharges *effluent* onto the surface of the ground must ensure the *effluent* is contained on the *property*.

4) An *open discharge system* shall be designed to minimize the pooling of *effluent* on the ground surface.

5) The design of the *open discharge* outlet and the landscaping in the area of the *open discharge system* shall ensure the *effluent* does not migrate more than 30 m (100 ft.) before infiltrating into the ground.

8.6.1.2. Preventing Erosion

1) The *soil* the *effluent* is discharged onto shall be protected from erosion caused by the discharge of *effluent* from the outlet.[1]

> [1] *Intent: Sentence (1) — The design of the point of discharge must include landscaping to effectively disperse the effluent while also protecting the soil from erosion.*

The design requirements and considerations of an open discharge system need to consider the effective treatment of effluent in the soil.

Where the site has coarse textured soils as set out in sentence (2) of this article, an open discharge that applies the effluent to a concentrated area is not allowed. The open discharge would cause saturated flow in the soil in the immediate area of the discharge point and treatment would be insufficient. The soil textures listed here as a restriction for an open discharge do not include all the coarse textured soils requiring the use of a pressure effluent lateral distribution system set out in Article 8.1.1.8 sentence (2). If any of the course textured soils described in Article 8.1.2.4 with over 35 % coarse fragments make up the soil at the site, the open discharge should be modified in some manner to more effectively distribute the effluent as compared to the typical single point open discharge system that is suitable on finer textured soils.

See Appendix B pg. **348** for more information on the design of open discharge systems.

8.6.2. Open Discharge — Prescriptive Requirements and Installation Standards

8.6.2.1. Separation Distances

1) An effluent discharge to the ground surface may be installed in a location that provides separation distances from the point of discharge of not less than

a) 50 m (165 ft.) to a *water source*,

b) 45 m (150 ft.) to a *water course* except as required by Article 2.1.2.4.,

c) 90 m (300 ft.) to a *property* line, and

d) 45 m (150 ft.) to a *building*.

These separation distances must be considered in locating the system.

Article 2.1.2.4 requires a 90m (300 ft.) separation from a lake, river, stream, or creek in specific circumstances.

See definition of building, pg. **7**, for clarity in applying this article. For example, farm buildings that do not fall under the requirements of the Building Code do not apply to this requirement. However, consideration of the potential impact the discharged effluent will have in increasing the risk of direct contact by people or animals must be considered by the system designer and property owner. Fencing of the area surrounding the effluent discharge area can help minimize the risk of direct contact.

8.6.2.2. Open Discharge Prohibited

1) An open discharge system shall not be installed on a property located within a quarter section where more than 4 parcels, excluding the remnant of the parcel, have been subdivided out of the quarter section.[1]

[1] *Intent: Sentence (1) — Existing systems may remain in operation but once the number of subdivided parcels exceeds 4, additional open discharge systems are not allowed.*

2) An open discharge system shall not be used where

a) the expected peak volume of *wastewater* per day, as determined by Section 2.2., exceeds 3 m3 (660 Imp. gal.) per day, or

b) the strength of the *effluent* will exceed the quality of *primary treated effluent level 1*.

See Appendix B pg. **349** for a graphic illustration of this requirement and further discussion.

This article limits the density of open discharge systems. Open discharge systems are suitable only in predominately agricultural land use areas. They are not an acceptable method of sewage management in areas of multiple subdivisions.

The effectiveness of an open discharge system is limited as the volume of sewage effluent increases. The open discharge is intended as a method for individual residences in agricultural settings at a low development density.

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Explanations & Related Articles

8.6.2.3. Multiple Discharge Systems

1) Where there are multiple *open discharge systems* located on a *property* or where there are no *property lines* in the area being developed, the distance between *open discharge systems* shall be not less than 300 m (984 ft.) except where the combined expected peak daily flow is less than 4.091 m^3 (900 Imp. gal.), in which case the distance between *open discharges* shall be at least 30 m (100 ft.).

In some situations, such as on First Nations reserve land, there may not be defined property lines but there are a number of homes served by open discharge systems.

The density of the systems is limited by the treatment capacity of the open discharge system. This Article limits the density of open discharge systems.

Part 9 Lagoons

Section 9.1. Lagoons

9.1.1. Lagoons — Objectives and Design Standards

9.1.1.1. Seepage

1) A *lagoon* shall be designed to control seepage

a) with a liner, consisting of porous material in which seepage is governed by Darcy's Law, which has a maximum hydraulic conductivity calculated by the following equation:

$$\text{Maximum } \mathbf{K_T} = \frac{\mathbf{C \times T}}{\mathbf{T + 2}}$$

Where:

K_T = maximum hydraulic conductivity of liner in the field, being at least one order of magnitude greater than the laboratory value, metres/second

T = required or proposed thickness of liner, metres

C = 5.2×10^{-9} metres/second,

or

b) with a flexible polymeric membrane liner having a minimum thickness of 0.5 mm or 500 µm (20 mils), and

i) membranes less than 1.5 mm or 1,500 µm (60 mils) thick are covered with a 300 mm (1 ft.) layer of fine grained *soil* on the slopes to prevent liner damage, and

ii) PVC and other membranes that are susceptible to weathering when exposed, shall be covered with *soil* on both the side slopes and bottom.

The lagoon is intended to hold the sewage and not allow infiltration into the underlying soils. As the depth the sewage in the lagoon increases, the forces pushing the effluent down through the soil increase.

Fine textured clay soils (soils that include more than 30% clay particle size) are considered adequate for compaction to meet this limited infiltration rate set out in this article. The amount of compaction and suitability of the soil to achieve this limit can be assessed by a soil lab.

9.1.1.2. Evaporation

1) A *lagoon* shall be designed to achieve the evaporation of the *wastewater* or *effluent* it receives.

The surface area of the lagoon needs to be large enough to enable the evaporation of the sewage received so no discharge is required from the lagoon.

9.1.1.3. Dimensions

1) A *lagoon* shall be designed to provide[1]

a) a *wastewater* depth of not greater than 1.5 m (5 ft.),

b) a 600 mm (2 ft.) freeboard height above the design operating depth,

c) a *berm* slope not steeper than 1 vertical to 3 horizontal,

d) sufficient surface area to evaporate 150% of the expected annual volume of *wastewater* or *effluent* discharged into it based on mean flow volumes and the design surface area of the lagoon shall[2]

i) consider the net evaporation at the system location determined by the average annual precipitation and evaporation rates recorded by the Prairie Farm Rehabilitation Administration as reproduced in Appendix A.2.A. and Appendix A.2.B., and

ii) provide adequate storage to hold expected volumes of *wastewater* or *effluent* during winter or other periods of low net evaporation,

e) a minimum *berm* width of 1.8 m (6 ft.), as measured at the top of the *berm*, and

f) a finished elevation of the *berm* that will be above the surrounding grade, to prevent the entry of surface run-off water into the lagoon.

[1] Intent: Sentence (1) — Lagoons for private systems built to this Standard are not meant to rely on periodic discharge and must be sized to evaporate all sewage. Annual

The lagoon shall be designed for a maximum 1.5m (5 ft.) depth of sewage or sewage effluent. It is often better to have a lesser depth in order to minimize the amount of earth that must be moved. The important feature of the lagoon design is to provide adequate surface area for evaporation. However, it does need to have the capacity to store accumulating effluent over periods of time when evaporation is limited or non-existent; such as in winter or in spring when precipitation exceeds evaporation rates.

precipitation and evaporative rates must be considered in the design.

[2] Note: Clause (1)(d) — Formulas to calculate the required size of the lagoon are included in Appendix A.2.

9.1.1.4. Influent Receiving Pit

1) The *wastewater* or *effluent* shall enter the *lagoon* into a receiving pit that is accessible for periodic cleaning and the receiving pit shall have the

a) capacity to provide storage of accumulating sludge below the elevation of the wastewater inlet pipe that is at least the volume of 2 times the average daily flow volume, and

b) inlet pipe entering into it at an elevation that is a minimum of 600 mm (2 ft.) below the bottom of the lagoon.[1]

[1] Intent: Clause (1)(b) — Entering the pipe in this pit should provide a constant 600 mm (2 ft.) cover of water over the pipe that should provide protection from frost. The pit should be approximately 1.8 m x 1.8 m x 1.8 m (6 ft. X 6 ft. X 6 ft.) deep with the pipe entering 1.2 m (4 ft.) above the bottom of the pit.

The receiving pit the effluent enters must be deep enough to prevent freezing and accumulate the settled solids from the sewage. The receiving pit should be located close to the berm to enable periodic removal of the accumulated solids.

See Appendix B pg. 350 for more description of lagoon construction methods.

9.1.1.5. Fencing of Lagoons

1) A *lagoon* serving other than a single-family *dwelling* or duplex or where the design operating depth exceeds 600 mm (2 ft.) shall be fenced.[1]

[1] Intent: Sentence (1) — The fence should be designed to preclude the entrance of children and to discourage trespassing. The fence should also serve to preclude the entrance of livestock. Fences should be located away from the outside toe of the berm to facilitate mowing and maintenance operations. Where the lagoon is located near developed areas, a chain link fence may be required to prevent children from gaining entry. In addition, an access gate should be provided to allow entry of maintenance equipment, and this gate should be equipped with a lock to prevent entrance of unauthorized personnel. Signs

Although this standard requires fencing of the lagoon only where the operating depth exceeds 600mm (2 ft.) and on all developments other than single family residences, it is advisable to fence all lagoons.

should be posted to identify the lagoon and advise against trespassing.

9.1.2. Lagoons — Prescriptive Requirements and Installation Standards

9.1.2.1. Separation Distances

1) A *lagoon* serving a single-family *dwelling* or duplex shall not be located within

a) 100 m (330 ft.) from a *water source*,

b) 90 m (300 ft.) from a *water course*,

c) 30 m (100 ft.) from a *property* line, and

d) 45 m (150 ft.) from a *building*.

For developments other than single family dwellings see sentence (2) of this article.

2) A *lagoon* serving other than a single-family *dwelling* or duplex shall not be located within

a) 100 m (330 ft.) from a *water source*,

b) 90 m (300 ft.) from a *water course*,

c) 30 m (100 ft.) from a *property* line,

d) 90 m (300 ft.) from a *building*, and

e) 90 m (300 ft.) from a numbered primary or secondary road.

3) *All* measurements shall be taken from the outside of the *berm*, where the side slope of the berm intersects with the natural ground surface.

Part 10 Privies

Section 10.1 Privies

10.1.1. Privies — Objectives and Design Standards

10.1.1.1. Containment of Waste

1) A *privy* shall adequately contain the waste to prevent contamination of water sources.

Privies can be an effective method of human waste management when the requirements of this section are applied.

10.1.2. Privies — Prescriptive Requirements and Installation Standards

10.1.2.1. Location of Privies

1) Except as provided in Sentence (2), a *privy* shall not be located within

a) 15 m (50 ft.) from a *water source*,

b) 15 m (50 ft.) from a *water course*, except as required by Article 2.1.2.4.,

c) 5 m (17 ft.) from a *property* line, and

d) 6 m (20 ft.) from a dwelling, store, restaurant, or other place where food is stored, prepared or consumed.

Article 2.1.1.4 requires a separation of 90 meters to a lake river stream or creek.

2) A *privy* equipped with a water-tight holding tank to contain the wastes shall not be located within

a) 10 m (33 ft.) from a *water source*, and

b) 10 m (33 ft.) from a *water course*.

3) A *privy* equipped with a water-tight holding tank to contain the wastes shall be located where it is accessible for removal of the waste by a vacuum truck.

10.1.2.2. Restriction on Receiving Water-carried Wastes

1) A *privy* that uses an earthen pit to contain the waste shall not have wastewater directed to the pit.

2) A *privy* equipped with a water-tight holding tank to contain wastes may receive greywater from outdoor wash stands or from a residence.

Wastewater discharged to an earthen pit privy can cause the contaminants to travel further though the soil as compared to the essentially solid waste typically deposited in a privy. A privy receiving strictly human waste without additional water can be an effective composting unit.

If any substantial amount of wastewater is received it must be put into a holding tank.

10.1.2.3. Accessories Required for Water-tight Holding Tanks

1) A water-tight holding tank used to contain the waste from a *privy* shall

a) include an opening to facilitate pump out of the tank, and

b) include child protection bars to prevent accidental entry into the tank when used in a location where public access is expected.

2) The bars referred to in Clause (1)(b) shall be

a) spaced so that a spherical object having a diameter of 100 mm cannot pass through, and

b) aligned to minimize the accumulation of waste material.

A water tight holding tank that needs to be pumped must provide access for pumping and protection to prevent anyone from entering the tank inadvertently.

10.1.2.4. Restricted Use of Earthen Pit Privy

1) An earthen pit *privy* may be used only for private use and shall not be used to serve a public or commercial use facility.

An earthen pit privy is intended for limited use such as anticipated at a private residence.

10.1.2.5. Earthen Privy Soil Conditions

1) The soil in which an earthen *privy* pit is constructed shall

a) be *fine sandy loam* or finer textured,

b) not include any lenses of soil coarser than *fine sandy loam* within the depth of the pit, and

c) include soil to a depth of at least 600 mm (2 ft.) below the bottom of the pit that is *fine sandy loam* or finer textured.

2) Below the bottom of the earthen pit there shall be a minimum of 1.2 m (4 ft.) of soil to saturated soil conditions or bedrock.

The soil the earthen pit privy is dug into must not be a coarse textured soil that may allow the movement of contaminants through the soil.

10.1.2.6. Maximum Depth of Earthen Pit Privy

1) The depth of an earthen pit serving a *privy* shall not exceed 1.2 m (4 ft.) below grade.

This maximum depth is to ensure air movement to the waste material is not severely limited and to provide a physical level of safety considering the possibility of someone (a child) somehow entering the dug pit below the privy.

10.1.2.7. Protection from Surface Water Infiltration

1) The *privy* shall be located where it will not be subject to pooling of surface water runoff.

2) An earthen pit *privy* shall include a berm surrounding the pit that is a minimum of 150 mm (6 in.) above the surrounding ground surface to prevent the entry of surface water runoff.

3) Openings into a tank used for a *privy* shall be a minimum of 150 mm (6 in.) above the surrounding finished ground surface to prevent surface water runoff from entering the tank.

The requirements of this article are to limit the possibility of surface water runoff from entering the pit and thus carrying the wastewater contaminants further through the soil, or causing the pit to fill with runoff water and overflowing, carrying the contaminants of the wastewater over the surface of the ground.

10.1.2.8. Venting of Storage Tank

1) The tank of a *privy* accessible to the public shall be ventilated with the termination of the vent above the roof of the *privy*.

Venting of the tank is intended to pull the smell and possible contaminated aerosols out of the privy into the surrounding air outside the privy where they can quickly disperse.

10.1.2.9. Privy Structure

1) A sanitary *privy* shall be provided with
- **a)** a self-closing door,
- **b)** natural lighting,
- **c)** seats and covers of non-absorbent, easily cleanable material,
- **d)** ventilation of the pit or water-tight tank,
- **e)** insect proof screens on ventilation openings, and
- **f)** a toilet paper dispenser.

Additional requirements set out in the Alberta Building Code may apply to the structure of the privy enclosure.

10.1.3. Privies — Requirements for Materials

10.1.3.1. Tanks Used under a Privy

1) A tank used to contain the waste from a *privy* shall meet or exceed the requirements of CAN/CSA-B66, “Design, Material, and Manufacturing Requirements for Prefabricated Septic Tanks and Sewage Holding Tanks,” and be certified by an accredited testing agency.

2) *A tank used to contain the waste from a privy shall be structurally capable of carrying the load of the privy building* and person traffic.

Tanks used for the containment of privy waste must meet the structural and material requirements set out for tanks in the CAN/CSA B66 Standard.

Where the tank top provides the floor of the privy structure it must be able to support the load of the building and persons using the facility. This determination may require the application of requirements in the Alberta Building Code.

APPENDIX A

A.1. Pressure Distribution Lateral Pipe System Tables

A.1.A. Number of Orifices per *Distribution Lateral Pipe*

A.1.A.	Number of Orifices in a Distribution Lateral Pipe										
	Orifice Diameter	1/8" (3.2mm)					5/32" (4mm)				
	NPS Pipe Size of Distribution Lateral	3/4" 19mm	1" 25mm	1-1/4" 32mm	1-1/2" 38mm	2" 51mm	3/4" 19mm	1" 25mm	1-1/4" 32mm	1-1/2" 38mm	2" 51mm
Squirt Height, ft.	Distribution Lateral Length, ft.	Maximum Orifices Permitted					Maximum Orifices Permitted				
2 to 4	10	-	-	-	-	-	-	-	-	-	-
	15	-	-	-	-	-	-	-	-	-	-
	20	-	-	-	-	-	-	-	-	-	-
	25	-	-	-	-	-	-	-	-	-	-
	30	-	-	-	-	-	-	-	-	-	-
	35	-	-	-	-	-	-	-	-	-	-
	40	-	-	-	-	-	-	-	-	-	-
	45	-	-	-	-	-	-	-	-	-	-
	50	-	-	-	-	-	-	-	-	-	-
	55	-	-	-	-	-	-	-	-	-	-
	60	-	-	-	-	-	-	-	-	-	-
	65	-	-	-	-	-	-	-	-	-	-
5 to 9	10	20	20	20	20	20	20	20	20	20	20
	15	26	30	30	30	30	17	30	30	30	30
	20	22	40	40	40	40	14	27	40	40	40
	25	20	37	50	50	50	13	24	48	50	50
	30	18	33	60	60	60	11	21	44	60	60
	35	16	31	70	70	70	11	20	40	60	70
	40	15	29	58	80	80	10	18	37	56	80
	45	14	27	55	82	90	9	17	35	53	90
	50	14	25	52	78	100	-	16	33	50	96
	55	13	24	49	74	110	-	15	32	47	91
	60	12	23	47	70	120	-	15	30	45	87
	65	12	22	45	67	130	-	14	29	43	83
10 to 15	10	20	20	20	20	20	20	20	20	20	20
	15	26	30	30	30	30	17	30	30	30	30
	20	23	40	40	40	40	15	27	40	40	40
	25	20	38	50	50	50	13	24	50	50	50
	30	18	34	60	60	60	12	22	45	60	60
	35	17	32	65	70	70	11	20	41	62	70
	40	16	29	60	80	80	10	19	39	58	80
	45	15	28	56	85	90	10	18	36	54	90
	50	14	26	53	80	100	-	17	34	51	99
	55	13	25	51	76	110	-	16	33	49	94
	60	13	24	48	72	120	-	15	31	46	89
	65	-	23	46	69	130	-	15	30	44	86

Table A.1.A Continued

A.1.A.	Number of Orifices in a Distribution Lateral Pipe										
	Orifice Diameter	**3/16" (4.8mm)**					**7/32" (5.6mm)**				
	NPS Pipe Size of Distribution Lateral	3/4" 19mm	1" 25mm	1-1/4" 32mm	1-1/2" 38mm	2" 51mm	3/4" 19mm	1" 25mm	1-1/4" 32mm	1-1/2" 38mm	2" 51mm
Squirt Height, ft.	**Distribution Lateral Length, ft.**	**Maximum Orifices Permitted**					**Maximum Orifices Permitted**				
2 to 4	10	-	-	-	-	-	10	19	20	20	20
	15	-	-	-	-	-	8	15	30	30	30
	20	-	-	-	-	-	7	13	27	40	40
	25	-	-	-	-	-	6	12	24	36	50
	30	-	-	-	-	-	6	11	22	32	60
	35	-	-	-	-	-	-	10	20	30	57
	40	-	-	-	-	-	-	9	19	28	53
	45	-	-	-	-	-	-	9	17	26	50
	50	-	-	-	-	-	-	-	16	25	47
	55	-	-	-	-	-	-	-	16	23	45
	60	-	-	-	-	-	-	-	15	22	43
	65	-	-	-	-	-	-	-	14	21	41
5 to 9	10	14	20	20	20	20	11	20	20	20	20
	15	12	22	30	30	30	9	16	30	30	30
	20	10	19	38	40	40	7	14	28	40	40
	25	9	16	34	50	50	7	12	25	37	50
	30	8	15	30	46	60	6	11	22	34	60
	35	7	14	28	42	70	-	10	21	31	59
	40	-	13	26	39	75	-	10	19	29	55
	45	-	12	25	37	71	-	9	18	27	52
	50	-	11	23	35	67	-	-	17	26	49
	55	-	11	22	33	63	-	-	16	24	47
	60	-	10	21	31	60	-	-	16	23	44
	65	-	10	20	30	58	-	-	15	22	43
10 to 15	10	15	20	20	20	20	11	20	20	20	20
	15	12	22	30	30	30	9	16	30	30	30
	20	10	19	39	40	40	8	14	29	40	40
	25	9	17	35	50	50	7	13	25	38	50
	30	8	15	31	47	60	6	11	23	35	60
	35	8	14	29	43	70	-	10	21	32	61
	40	-	13	27	40	77	-	10	20	30	57
	45	-	12	25	38	73	-	9	19	28	53
	50	-	12	24	36	69	-	9	18	26	50
	55	-	11	23	34	65	-	-	17	25	48
	60	-	-	22	32	62	-	-	16	24	46
	65	-	-	21	31	60	-	-	15	23	44

(continued)

Table A.1.A. Continued

A.1.A.	Number of Orifices in a Distribution Lateral Pipe										
	Orifice Diameter	**1/4" (6.4mm)**					**9/32" (7.1mm)**				
	NPS Pipe Size of Distribution Lateral	3/4" 19mm	1" 25mm	1-1/4" 32mm	1-1/2" 38mm	2" 51mm	3/4" 19mm	1" 25mm	1-1/4" 32mm	1-1/2" 38mm	2" 51mm
Squirt Height, ft.	**Distribution Lateral Length, ft.**	**Maximum Orifices Permitted**					**Maximum Orifices Permitted**				
2 to 4	10	8	15	20	20	20	6	12	20	20	20
	15	6	12	24	30	30	5	9	19	28	30
	20	6	10	21	31	40	4	8	16	24	40
	25	5	9	18	27	50	-	7	15	22	42
	30	-	8	17	25	48	-	7	13	20	38
	35	-	8	15	23	44	-	-	12	18	35
	40	-	-	14	21	41	-	-	11	17	32
	45	-	-	13	20	38	-	-	11	16	30
	50	-	-	13	19	36	-	-	10	15	29
	55	-	-	12	18	34	-	-	-	14	27
	60	-	-	12	17	33	-	-	-	14	26
	65	-	-	-	16	31	-	-	-	13	25
5 to 9	10	8	15	20	20	20	7	12	20	20	20
	15	7	12	25	30	30	5	10	20	30	30
	20	6	11	21	32	40	5	8	17	25	40
	25	5	9	19	28	50	-	7	15	22	43
	30	-	9	17	26	49	-	7	14	20	39
	35	-	8	16	24	46	-	-	13	19	36
	40	-	-	15	22	42	-	-	12	18	34
	45	-	-	14	21	40	-	-	11	16	32
	50	-	-	13	20	38	-	-	10	16	30
	55	-	-	13	19	36	-	-	-	15	28
	60	-	-	12	18	34	-	-	-	14	27
	65	-	-	-	17	33	-	-	-	14	26
10 to 15	10	8	16	20	20	20	7	12	20	20	20
	15	7	13	26	30	30	5	10	20	30	30
	20	6	11	22	33	40	5	9	17	26	40
	25	5	10	20	29	50	-	8	16	23	44
	30	-	9	18	26	51	-	7	14	21	40
	35	-	8	16	24	47	-	-	13	19	37
	40	-	8	15	23	44	-	-	12	18	35
	45	-	-	14	21	41	-	-	11	17	32
	50	-	-	14	20	39	-	-	11	16	31
	55	-	-	13	19	37	-	-	-	15	29
	60	-	-	12	18	35	-	-	-	15	28
	65	-	-	-	18	34	-	-	-	14	27

Table A.1.A. Continued

A.1.A. Number of Orifices in a Distribution Lateral Pipe						
	Orifice Diameter	**5/16" (7.9mm)**				
	NPS Pipe Size of Distribution Lateral	3/4" 19mm	1" 25mm	1-1/4" 32mm	1-1/2" 38mm	2" 51mm
Squirt Height, ft.	**Distribution Lateral Length, ft.**	**Maximum Orifices Permitted**				
2 to 4	10	5	9	19	20	20
	15	4	8	16	23	30
	20	4	7	13	20	38
	25	-	6	12	18	34
	30	-	-	11	16	31
	35	-	-	10	15	28
	40	-	-	9	14	26
	45	-	-	9	13	25
	50	-	-	-	12	23
	55	-	-	-	12	22
	60	-	-	-	-	21
	65	-	-	-	-	20
5 to 9	10	5	10	20	20	20
	15	4	8	16	24	30
	20	4	7	14	21	39
	25	-	6	12	18	35
	30	-	6	11	17	32
	35	-	-	10	15	29
	40	-	-	10	14	27
	45	-	-	9	13	26
	50	-	-	-	13	24
	55	-	-	-	12	23
	60	-	-	-	-	22
	65	-	-	-	-	21
10 to 15	10	5	10	20	20	20
	15	4	8	17	25	30
	20	4	7	14	21	40
	25	-	6	13	19	36
	30	-	6	11	17	33
	35	-	-	11	16	30
	40	-	-	10	15	28
	45	-	-	9	14	26
	50	-	-	-	13	25
	55	-	-	-	12	24
	60	-	-	-	12	23
	65	-	-	-	-	22

A.1.B. Orifice Discharge Rates

A.1.B.1. Orifice Discharge Rate in Imperial Gallons per Minute									
Pressure Head, ft.	Orifice Diameter, Inches								
	1/8	5/32	3/16	7/32	1/4	9/32	5/16	11/32	3/8
2.0	-	-	-	0.66	0.87	1.10	1.36	1.64	1.95
2.5	-	-	-	0.74	0.97	1.23	1.52	1.83	2.18
3.0	-	-	-	0.81	1.06	1.35	1.66	2.01	2.39
3.5	-	-	-	0.88	1.15	1.45	1.79	2.17	2.58
4.0	-	-	-	0.94	1.23	1.55	1.92	2.32	2.76
4.5	-	-	-	1.00	1.30	1.65	2.03	2.46	2.93
5.0	0.34	0.54	0.77	1.05	1.37	1.74	2.14	2.59	3.09
5.5	0.36	0.56	0.81	1.10	1.44	1.82	2.25	2.72	3.24
6.0	0.38	0.59	0.85	1.15	1.50	1.90	2.35	2.84	3.38
6.5	0.39	0.61	0.88	1.20	1.56	1.98	2.45	2.96	3.52
7.0	0.41	0.63	0.91	1.24	1.62	2.06	2.54	3.07	3.65
7.5	0.42	0.66	0.95	1.29	1.68	2.13	2.63	3.18	3.78
8.0	0.43	0.68	0.98	1.33	1.74	2.20	2.71	3.28	3.91
8.5	0.45	0.70	1.01	1.37	1.79	2.26	2.80	3.38	4.03
9.0	0.46	0.72	1.04	1.41	1.84	2.33	2.88	3.48	4.14
9.5	0.47	0.74	1.06	1.45	1.89	2.39	2.96	3.58	4.26
10.0	0.49	0.76	1.09	1.49	1.94	2.46	3.03	3.67	4.37
10.5	0.50	0.78	1.12	1.52	1.99	2.52	3.11	3.76	4.48
11.0	0.51	0.80	1.15	1.56	2.04	2.58	3.18	3.85	4.58
11.5	0.52	0.81	1.17	1.59	2.08	2.63	3.25	3.94	4.68
12.0	0.53	0.83	1.20	1.63	2.13	2.69	3.32	4.02	4.78
12.5	0.54	0.85	1.22	1.66	2.17	2.75	3.39	4.10	4.88
13.0	0.55	0.86	1.24	1.69	2.21	2.80	3.46	4.18	4.98
13.5	0.56	0.88	1.27	1.73	2.26	2.85	3.52	4.26	5.07
14.0	0.57	0.90	1.29	1.76	2.30	2.91	3.59	4.34	5.17
14.5	0.58	0.91	1.31	1.79	2.34	2.96	3.65	4.42	5.26
15.0	0.59	0.93	1.34	1.82	2.38	3.01	3.71	4.49	5.35

based on $q = 16.37Cd^2h^{1/2}$
where q = Imperial gallons per minute flow rate
C = coefficient of discharge (0.60)
d = diameter in inches
h = pressure head in feet

Use A Minimum 2.0 ft. (600 mm) Of Pressure Head
Note: Some pump manufacturers rate pump capacities in US gallons.
Pump ratings in US gallons must be converted to Imperial gallons.
US Gallons x 0.83 = Imperial Gallons

Note: *This table is used to determine the flow rate of an orifice size at a selected pressure head. To determine the total flow, multiply the flow rate for an orifice by the number of orifices in the distribution lateral pipes.*

A.1.B.2.	Orifice Discharge Rate in Litres per Minute								
Pressure Head, mm	**Orifice Diameter, mm (in.)**								
	3.2 mm (1/8")	4.0 mm (5/32")	4.8 mm (3/16")	5.6 mm (7/32")	6.4 mm (1/4")	7.1 mm (9/32")	7.9 mm (5/16")	8.7 mm (11/32")	9.5 mm (3/8")
600	-	-	-	3.02	3.95	4.99	6.17	7.46	8.88
750	-	-	-	3.38	4.41	5.58	6.89	8.34	9.93
900	-	-	-	3.70	4.83	6.12	7.55	9.14	10.87
1050	-	-	-	4.00	5.22	6.61	8.16	9.87	11.75
1200	-	-	-	4.27	5.58	7.06	8.72	10.55	12.56
1350	-	-	-	4.53	5.92	7.49	9.25	11.19	13.32
1500	1.56	2.44	3.51	4.78	6.24	7.90	9.75	11.80	14.04
1650	1.64	2.56	3.68	5.01	6.54	8.28	10.23	12.37	14.72
1800	1.71	2.67	3.84	5.23	6.84	8.65	10.68	12.92	15.38
1950	1.78	2.78	4.00	5.45	7.11	9.00	11.12	13.45	16.01
2100	1.85	2.88	4.15	5.65	7.38	9.34	11.54	13.96	16.61
2250	1.91	2.99	4.30	5.85	7.64	9.67	11.94	14.45	17.19
2400	1.97	3.08	4.44	6.04	7.89	9.99	12.33	14.92	17.76
2550	2.03	3.18	4.58	6.23	8.14	10.30	12.71	15.38	18.30
2700	2.09	3.27	4.71	6.41	8.37	10.60	13.08	15.83	18.84
2850	2.15	3.36	4.84	6.58	8.60	10.89	13.44	16.26	19.35
3000	2.21	3.45	4.96	6.76	8.82	11.17	13.79	16.68	19.85
3150	2.26	3.53	5.09	6.92	9.04	11.44	14.13	17.10	20.34
3300	2.31	3.62	5.21	7.09	9.25	11.71	14.46	17.50	20.82
3450	2.37	3.70	5.32	7.25	9.46	11.98	14.79	17.89	21.29
3600	2.42	3.78	5.44	7.40	9.67	12.23	15.10	18.28	21.75
3750	2.47	3.85	5.55	7.55	9.87	12.49	15.42	18.65	22.20
3900	2.52	3.93	5.66	7.70	10.06	12.73	15.72	19.02	22.64
4050	2.56	4.01	5.77	7.85	10.25	12.98	16.02	19.38	23.07
4200	2.61	4.08	5.87	7.99	10.44	13.21	16.31	19.74	23.49
4350	2.66	4.15	5.98	8.14	10.63	13.45	16.60	20.09	23.91
4500	2.70	4.22	6.08	8.27	10.81	13.68	16.89	20.43	24.32

Note: *This table is used to determine the flow rate of an orifice size at a selected pressure head. To determine the total flow, multiply the flow rate for an orifice by the number of orifices in the distribution lateral pipes.*

A.1.C.1. Friction Loss in PVC Schedule 40 Pipe – Imperial & U.S. Gallons

A.1.C.1. Friction Loss in Feet *Pressure Head* per 100 Feet in Schedule 40 PVC Pipe (C=150)													
Flow in Imp gpm	**Nominal Pipe Diameter (in.)**						**Flow in US gpm**	**Nominal Pipe Diameter (in.)**					
	3/4	**1**	**1 1/4**	**1 1/2**	**2**	**3**		**3/4**	**1**	**1 1/4**	**1 1/2**	**2**	**3**
1	0.35	0.11	0.03	0.01	0.00	0.00	**1**	0.25	0.08	0.02	0.01	0.00	0.00
2	1.27	0.39	0.10	0.05	0.01	0.00	**2**	0.91	0.28	0.07	0.03	0.01	0.00
3	2.69	0.83	0.22	0.10	0.03	0.00	**3**	1.92	0.59	0.16	0.07	0.02	0.00
4	4.59	1.42	0.37	0.18	0.05	0.01	**4**	3.27	1.01	0.27	0.13	0.04	0.01
5	6.93	2.14	0.56	0.27	0.08	0.01	**5**	4.95	1.53	0.40	0.19	0.06	0.01
6	9.71	3.00	0.79	0.37	0.11	0.02	**6**	6.93	2.14	0.56	0.27	0.08	0.01
7	12.92	3.99	1.05	0.50	0.15	0.02	**7**	9.22	2.85	0.75	0.35	0.11	0.02
8	16.54	5.11	1.35	0.64	0.19	0.03	**8**	11.80	3.65	0.96	0.45	0.13	0.02
9	20.56	6.35	1.67	0.79	0.23	0.03	**9**	14.67	4.53	1.19	0.56	0.17	0.02
10	24.99	7.72	2.03	0.96	0.28	0.04	**10**	17.83	5.51	1.45	0.69	0.20	0.03
11	29.80	9.21	2.42	1.15	0.34	0.05	**11**	21.27	6.57	1.73	0.82	0.24	0.04
12	35.01	10.82	2.85	1.35	0.40	0.06	**12**	24.99	7.72	2.03	0.96	0.28	0.04
13	40.60	12.54	3.30	1.56	0.46	0.07	**13**	28.97	8.95	2.36	1.11	0.33	0.05
14		14.38	3.79	1.79	0.53	0.08	**14**	33.23	10.27	2.70	1.28	0.38	0.06
15		16.34	4.30	2.03	0.60	0.09	**15**	37.76	11.66	3.07	1.45	0.43	0.06
16		18.42	4.85	2.29	0.68	0.10	**16**	42.54	13.14	3.46	1.63	0.48	0.07
17		20.60	5.42	2.56	0.76	0.11	**17**		14.70	3.87	1.83	0.54	0.08
18		22.90	6.03	2.85	0.84	0.12	**18**		16.34	4.30	2.03	0.60	0.09
19		25.31	6.66	3.15	0.93	0.14	**19**		18.06	4.76	2.25	0.67	0.10
20		27.83	7.33	3.46	1.03	0.15	**20**		19.86	5.23	2.47	0.73	0.11
25		42.05	11.07	5.23	1.55	0.23	**25**		30.01	7.90	3.73	1.11	0.16
30			15.51	7.33	2.17	0.32	**30**		42.05	11.07	5.23	1.55	0.23
35			20.63	9.75	2.89	0.42	**35**			14.73	6.96	2.06	0.30
40			26.42	12.48	3.70	0.54	**40**			18.85	8.91	2.64	0.39
45			32.85	15.52	4.60	0.67	**45**			23.44	11.07	3.28	0.48
50			39.92	18.85	5.59	0.82	**50**			28.49	13.46	3.99	0.58
55				22.49	6.67	0.98	**55**			33.98	16.05	4.76	0.70
60				26.42	7.83	1.15	**60**			39.92	18.85	5.59	0.82
65				30.63	9.08	1.33	**65**				21.86	6.48	0.95
70				35.14	10.42	1.53	**70**				25.08	7.44	1.09
75				39.92	11.84	1.73	**75**				28.49	8.45	1.24
80					13.34	1.95	**80**				32.10	9.52	1.39
85					14.92	2.18	**85**				35.91	10.65	1.56
90					16.58	2.43	**90**				39.92	11.84	1.73
95					18.33	2.68	**95**					13.08	1.91
100					20.15	2.95	**100**					14.38	2.11
125					30.45	4.46	**125**					21.73	3.18
150					42.67	6.25	**150**					30.45	4.46
175						8.31	**175**					40.50	5.93
200						10.64	**200**						7.59
250						16.07	**250**						11.47
300						22.52	**300**						16.07

Note: *The values contained within the bolded lines represent a flow velocity within the desired range of 2 to 5 ft. per second. Flow velocity should exceed 2 ft. per second to achieve required scouring of deposits and growth on pipe walls cause by the effluent. Flow velocity over 5 ft. per second should be used cautiously due to excessive pressure being created from sudden flow stops caused by quick closing valves or shock occurring from trapped air in portions of the effluent lines.*

A.1.C.2. Friction Loss in PVC Schedule 40 Pipe – Metric

A.1.C.2. Friction Loss in mm Pressure Head per 30.5 Metres in Schedule 40 PVC Pipe (C=150)						
Flow in L/min.	Nominal Pipe Diameter (in.)					
	¾	1	1 1/4	1 1/2	2	3
5	128	40	10	5	1	0
10	462	143	38	18	5	1
15	979	302	80	38	11	2
20	1667	515	136	64	19	3
25	2519	778	205	97	29	4
30	3530	1090	287	136	40	6
35	4695	1450	382	180	53	8
40	6010	1857	489	231	68	10
45	7473	2309	608	287	85	12
50	9082	2806	739	349	103	15
55	10833	3347	881	416	123	18
60	12725	3931	1035	489	145	21
65	14756	4559	1200	567	168	25
70		5228	1377	650	193	28
75		5940	1564	739	219	32
80		6694	1763	833	247	36
85		7488	1972	931	276	40
90		8323	2192	1035	307	45
95		9199	2422	1144	339	50
100		10114	2663	1258	373	55
120		14172	3732	1763	523	77
140			4963	2344	695	102
160			6354	3001	890	130
180			7901	3732	1107	162
200			9602	4535	1345	197
220			11453	5410	1604	235
240				6355	1884	276
260				7369	2185	320
280				8452	2506	367
300				9603	2847	417
320				10820	3208	470
340					3589	525
360					3989	584
380					4409	645
400					4848	710
450					6028	882
500					7325	1072
550					8738	1279
600						1502
700						1998
800						2558
900						3181

Note: *The values contained within the bolded lines represent a flow velocity within the desired range of 2 to 5 ft. per second. Flow velocity should exceed 2 ft. per second to achieve required scouring of deposits on pipe walls. Flow velocity over 5 ft. per second should be used cautiously due to excessive pressure being created from sudden flow stops caused by quick closing valves.*

A.1.C.3. Friction Loss in Polyethylene Pipe – Gallons

A.1.C.3. Friction Loss in Feet *Pressure Head* per 100 Feet in Polyethylene Pipe, "Carlon" (C=147)													
Flow in Imp gpm	**Nominal Pipe Diameter (in.)**						**Flow in US gpm**	**Nominal Pipe Diameter (in.)**					
	3/4	**1**	**1 ¼**	**1 1/2**	**2**	**3**		**3/4**	**1**	**1 1/4**	**1 1/2**	**2**	**3**
1	0.37	0.11	0.03	0.01	0.00	0.00	**1**	0.26	0.08	0.02	0.01	0.00	0.00
2	1.32	0.41	0.11	0.05	0.02	0.00	**2**	0.94	0.29	0.08	0.04	0.01	0.00
3	2.80	0.86	0.23	0.11	0.03	0.00	**3**	2.00	0.62	0.16	0.08	0.02	0.00
4	4.76	1.47	0.39	0.18	0.05	0.01	**4**	3.40	1.05	0.28	0.13	0.04	0.01
5	7.19	2.22	0.59	0.28	0.08	0.01	**5**	5.13	1.59	0.42	0.20	0.06	0.01
6	10.08	3.11	0.82	0.39	0.11	0.02	**6**	7.19	2.22	0.59	0.28	0.08	0.01
7	13.41	4.14	1.09	0.52	0.15	0.02	**7**	9.57	2.96	0.78	0.37	0.11	0.02
8	17.16	5.30	1.40	0.66	0.20	0.03	**8**	12.25	3.78	1.00	0.47	0.14	0.02
9	21.34	6.59	1.74	0.82	0.24	0.04	**9**	15.23	4.71	1.24	0.59	0.17	0.03
10	25.94	8.01	2.11	1.00	0.30	0.04	**10**	18.51	5.72	1.51	0.71	0.21	0.03
11	30.94	9.56	2.52	1.19	0.35	0.05	**11**	22.08	6.82	1.80	0.85	0.25	0.04
12	36.34	11.23	2.96	1.40	0.41	0.06	**12**	25.94	8.01	2.11	1.00	0.30	0.04
13	42.14	13.02	3.43	1.62	0.48	0.07	**13**	30.08	9.29	2.45	1.16	0.34	0.05
14		14.93	3.93	1.86	0.55	0.08	**14**	34.50	10.66	2.81	1.33	0.39	0.06
15		16.97	4.47	2.11	0.63	0.09	**15**	39.19	12.11	3.19	1.51	0.45	0.07
16		19.12	5.03	2.38	0.71	0.10	**16**	44.16	13.64	3.59	1.70	0.50	0.07
17		21.39	5.63	2.66	0.79	0.12	**17**		15.26	4.02	1.90	0.56	0.08
18		23.77	6.26	2.96	0.88	0.13	**18**		16.97	4.47	2.11	0.63	0.09
19		26.27	6.92	3.27	0.97	0.14	**19**		18.75	4.94	2.33	0.69	0.10
20		28.89	7.61	3.59	1.07	0.16	**20**		20.62	5.43	2.56	0.76	0.11
25		43.65	11.49	5.43	1.61	0.24	**25**		31.15	8.20	3.87	1.15	0.17
30			16.11	7.61	2.26	0.33	**30**		43.65	11.49	5.43	1.61	0.24
35			21.42	10.12	3.00	0.44	**35**			15.29	7.22	2.14	0.31
40			27.42	12.95	3.84	0.56	**40**			19.57	9.24	2.74	0.40
45			34.10	16.11	4.78	0.70	**45**			24.34	11.50	3.41	0.50
50			41.44	19.57	5.80	0.85	**50**			29.57	13.97	4.14	0.61
55				23.35	6.92	1.01	**55**			35.28	16.66	4.94	0.72
60				27.42	8.13	1.19	**60**			41.44	19.57	5.80	0.85
65				31.80	9.43	1.38	**65**				22.70	6.73	0.99
70				36.47	10.81	1.58	**70**				26.03	7.72	1.13
75				41.44	12.29	1.80	**75**				29.58	8.77	1.28
80					13.85	2.03	**80**				33.33	9.88	1.45
85					15.49	2.27	**85**				37.28	11.05	1.62
90					17.22	2.52	**90**				41.44	12.29	1.80
95					19.03	2.79	**95**					13.58	1.99
100					20.92	3.06	**100**					14.93	2.19
125					31.61	4.63	**125**					22.56	3.30
150					44.29	6.48	**150**					31.61	4.63
175						8.62	**175**					42.05	6.15
200						11.04	**200**						7.88
250						16.68	**250**						11.91
300						23.37	**300**						16.68

Note: *The values contained within the bolded lines represent a flow velocity within the desired range of 2 to 5 ft. per second. Flow velocity should exceed 2 ft. per second to achieve required scouring of deposits on pipe walls. Flow velocity over 5 ft. per second should be used cautiously due to excessive pressure being created from sudden flow stops caused by quick closing valves.*

A.1.C.4. Friction Loss in Polyethylene Pipe - Metric

A.1.C.4. Friction Loss in mm Pressure Head per 30.5 Metres in Polyethylene Pipe, "Carbon" (C=147)						
Flow in L/min.	**Nominal Pipe Diameter (in.)**					
	¾	**1**	**1 1/4**	**1 1/2**	**2**	**3**
5	133	41	11	5	2	0
10	480	148	39	18	5	1
15	1016	314	83	39	12	2
20	1731	535	141	67	20	3
25	2615	808	213	100	30	4
30	3664	1132	298	141	42	6
35	4873	1506	396	187	56	8
40	6239	1927	508	240	71	10
45	7758	2397	631	298	88	13
50	9428	2912	767	362	107	16
55	11246	3474	915	432	128	19
60	13210	4081	1075	508	151	22
65	15318	4732	1246	589	175	26
70		5428	1429	675	200	29
75		6166	1624	767	227	33
80		6948	1830	864	256	38
85		7773	2047	967	287	42
90		8640	2275	1075	319	47
95		9549	2515	1188	352	52
100		10500	2765	1306	387	57
120		14711	3874	1830	543	79
140			5152	2434	722	106
160			6596	3116	924	135
180			8202	3874	1149	168
200			9967	4708	1396	204
220			11889	5616	1665	244
240				6597	1956	286
260				7650	2268	332
280				8774	2601	381
300				9968	2956	433
320				11232	3330	488
340					3726	545
360					4141	606
380					4577	670
400					5032	737
450					6258	916
500					7604	1113
550					9071	1328
600						1560
700						2074
800						2656
900						3302

Note: *The values contained within the bolded lines represent a flow velocity within the desired range of 2 to 5 ft. per second. Flow velocity should exceed 2 ft. per second to achieve required scouring of deposits on pipe walls. Flow velocity over 5 ft. per second should be used cautiously due to excessive pressure being created from sudden flow stops caused by quick closing valves.*

A.1.C.5. Friction Loss Equivalent Lengths for Fittings – Polyethylene Pipe

A.1.C.5. Friction Loss Equivalent Lengths for Polyethylene Piping Insert Fittings						
Expressed in Approximate Length of Straight Pipe						
Pipe Size (in.)	Make/Female 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	0.3	0.5	0.15	3	0.91
3/4	1.5	0.46	0.75	0.23	4.3	1.31
1	2	0.61	1	0.3	6	1.83
1 1/4	2.7	0.82	1.3	0.4	8.6	2.62
1 1/5	3.4	1.04	1.6	0.49	10.5	3.2
2	4.4	1.34	2	0.61	13.2	4.02
3	6.2	1.89	2.9	0.88	17	5.18

A.1.C.6. Friction Loss Equivalent Lengths for Fittings – Schedule 40 PVC Pipe

A.1.C.6. Friction Loss Equivalent Length – Schedule 40 PVC Pipe								
Expressed in Approximate Length of Straight Pipe (feet)								
	Nominal Pipe Size (inches)							
Fitting	1/2	3/4	1	1 1/4	1 1/2	2	2 1/2	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 - Run	1	1.4	1.7	2.3	2.7	4.3	5.1	6.2
Tee Flow - 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

A.1.D.1. Liquid Volume of Pipes

Nominal Pipe Diameter, Inches	Volume (per 100 feet of pipe)	
	Litres	Imp Gallons
¾	8.7	1.9
1	17	3.74
1 1/4	30	6.48
1 1/2	40	8.82
2	66	14.66
3	145	30
4	250	55.1

A.1.E.1. Effluent Soil Loading Rates and Linear Loading Rates (Imp. gal.)

Table A.1.E.1. Effluent Soil Loading Rates and Linear Loading Rates (Imp. Gal.)

Soil characteristics			Infiltration loading rate: gal/day/ft²		Hydraulic Linear Loading Rate, gal/day/ft — Slope of land								
					0-4%			>4-9%			>9%		
Texture	Structure		Effluent Quality		Infiltration distance, in.[1]			Infiltration distance, in.[1]			Infiltration distance, in.[1]		
	Shape	Grade	30-150 mg/L	<30 mg/L	8-<12	12-<24	24-<48	8-<12	12-<24	24-<48	8-<12	12-<24	24-<48
COS[2], MS, LCOS, LMS **Requires pressure distribution**	--	0SG	0.3	0.3	4.0	5.0	6.0	5.0	6.0	7.0	6.0	7.0	8.0
FS,VFS,LFS,LVFS **Requires pressure distribution**	--	0SG	0.4	0.5	3.5	4.5	5.5	4.0	5.0	6.0	5.0	6.0	7.0
COSL, MSL **Requires pressure distribution**	--	0M	0.2	0.6	3.0	3.5	4.0	3.6	4.1	4.6	5.0	6.0	7.0
	PL	1	0.2	0.5	3.0	3.5	4.0	3.6	4.1	4.6	4.0	5.0	6.0
		2,3	0.0	0.2	2.0	2.5	3.0	2.2	2.7	3.2	2.4	2.9	3.4
	PR/BK /GR	1	0.4	0.6	3.5	4.5	5.5	4.0	5.0	6.0	5.0	6.0	7.0
		2,3	0.6	0.6	3.5	4.5	5.5	4.0	5.0	6.0	5.0	6.0	7.0
FSL,VFSL	--	0M	0.18	0.36	2.0	2.3	2.6	2.4	2.7	3.0	2.7	3.2	3.7
	PL	1	0.18	0.36	2.0	2.3	2.6	2.4	2.7	3.0	2.7	3.2	3.7
		2,3	0.0	0.15	2.0	2.5	3.0	2.2	2.7	3.2	2.4	2.9	3.4
	PR/BK /GR	1	0.18	0.45	3.0	3.5	4.0	3.3	3.8	4.3	3.6	4.1	4.6
		2,3	0.32	0.63	3.3	3.8	4.3	3.6	4.1	4.6	3.9	4.4	4.9
L	--	0M	0.18	0.45	2.0	2.3	2.6	2.4	2.7	3.0	2.7	3.2	3.7
	PL	1	0.3	0.45	3.0	3.5	4.0	3.3	3.8	4.3	3.6	4.1	4.6
		2,3	0.0	0.15	2.0	2.5	3.0	2.2	2.7	3.2	2.4	2.9	3.4
	PR/BK /GR	1	0.3	0.45	3.0	3.5	4.0	3.3	3.8	4.3	3.6	4.1	4.6
		2,3	0.45	0.63	3.3	3.8	4.3	3.6	4.1	4.6	3.9	4.4	4.9
SIL	--	0M	0.0	0.18	2.0	2.5	3.0	2.2	2.7	3.2	2.4	2.9	3.4
	PL	1	0.0	0.15	2.0	2.5	3.0	2.2	2.7	3.2	2.4	2.9	3.4
		2,3	0.0	0.0	-	-	-	-	-	-	-	-	-
	PR/BK /GR	1	0.3	0.45	2.4	2.7	3.0	2.7	3.0	3.3	3.0	3.5	4.0
		2,3	0.45	0.63	2.7	3.2	3.7	3.0	3.5	4.0	3.3	3.8	4.3
SCL, CL, SICL, SI	--	0M	0.0	0.0	-	-	-	-	-	-	-	-	-
	PL	1	0.0	0.15	1.2	1.7	2.2	1.4	1.9	2.4	1.6	2.1	2.6
		2,3	0.0	0.0	-	-	-	-	-	-	-	-	-
	PR/BK /GR	1	0.18	0.27	2.0	2.5	3.0	2.2	2.7	3.2	2.4	2.9	3.4
		2,3	0.27	0.45	2.4	2.9	3.4	2.7	3.2	3.7	3.0	3.5	4.0
SC, C, SIC	--	0M	0.0	0.0	--	--	--	--	--	--	--	--	--
	PL	1,2,3,	0.0	0.0	--	--	--	--	--	--	--	--	--
	PR/BK /GR	1	0.0	0.0	--	--	--	--	--	--	--	--	--
		2,3	0.14	0.20	2.0	2.5	3.0	2.2	2.7	3.2	2.4	2.9	3.4
HC	--	0M	0.0	0.0	--	--	--	--	--	--	--	--	--
	PL	1,2,3,	0.0	0.0	--	--	--	--	--	--	--	--	--
	PR/BK /GR	1	0.0	0.0	--	--	--	--	--	--	--	--	--
		2,3	0.09	0.16	1.6	2.1	2.6	1.8	2.3	2.8	2.0	2.5	3.0

***Note:** See pg. Error! Bookmark not defined. for editorial corrections made to headings in this table and pg. **304** for direction on the use of this table and direction in its application.*

Table A.1.E.1 Abbreviation Legend

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

PL	Platy	**PR**	Prismatic	**BK**	Blocky	**GR**	Granular	**M**	Massive	**SG**	Single Grain
0	Structureless	**1**	Weak	**2**	Moderate	**3**	Strong				

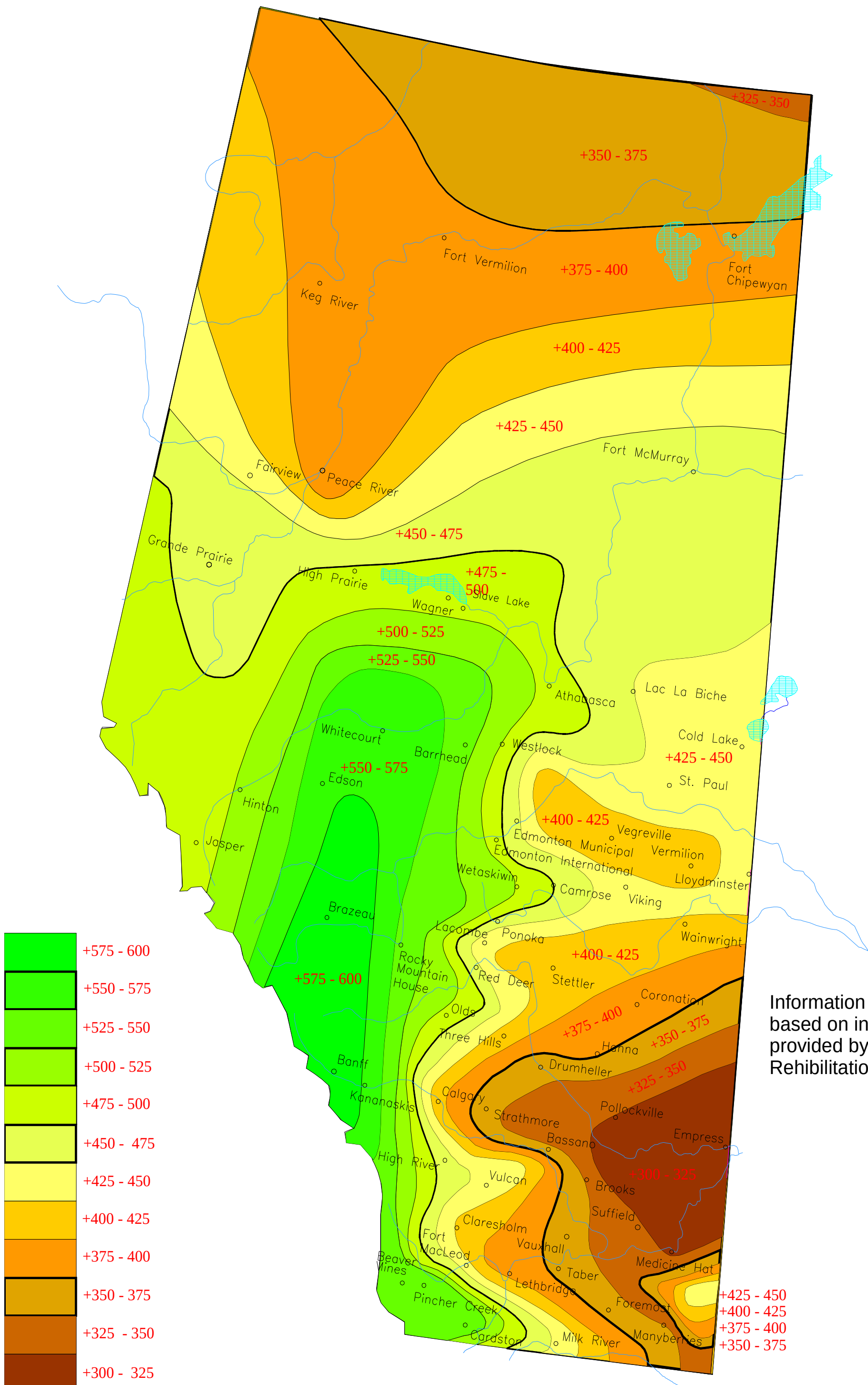
[1] *Note: Infiltration distance is the depth as suitable soil below the in situ soil infiltration surface effluent is applied to.*

Table A.1.E.1 Infiltration rates in gal/d/ft^2 for wastewater of >30 mg/L BOD_5 or wastewater of <30 mg/L BOD_5 and hydraulic linear loading rates in gal/d/ft for soil characteristics of texture and structure and site conditions of slope and infiltration depth to limiting soil layers. Values assume daily wastewater volume estimates used in the design are based on the values set out in Subsection 2.2.2. or include the same factor of safety. If horizon consistence is stronger than firm or any cemented class or the clay mineralogy is smectitic, the horizon is limiting regardless of other soil characteristics (adapted from 2000 E. Jerry Tyler).

[2] *Note: The application of effluent to Coarse Sand is not allowed except where the requirements of Sentence 8.1.1.3. (2) are met.*

A.2. Lagoon System Design Data

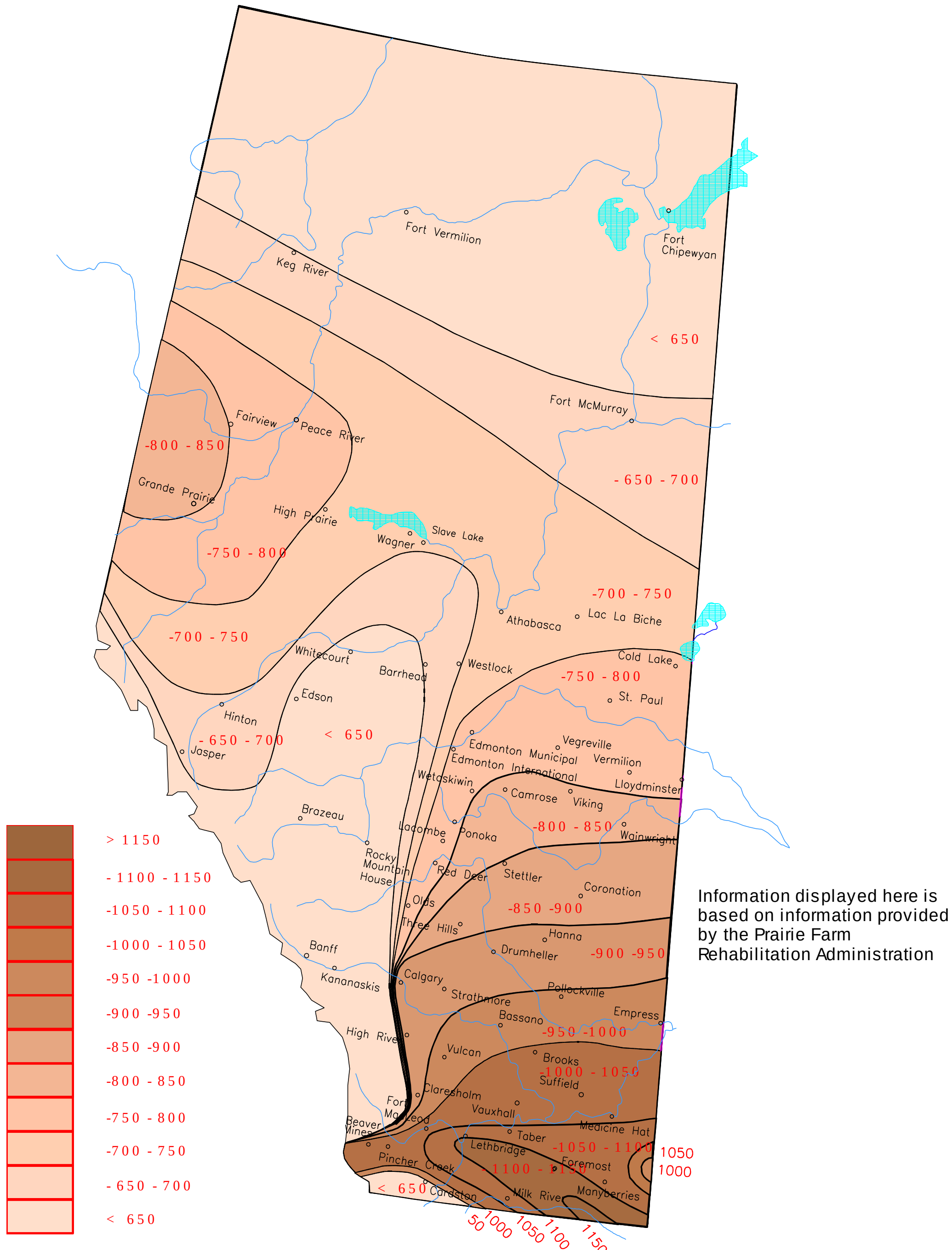
A.2.A. Precipitation Rates



Information displayed here is based on information provided by the Prairie Farm Rehabilitation Administration

Average Annual Precipitation in mm

A.2.B. Evaporation Rates



Average Annual Evaporation in mm

A.2.C. Calculation of Lagoon Surface Area Requirements for Evaporation

Note: *The following formulas are used to determine the required surface area of a lagoon to accomplish the evaporation of 150% of the expected average sewage volume per year based on average precipitation and evaporation rates (factor of safety = 1.25).*

$$\text{Gallons of Evaporation per Sq. Ft per Year} = \frac{(\text{inches of evaporation per year - inches of precipitation per year}) \times 144}{\text{277 cubic inches per Imperial gallon}}$$

$$\text{Litres of Evaporation per Sq. M. per Year} = (\text{mm of Evaporation per year - mm of Precipitation per year}) \times 1$$

$$\text{Square Feet Required} = \frac{\text{Average Gallons of Sewage per Year} \times 1.5}{\text{Gallons of Evaporation per Square Foot per Year}}$$

$$\text{Square Metres Required} = \frac{\text{Average Litres of Sewage per Year} \times 1.5}{\text{Litres of Evaporation per Square Metre per Year}}$$

A.2.D. Lagoon Volumes

A.2.D. Calculation of *Sewage Lagoon* Volume				
Approximate Volume in Litres (gal.)	**Size at Base in Metres (ft.)**	**Size at Mid Depth 750 mm (2.5 ft.)**	**Size at Full Depth 1500 mm (5 ft.)**	**Size at Top of *Berm* 600 mm (2.0 ft.) Freeboard, (2100 mm (7.0 ft.) Above Bottom of *Lagoon*)**
138,106 (30,420)	*4.57 x 4.57 (15 ft. x 15 ft.)*	*9.14 x 9.14 (30 ft. x 30 ft.)*	*13.72 x 13.72 (45 ft. x 45 ft.)*	*17.37 x 17.371 (57 ft. x 57 ft.)*
184,142 (40,560)	*6.10 x 6.10 (20 ft. x 20 ft.)*	*10.67 x 10.67 (35 ft. x 35 ft.)*	*15.24 x 15.24 (50 ft. x 50 ft.)*	*18.90 x 18.90 (62 ft. x 62 ft.)*
237,260 (52,260)	*7.62 x 7.62 (25 ft. x 25 ft.)*	*12.19 x 12.19 (40 ft. x 40 ft.)*	*16.76 x 16.76 (55 ft. x 55 ft.)*	*18.90 x 18.90 (67 ft. x 67 ft.)*
297,460 (62,520)	*9.14 x 9.14 (30 ft. x 30 ft.)*	*13.72 x 13.72 (45 ft. x 45 ft.)*	*18.29 x 18.29 (60 ft. x 60 ft.)*	*21.95 x 21.96 (72 ft. x 72 ft.)*
364,743 (80,340)	*10.67 x 10.67 (35 ft. x 35 ft.)*	*15.24 x 15.24 (50 ft. x 50 ft.)*	*19.81 x 19.81 (65 ft. x 65 ft.)*	*23.47 x 23.47 (77 ft. x 77 ft.)*
439,109 (96,720)	*12.19 x 12.19 (40 ft. x 40 ft.)*	*16.76 x 16.76 (55 ft. x 55 ft.)*	*21.34 x 21.34 (70 ft. x 70 ft.)*	*24.99 x 24.99 (82 ft. x 82 ft.)*
609,086 (134,160)	*15.24 x 15.24 (50 ft. x 50 ft.)*	*19.21 x 19.11 (65 ft. x 65 ft.)*	*24.38 x 24.38 (80 ft. x 80 ft.)*	*28.04 x 28.04 (92 ft. x 92 ft.)*
807,393 (177,840)	*18.29 x 18.29 (60 ft. x 60 ft.)*	*22.86 x 22.86 (75 ft. x 75 ft.)*	*27.43 x 27.43 (90 ft. x 90 ft.)*	*31.09 x 31.09 (102 ft. x 102 ft.)*
1034,030 (227,760)	*21.34 x 21.34 (70 ft. x 70 ft.)*	*25.91 x 25.91 (85 ft. x 85 ft.)*	*30.48 x 30.48 (100 ft. x 100*	*34.14 x 34.14 (112 ft. x 112 ft.)*
1,883,918 (414,960)	*30.48 x 30.48 (100 ft. x 100 ft.)*	*35.05 x 35.05 (115 ft. x 115 ft.)*	*39.62 x 39.62 (130 ft. x 130*	*43.28 x 43.28 (142 ft. x 142 ft.)*
2,592,158 (570,960)	*36.58 x 36.58 (120 ft. x 120 ft.)*	*41.15 x 41.15 (135 ft. x 135 ft.)*	*45.72 x 45.72 (150 ft. x 150*	*49.38 x 49.38 (162 ft. x 162 ft.)*
3,866,990 (851,760)	*45.72 x 45.72 (150 ft. x 150 ft.)*	*50.29 x 58.21 (165 ft. x 165 ft.)*	*54.86 x 54.86 (180 ft. x 180*	*58.52 x 58.52 (192 ft. x 192 ft.)*
4,514,694 (1,128,660)	*53.34 x 53.34 (175 ft. x 175 ft.)*	*57.91 x 57.91 (190 ft. x 190 ft.)*	*62.48 x 62.48 (205 ft. x 205*	*66.14 x 66.14 (217 ft. x 217 ft.)*
6,558,302 (1,444,560)	*60.96 x 60.96 (200 ft. x 200 ft.)*	*65.53 x 65.53 (215 ft. x 215 ft.)*	*70.10 x 70.10 (230 ft. x 230*	*73.76 x 73.76 (242 ft. x 242 ft.)*
9,957,854 (2,193,360)	*76.20 x 76.20 (250 ft. x 250 ft.)*	*80.77 x 80.77 (265 ft. x 265 ft.)*	*85.34 x 85.34 (280 ft. x 280*	*89.0 x 89.0 (292 ft. x 292 ft.)*
14,065,646 (3,098,160)	*91.44 x 91.44 (300 ft. x 300 ft.)*	*96.01 x 96.01 (315 ft. x 315 ft.)*	*100.60 x 100.60 (330 ft. x 330*	*104.3 x 104.3 (342 ft. x 342 ft.)*
24,405,905 (5,375,760)	*121.90 x 121.50 (400 ft. x 400 ft.)*	*126.50 x 126.50 (415 ft. x 415 ft.)*	*131.1 x 131.1 (430 ft. x 430*	*134.7 x 134.7 (442 ft. x 442 ft.)*

Note: *To calculate the volume of a square or rectangular lagoon* of a size not listed above, the following formula may be used based on an inside *berm* slope of 3 horizontal to 1 vertical.

Volume={H} over {0.167} times (A+4B+C) times 28.33

V = Volume in litres
H = Depth of liquid (maximum of 1.5 metres)
A = Area of bottom of *lagoon* in square metres
B = Area at mid-depth in square metres
C = Area at the high water level in square metres (maximum 1.5 metre depth)

A.3. Alberta Design Data

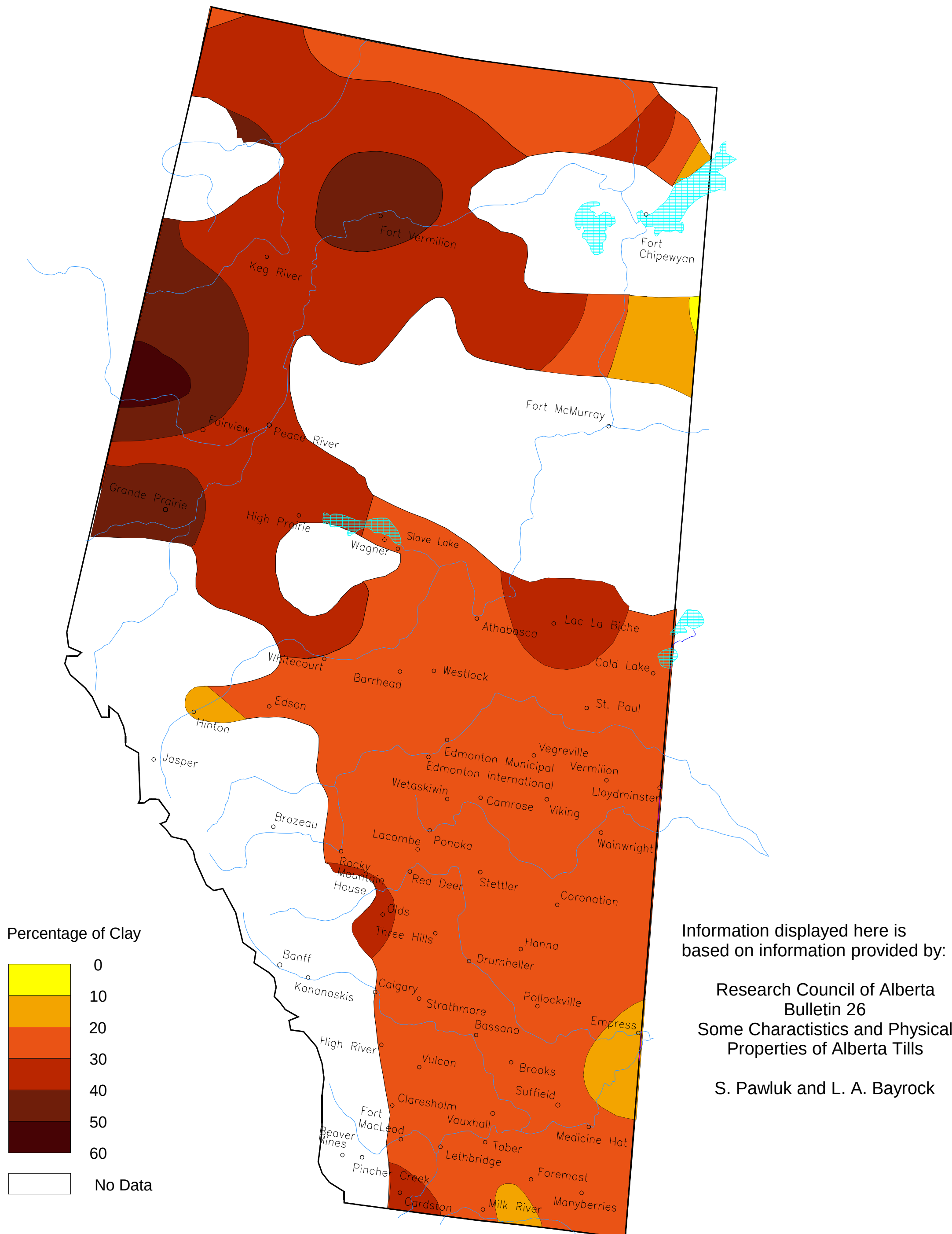
A.3.A.	Alberta Climate Design Data by Town								
Site Name	Elevation(m)	Design Temperature				Degree-Days Below 18°C	15 Min. Rain, mm	One Day Rain, 1/50, mm	Ann. Tot. Ppn., mm
		January		July 2.5%					
		2.5% °C	1%°C	Dry °C	Wet °C				
Acadia Valley	716	-33	-36	31	20	5500	18	75	310
Airdrie	1098	-32	-34	28	18	5200	17	95	440
Athabasca	515	-35	-38	28	19	6000	18	86	480
Banff	1400	-30	-32	27	17	5500	18	65	500
Barrhead	645	-34	-37	28	19	6000	20	86	475
Bashaw	793	-36	-39	27	19	5600	21	85	460
Bassano	792	-32	-34	28	18	5350	17	85	340
Beaumont	735	-37	-40	27	19	5700	20	90	475
Beaver Lodge	730	-35	-38	28	18	5900	25	92	470
Berwyn	643	-40	-42	27	18	6350	14	80	395
Black Diamond	1159	-32	-34	28	18	5300	16	90	495
Blackfalds	880	-34	-38	28	19	5700	19	95	475
Bon Accord	625	-37	-40	27	19	5750	19	85	485
Bonnyville	564	-36	-39	28	20	6100	21	75	430
Bow Island	799	-32	-36	32	20	4800	17	80	340
Bowden	991	-34	-38	28	19	5700	17	95	480
Brooks	760	-32	-34	32	19	5200	18	86	340
Bruderheim	637	-37	-40	27	19	5800	19	95	480
Calgary	1045	-31	-33	29	17	5200	23	103	425
Calmar	730	-35	-38	27	19	5600	20	95	490
Campsie	660	-34	-37	28	19	6000	20	86	475
Camrose	740	-33	-35	29	19	5700	20	92	470
Canmore	1375	-31	-32	27	17	5500	18	65	500
Cardston	1130	-30	-33	29	18	4750	20	108	550
Carstairs	1060	-33	-36	28	18	5600	17	105	475
Castor	816	-33	-36	29	20	5600	21	85	405
Claresholm	1030	-31	-34	29	18	4800	15	103	440
Coaldale	863	-31	-35	31	19	4700	17	85	390
Cochrane	1159	-32	-34	28	18	5400	17	75	500
Cold Lake	540	-36	-38	28	20	6100	15	81	430
Coleman	1320	-31	-34	28	18	5300	15	76	550
Coronation	790	-31	-33	30	19	5800	20	92	400
Cowiey	1175	-31	-34	29	18	5100	15	81	525
Crossfield	1113	-32	-34	28	18	5500	17	105	485
Daysland	708	-36	-39	28	19	5700	21	85	455
Devon	709	-37	-40	27	19	5600	20	90	490
Didsbury	1037	-33	-36	28	18	5600	17	100	480
Drayton Valley	869	-35	-37	27	19	5700	20	85	525
Drumheller	685	-31	-33	29	18	5300	20	86	375
Eckville	930	-34	-37	27	19	5700	17	105	540
Edmonton	645	-32	-34	28	19	5400	23	97	460
Edson	920	-34	-37	28	18	5900	18	81	570
Elk Point	598	-38	-40	28	20	6200	21	75	440
Embarras Portage	220	-41	-44	27	19	7100	10	86	390
Fairview	670	-38	-40	27	18	6050	15	86	450

A.3.A. Alberta Climate Design Data by Town (continued)									
Site Name	Elevation (m)	Design Temperature				Degree -Days Below 18°C	15 Min. Rain, mm	One Day Rain, 1/50, mm	Ann. Tot. Ppn., mm
		January		July 2.5%					
		2.5% °C	1%°C	Dry °C	Wet °C				
Falher	587	-40	-42	27	18	5900	15	55	420
Foremost	889	-32	-36	32	20	4800	14	70	360
Fort Chipewayan	221	-43	-46	26	19	7400	12	70	381
Fort MacLeod	945	-31	-33	31	18	4600	16	97	425
Fort McMurray	255	-39	-41	28	19	6550	13	92	460
Fort Saskatchewan	610	-32	-35	28	19	5700	20	86	425
Fort Vermilion	270	-41	-43	28	18	6900	13	65	380
Fox Creek	808	-36	-40	27	19	5900	17	90	550
Gibbons	643	-37	-40	27	19	5800	19	85	485
Gleichen	903	-32	-34	28	18	5300	17	90	360
Grand Centre	541	-36	-39	28	20	6100	21	75	435
Grande Cache	1220	-35	-38	27	15	5700	14	70	605
Grande Prairie	650	-36	-39	27	18	6000	23	86	450
Granum	991	-33	-36	30	18	4800	17	95	440
Grimshaw	603	-40	-42	27	18	6350	14	80	390
Habay	335	-41	-43	28	18	7150	13	70	425
Hanna	785	-33	-36	29	20	5700	19	90	390
Hardisty	615	-33	-35	30	19	5900	20	76	425
High Level	320	-46	-47	26	18	7200	11	75	420
High Prairie	595	-38	-40	25	19	6000	15	75	470
High River	1040	-31	-33	28	17	5300	18	103	425
Hinton	990	-34	-38	27	17	5700	13	81	500
Innisfail	945	-34	-38	28	19	5700	18	95	480
Irvine	763	-32	-36	32	20	4900	17	75	360
Jasper	1060	-32	-35	28	18	5500	10	76	400
Keg River	420	-40	-42	28	18	6800	13	65	450
Killam	680	-35	-38	29	20	5700	21	90	445
Kitscoty	670	-35	-38	29	20	6150	22	80	430
Lac la Biche	560	-35	-38	28	19	6150	15	86	475
Lacombe	855	-33	-35	29	18	5700	23	92	450
Lake Louise	1600	-33	-34	27	14	6700	11	55	580
Lamont	653	-37	-40	27	19	5800	19	90	460
Leduc	730	-35	-38	27	19	5600	20	90	485
Lethbridge	910	-30	-33	31	18	4650	20	97	390
Lloydminster	645	-35	-38	29	20	6100	18	70	430
Magrath	983	-31	-35	31	19	4800	17	80	430
Manning	465	-39	-41	27	18	6700	13	81	390
Mayerthorpe	712	-36	-40	27	19	5950	15	90	555
McLennan	625	-40	-42	27	18	5900	15	65	425
Medicine Hat	705	-31	-34	33	19	4750	23	92	325
Milk River	1059	-31	-35	31	19	4800	16	70	375
Millet	755	-35	-38	27	19	5600	21	95	475
Morinville	700	-37	-40	27	19	5700	19	90	480
Morrin	832	-34	-38	28	19	5500	19	75	390
Mundare	678	-37	-40	27	19	6100	20	90	450
Nanton	1024	-32	-34	28	18	5000	17	95	440

A.3.A. Alberta Climate Design Data by Town (continued)									
Site Name	Elevation (m)	Design Temperature				Degree -Days Below 18°C	15 Min. Rain, mm	One Day Rain, 1/50, mm	Ann. Tot. Ppn., mm
		January		July 2.5%					
		2.5% °C	1%°C	Dry °C	Wet °C				
Okotoks	1051	-32	-34	28	18	5300	17	95	470
Olds	1041	-33	-36	28	18	5600	17	95	485
Oyen	770	-33	-36	29	20	5600	19	75	330
Peace River	330	-37	-40	27	18	6350	15	65	390
Penhold	871	-34	-38	28	19	5750	18	95	470
Picture Butte	905	-31	-35	31	19	4700	17	85	400
Pincher Creek	1130	-32	-34	29	18	5000	18	108	575
Ponoka	807	-34	-37	27	19	5600	21	80	480
Provost	668	-33	-36	29	20	5900	21	80	415
Rainbow Lake	534	-46	-47	26	18	7200	16	75	450
Ranfurly	670	-34	-37	29	19	5950	18	92	420
Raymond	960	-31	-35	31	19	4750	17	75	420
Red Deer	855	-32	-35	29	18	5750	23	97	475
Redcliff	745	-32	-36	32	20	4800	17	85	325
Redwater	625	-37	-40	27	19	5900	19	80	470
Rimbey	930	-34	-37	27	19	5700	20	100	505
Rocky Mountain House	985	-31	-33	28	18	5700	20	86	550
Ryley	693	-35	-38	27	19	5800	21	90	465
Sangudo	680	-36	-40	27	19	5900	17	95	555
Sedgewick	663	-35	-38	29	20	5700	21	95	440
Sexsmith	724	-38	-41	27	18	6000	18	85	445
Sherwood Park	729	-37	-40	27	19	5500	20	90	480
Slave Lake	590	-36	-39	27	19	6000	15	81	500
Smoky Lake	623	-39	-42	27	20	6000	19	75	480
Spirit River	640	-38	-41	27	18	6200	18	75	440
Spruce Grove	709	-37	-40	27	19	5600	19	90	500
Stavely	1044	-33	-36	30	18	4800	17	95	440
Stettler	820	-32	-34	30	19	5700	20	97	450
Stony Plain	710	-32	-35	28	19	5500	23	97	540
Strathmore	973	-32	-34	28	18	5300	17	80	430
St. Albert	689	-37	-40	27	19	5600	20	95	480
St. Paul	646	-37	-40	28	20	6100	21	75	440
Suffield	755	-32	-34	33	19	4900	20	86	325
Sundre	1093	-34	-37	27	19	5700	15	95	530
Swan Hills	1113	-36	-40	27	19	6100	15	95	500
Sylvan Lake	945	-34	-37	27	19	5700	18	95	545
Taber	815	-31	-33	31	19	4800	20	92	370
Thorhild	649	-37	-40	27	19	6000	17	75	480
Three Hills	896	-34	-38	28	19	5450	19	80	400
Tofield	700	-37	-40	27	19	5800	21	95	465
Trochu	872	-34	-38	28	19	5450	18	75	405
Turner Valley	1215	-31	-33	28	17	5600	20	97	600
Two Hills	603	-38	-40	28	20	6000	21	80	450
Valleyview	700	-37	-40	27	18	5900	18	86	490
Vauxhall	779	-31	-35	31	19	4850	17	85	335
Vegreville	635	-34	-36	29	19	6100	18	86	410
Vermilion	580	-35	-38	29	20	6150	18	86	410

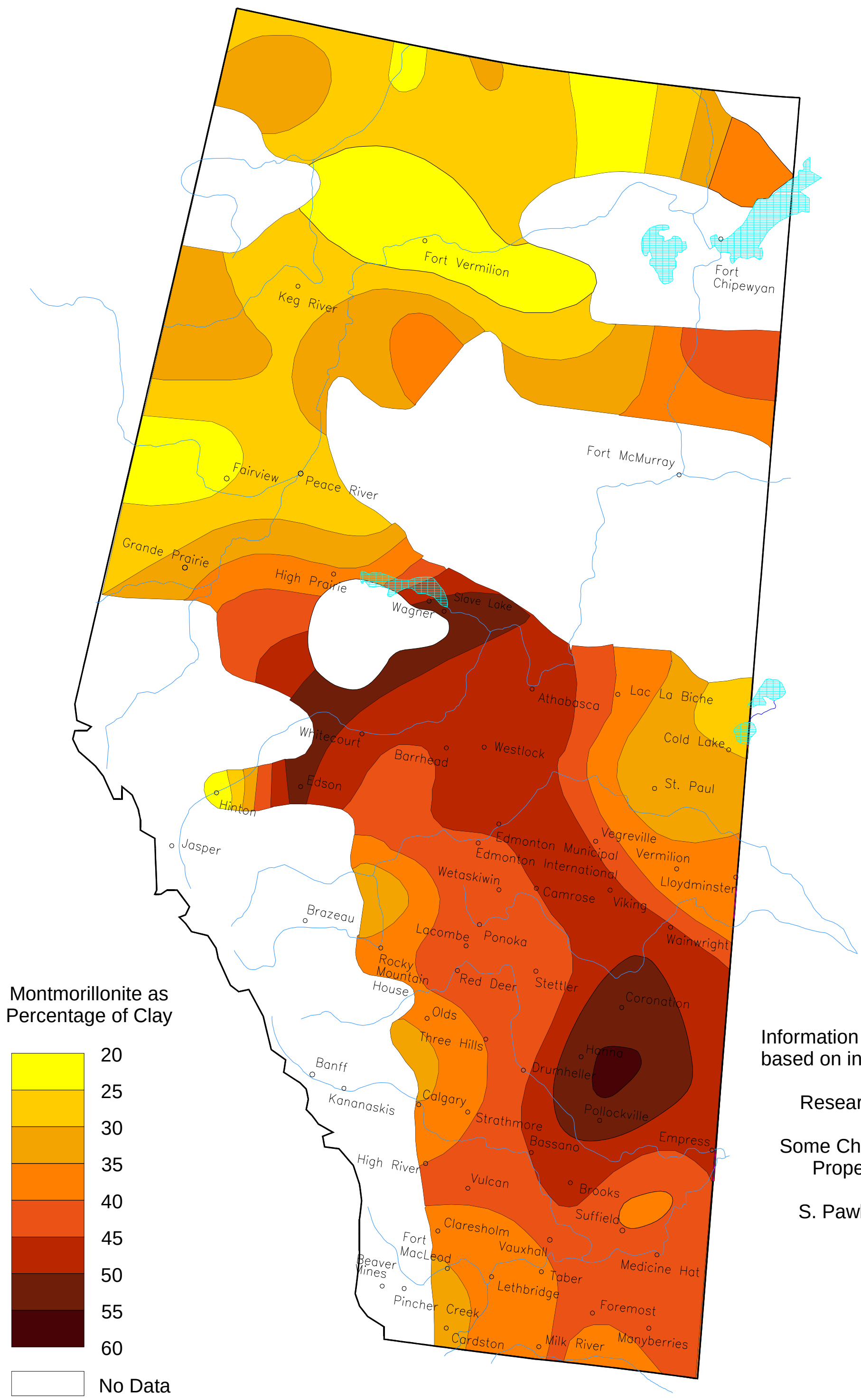
A.3.A. Alberta Climate Design Data by Town (continued)									
Site Name	**Elevation (m)**	**Design Temperature**				**Degree -Days Below 18°C**	**15 Min. Rain, mm**	**One Day Rain, 1/50, mm**	**Ann. Tot. Ppn., mm**
		January		**July 2.5%**					
		2.5% °C	1%°C	Dry °C	Wet °C				
Viking	691	-38	-40	28	20	5750	21	65	445
Vulcan	1049	-31	-34	30	18	5000	17	90	410
Wagner	585	-36	-39	27	19	6000	15	76	500
Wainwright	675	-33	-36	29	19	6000	20	81	425
Warner	1021	-31	-35	31	19	4750	16	75	375
Wembley	724	-38	-41	27	18	5900	18	85	470
Westlock	648	-37	-40	27	19	5900	17	75	490
Wetaskiwin	760	-33	-35	29	19	5800	23	86	500
WhiteCourt	690	-35	-38	27	18	6000	20	97	550
Wimborne	975	-31	-34	29	18	5650	23	92	450

A.3.B. Soil Clay Content Map



Distribution of Clay

A.3.C. Soil Montmorillonite Content Map



Information displayed here is based on information provided by:

Research Council of Alberta
Bulletin 26
Some Charactistics and Physical Properties of Alberta Tills

S. Pawluk and L. A. Bayrock

Distribution of Montmorillonite

A.4. Treatment Field Design Data

A.4.A. Disposal Field Loading Rates Per Day and Sizes

Table A.4.A.		2 Bedrooms		3 Bedrooms		4 Bedrooms		5 Bedrooms		6 Bedrooms	
Loading rate, L/m2	Loading rate, Imp. gal./sq.ft.	Square Metres 2 BR = 340x2x2	Sq. ft. 2 bedrooms= 75x2x2	Square Metres 3 BR = 340x1.5x3	Sq. ft. 3 Bedrooms = 75x1.5x3	Square Metres 4 BR = 340x1.5x4	Square ft. 4 bedrooms= 75x1.5x4	Square Metres 5 BR = 340x1.5 x5	Sq. ft. 5 bedrooms= 75x1.5x5	Square Metres 6 BR = 340x1.5 x6	Sq. ft. 6 bedrooms= 75x1.5x6
per day		1360 L	300 gal	1530 L	337.5 gal	2040 L	450 gal	2550 L	562.5 gal	3060 L	675 gal
4.89	0.10	277.93	3000.00	312.67	3375.00	416.90	4500.00	521.12	5625.00	625.34	6750.00
5.38	0.11	252.66	2727.27	284.25	3068.18	379.00	4090.91	473.74	5113.64	568.49	6136.36
5.87	0.12	231.61	2500.00	260.56	2812.50	347.41	3750.00	434.27	4687.50	521.12	5625.00
6.36	0.13	213.79	2307.69	240.52	2596.15	320.69	3461.54	400.86	4326.92	481.03	5192.31
6.85	0.14	198.52	2142.86	223.34	2410.71	297.78	3214.29	372.23	4017.86	446.67	4821.43
7.34	0.15	185.29	2000.00	208.45	2250.00	277.93	3000.00	347.41	3750.00	416.90	4500.00
7.83	0.16	173.71	1875.00	195.42	2109.38	260.56	2812.50	325.70	3515.63	390.84	4218.75
8.32	0.17	163.49	1764.71	183.92	1985.29	245.23	2647.06	306.54	3308.82	367.85	3970.59
8.81	0.18	154.41	1666.67	173.71	1875.00	231.61	2500.00	289.51	3125.00	347.41	3750.00
9.30	0.19	146.28	1578.95	164.56	1776.32	219.42	2368.42	274.27	2960.53	329.13	3552.63
9.79	0.20	138.97	1500.00	156.34	1687.50	208.45	2250.00	260.56	2812.50	312.67	3375.00
10.28	0.21	132.35	1428.57	148.89	1607.14	198.52	2142.86	248.15	2678.57	297.78	3214.29
10.77	0.22	126.33	1363.64	142.12	1534.09	189.50	2045.45	236.87	2556.82	284.25	3068.18
11.25	0.23	120.84	1304.35	135.94	1467.39	181.26	1956.52	226.57	2445.65	271.89	2934.78
11.74	0.24	115.80	1250.00	130.28	1406.25	173.71	1875.00	217.13	2343.75	260.56	2812.50
12.23	0.25	111.17	1200.00	125.07	1350.00	166.76	1800.00	208.45	2250.00	250.14	2700.00
12.72	0.26	106.90	1153.85	120.26	1298.08	160.34	1730.77	200.43	2163.46	240.52	2596.15
13.21	0.27	102.94	1111.11	115.80	1250.00	154.41	1666.67	193.01	2083.33	231.61	2500.00
13.70	0.28	99.26	1071.43	111.67	1205.36	148.89	1607.14	186.11	2008.93	223.34	2410.71
14.19	0.29	95.84	1034.48	107.82	1163.79	143.76	1551.72	179.70	1939.66	215.64	2327.59
14.68	0.3	92.64	1000.00	104.22	1125.00	138.97	1500.00	173.71	1875.00	208.45	2250.00
15.17	0.31	89.65	967.74	100.86	1088.71	134.48	1451.61	168.10	1814.52	201.72	2177.42
15.66	0.32	86.85	937.50	97.71	1054.69	130.28	1406.25	162.85	1757.81	195.42	2109.38
16.15	0.33	84.22	909.09	94.75	1022.73	126.33	1363.64	157.91	1704.55	189.50	2045.45
16.64	0.34	81.74	882.35	91.96	992.65	122.62	1323.53	153.27	1654.41	183.92	1985.29
17.13	0.35	79.41	857.14	89.33	964.29	119.11	1285.71	148.89	1607.14	178.67	1928.57
17.62	0.36	77.20	833.33	86.85	937.50	115.80	1250.00	144.76	1562.50	173.71	1875.00
18.11	0.37	75.12	810.81	84.51	912.16	112.67	1216.22	140.84	1520.27	169.01	1824.32
18.59	0.38	73.14	789.47	82.28	888.16	109.71	1184.21	137.14	1480.26	164.56	1776.32
19.08	0.39	71.26	769.23	80.17	865.38	106.90	1153.85	133.62	1442.31	160.34	1730.77
19.57	0.40	69.48	750.00	78.17	843.75	104.22	1125.00	130.28	1406.25	156.34	1687.50
20.06	0.41	67.79	731.71	76.26	823.17	101.68	1097.56	127.10	1371.95	152.52	1646.34
20.55	0.42	66.17	714.29	74.45	803.57	99.26	1071.43	124.08	1339.29	148.89	1607.14
21.04	0.43	64.63	697.67	72.71	784.88	96.95	1046.51	121.19	1308.14	145.43	1569.77
21.53	0.44	63.17	681.82	71.06	767.05	94.75	1022.73	118.44	1278.41	142.12	1534.09
22.02	0.45	61.76	666.67	69.48	750.00	92.64	1000.00	115.80	1250.00	138.97	1500.00

Table A.4.A. Cont'd		2 Bedrooms		3 Bedrooms		4 Bedrooms		5 Bedrooms		6 Bedrooms	
		Square Metres	Sq. ft.	Square Metres	Sq. ft.	Square Metres	Square ft.	Square Metres	Sq. ft.	Square Metres	Sq. ft.
Loading rate L/m2	Loading rate, Imp. gal./sq.ft.	2 BR = 340x2x2	2 bedrooms= 75x2x2	3 BR = 340x1.5x3	3 Bedrooms = 75x1.5x3	4 BR = 340x1.5x4	4 bedrooms= 75x1.5x4	5 BR = 340x1.5 x5	5 bedrooms= 75x1.5x5	6 BR = 340x1.5 x6	6 bedrooms= 75x1.5x6
per day		1360 L	300 gal	1530 L	337.5 gal	2040 L	450 gal	2550 L	562.5 gal	3060 L	675 gal
22.51	0.46	60.42	652.17	67.97	733.70	90.63	978.26	113.29	1222.83	135.94	1467.39
23.00	0.47	59.13	638.30	66.53	718.09	88.70	957.45	110.88	1196.81	133.05	1436.17
23.49	0.48	57.90	625.00	65.14	703.13	86.85	937.50	108.57	1171.88	130.28	1406.25
23.98	0.49	56.72	612.24	63.81	688.78	85.08	918.37	106.35	1147.96	127.62	1377.55
24.47	0.50	55.59	600.00	62.53	675.00	83.38	900.00	104.22	1125.00	125.07	1350.00
24.96	0.51	54.50	588.24	61.31	661.76	81.74	882.35	102.18	1102.94	122.62	1323.53
25.45	0.52	53.45	576.92	60.13	649.04	80.17	865.38	100.22	1081.73	120.26	1298.08
25.93	0.53	52.44	566.04	58.99	636.79	78.66	849.06	98.32	1061.32	117.99	1273.58
26.42	0.54	51.47	555.56	57.90	625.00	77.20	833.33	96.50	1041.67	115.80	1250.00
26.91	0.55	50.53	545.45	56.85	613.64	75.80	818.18	94.75	1022.73	113.70	1227.27
27.40	0.56	49.63	535.71	55.83	602.68	74.45	803.57	93.06	1004.46	111.67	1205.36
27.89	0.57	48.76	526.32	54.85	592.11	73.14	789.47	91.42	986.84	109.71	1184.21
28.38	0.58	47.92	517.24	53.91	581.90	71.88	775.86	89.85	969.83	107.82	1163.79
28.87	0.59	47.11	508.47	53.00	572.03	70.66	762.71	88.33	953.39	105.99	1144.07
29.36	0.60	46.32	500.00	52.11	562.50	69.48	750.00	86.85	937.50	104.22	1125.00
29.85	0.61	45.56	491.80	51.26	553.28	68.34	737.70	85.43	922.13	102.52	1106.56
30.34	0.62	44.83	483.87	50.43	544.35	67.24	725.81	84.05	907.26	100.86	1088.71
30.83	0.63	44.12	476.19	49.63	535.71	66.17	714.29	82.72	892.86	99.26	1071.43
31.32	0.64	43.43	468.75	48.85	527.34	65.14	703.13	81.42	878.91	97.71	1054.69
31.81	0.65	42.76	461.54	48.10	519.23	64.14	692.31	80.17	865.38	96.21	1038.46
32.30	0.66	42.11	454.55	47.37	511.36	63.17	681.82	78.96	852.27	94.75	1022.73

A.5. Acceptable Piping Materials Table

A.5.A. Piping Materials

Type of Piping	Standard Reference	Gravity *Sewage* or *Effluent* Piping	*Pressure Effluent Line*	*Weeping Lateral* Piping	*Pressure Effluent Distribution Lateral*
Polyethylene water pipe and tubing *Series 160 sizes* with compression fittings Series 75, 100 and 125	CAN3-B137.1	N	P	N	N
Poly vinyl chloride (PVC) water pipe Series 60, 100, 125, 160 and 200	CAN3-B137.3 Schedule 40 (or 80)	P	P	P	P
Chlorinated poly vinyl chloride (CPVC) water pipe	CAN3-B137.6	N	N	N	P
Plastic Sewer Pipe	CAN/CSA-B182.1				
perforated		N	N	P	N
non perforated		P	N	N	N
Corrugated Polyethylene	CGSB 41-GP-31				
perforated		N	N	P	N
non-perforated		P	N	N	N
Acrylonitnle-butadiene-styrene (ABS) *DWV pipe*	CAN/CSA-B181.1	P	N	N	N
Poly (vinyl chloride) (PVC) *DWV pipe*	CAN/CSA-B181.2	P	N	N	N
Type PSM PVC sewer pipe > 35 SDR	CAN/CSA-B182.2	P	N	N	N
Profile poly (vinyl chloride) (PVC) sewer pipe PS 320 kPa	CAN/CSA-B182.6	P	N	N	N
Profile polyethylene sewer pipe PS 320 kPa	CAN/CSA-182.6	P	N	N	N
Cast iron soil pipe	CAN3-B70	P	N	N	N

P = Permitted
N = Not Permitted

A.6. Septic Tank Sludge and Scum Accumulation Rates for Other Than Residential

A.6.A. Septic Tank Sludge and Scum Accumulation Rates

A.6.A. Septic Tank Sludge and Scum Accumulation Rates

Premises	Fixtures	Sludge/scum rate: *Number of Persons*	Sludge/scum rate: *Rate: litres/person/year*
Note: Calculate each use and add to obtain total capacity Note: The term **average** or **highest daily number** over an "x" day period means the highest number in any 12 month period			
RECREATIONAL VEHICLE PARKS			
Permanent Occupation	wc/urinal basin bath/shower laundry kitchen sink	Total number of sites x 3.5	80
Casual Occupation	wc/urinal basin bath/shower laundry kitchen sink	Average number of sites occupied per year x 3.5	48
CHILD DAY CARE CENTRES			
	wc/urinal basin bath/shower laundry kitchen sink	Total number of children and staff	48
CHURCHES, PUBLIC HALLS etc.			
	wc/urinal basin kitchen sink (tea service area only)	Average daily number over 7 day period	25 up to 4 days use/ week 40 over 4 days use/week
Addition:	where kitchen area provided for catering		Add 10 to either of above

A.6.A. Septic Tank Sludge and Scum Accumulation Rates (continued)

Premises	Fixtures	Sludge/scum rate: *Number of Persons*	Sludge/scum rate: *Rate: litres/person/year*
CLUBS			
Membership entry only. Members/guests & staff using facilities	wc/urinal basin bath/shower kitchen sink (tea service area only)	Average daily number over 7 day period	35
Licensed area Bar trade only	wc/urinal basin bar sink glass washer	Average daily number over 7 day period	5
Licensed bar & restaurant/meals area	wc/urinalbasinkitchen sinkdishwasher	Average daily number over 7 day period	10
COFFEE / TEA SHOPS / KIOSKS			
e.g. light refreshments and prepared food, cakes etc.	wc/urinal basin kitchen sink	Average daily number over 7 day period	30
CONSTRUCTION CAMPS - TEMPORARY			
	wc/urinal basin shower laundry kitchen sink dishwasher	Total number of persons using facilities	80 x number of years to be used
HOLIDAY CAMPS			
e.g. scout, youth and church centres with casual occupation	wc/urinal hand basin shower kitchen sink	Total number of beds (single equivalent)	48

(staff and/or residential caretaker data to be included where applicable)

A.6.A. Septic Tank Sludge and Scum Accumulation Rates (continued)

Premises	Fixtures	Sludge/scum rate: *Number of Persons*	*Rate: litres/person/year*
HOSPITALS AND NURSING HOMES			
Accommodation and resident staff	wc/urinal basin bath/shower laundry kitchen sink dishwasher	Total number of beds plus resident staff	80
Non-resident staff	wc/urinal basin kitchen sink (tea service area only)	Number of employees per shift x number of shifts	25
HOTELS / MOTELS / LIVE IN CONFERENCE CENTRES			
Accommodation	wc/urinal basin bath/shower kitchen sink laundry	Total number of beds (single equivalents)	48
Permanent residents, staff etc.	wc/urinal basin bath/shower kitchen sink laundry	Total number of live in staff	80
Bar trade	wc/urinal basin bar sink glass washer	Average daily number attending in 7 day period	5
Dining room lounge area non-resident use	wc/urinal basin kitchen sink dishwasher	Average daily number of diners per 7 day period	10
Non-resident staff	wc/urinal basin kitchen sink (tea service area only)	Number of employees per shift x number of shifts	25

A.6.A. Septic Tank Sludge and Scum Accumulation Rates (continued)

Premises	Fixtures	Sludge/scum rate	
		Number of Persons	*Rate: litres/person/year*
MEDICAL CONSULTING ROOMS			
e.g. doctors, dentists, etc. Staff	wc/urinal basin kitchen sink (tea service area only)	Number of persons using system per shift x number of shifts	40
Consulting rooms		Per consulting room	80
PUBLIC SWIMMING POOLS			
include kiosk e.g. take away food	wc/urinal basin shower kitchen sink (tea service area only)	Average daily number over 7 day period	20
PUBLIC TOILETS			
	wc/urinal basin	Average daily number over 7 day period	20
Addition:	where shower provided	as above	5
RESTAURANTS			
No liquor license	wc/urinal basin kitchen sink dishwasher	Average daily number over 7 day period plus staff	35
With liquor license	wc/urinal basin kitchen sink dishwasher glass washer	Average daily number over 7 day period plus staff	35

A.6.A. Septic Tank Sludge and Scum Accumulation Rates (continued)

Premises	Fixtures	Sludge/scum rate: *Number of Persons*	*Rate: litres/person/year*
REST HOMES, BOARDING & LODGING HOUSES			
Accommodation and resident staff	wc/urinal basin bath/shower laundry kitchen sink	Total number of beds plus resident staff (single equivalents)	80
Non-resident staff	wc/urinal basin kitchen sink (tea service only)	Number of employees per shift x number of shifts	25
ROAD-HOUSES / SERVICE STATIONS			
Staff	wc/urinal basin kitchen sink (tea service area only)	Number of employees per shift x number of shifts	25
Public toilets	wc/urinal basin	Average daily number over 7 day period	20
	with shower	as above	5
Restaurant take away and sit down meals	wc/urinal basin kitchen sink dishwasher	Average daily number over 7 day period	10

A.6.A. Septic Tank Sludge and Scum Accumulation Rates (continued)

Premises	Fixtures	Sludge/scum rate	
		Number of Persons	*Rate: litres/person/year*
SCHOOLS			
Including kiosk facilities e.g. take away food	wc/urinal basin kitchen sink	Total number of students plus staff	25
Where canteen facilities provided e.g. plated hot and cold meals	kitchen sink dishwasher	as above	10
SEMINAR / CONFERENCE ROOMS			
No meals	wc/urinal basin kitchen sink (tea service area only)	Total seating capacity plus staff	25
Meals No liquor license	wc/urinal basin kitchen sink dishwasher glass washer	Total seating capacity plus staff	35
Meals with liquor license	wc/urinal basin kitchen sink dishwasher glass washer	Total seating capacity plus staff	35
	with shower	as above	5
Restaurant take away and sit down meals	wc/urinal basin kitchen sink dishwasher	Average daily number over 7 day period	10

A.6.A. Septic Tank Sludge and Scum Accumulation Rates (continued)

Premises	Fixtures	Sludge/scum rate: *Number of Persons*	Sludge/scum rate: *Rate: litres/person/year*
SHOPPING CENTRES			
Staff	wc/urinal basin kitchen sink (tea service area only)	Number of employees per shift x number of shifts	25
Public	wc/urinal basin	average daily number over 7 day period	20
Shop Facilities	double bowl sink basin	per shop	20
Supermarket	double bowl sink basin cleaners sink	per supermarket	40
SPORTS CENTRES			
e.g. health and fitness clubs, squash courts indoor hockey, basketball	wc/urinal basin shower kitchen sink (tea service area only)	average daily number over 7 day period plus staff	25
STAFF ABLUTIONS, WORK PLACE INSTALLATIONS			
e.g. factories commercial office	wc/urinal basin kitchen sink (tea service area only)	number of employees per shift x number of shifts	25
Where canteen facilities provided for kiosk meals, e.g. pies, pastries, sandwiches	kitchen sink		
Where plated meals provided e.g. hot/cold meals prepared onsite	kitchen sink dishwasher	as above	10

A.6.A. Septic Tank Sludge and Scum Accumulation Rates (continued)

Premises	Fixtures	Sludge/scum rate	
		Number of Persons	*Rate: litres/person/year*
WINE TASTING			
	wc/urinal basin kitchen sink glass washer	average daily number over 7 day period	5

A.7. Conversion Factors

1 pound = 0.45359 kilograms
1 inch = 2.540 centimetres
1 foot = 0.3048 metres
1 yard = 0.9144 metres
1 yard = 36.00 inches
1 mile = 1.609 kilometres
1 square inch = 6.452 square centimetres
1 square foot = 0.093 square metres
1 square yard = 0.836 square metres
1 acre = 0.405 hectares
1 acre = 43560 sq. ft. or 208.7x 208.7 ft.
1 square mile = 259 hectares
1 square mile = 2.59 square kilometres
1 cubic inch = 16.387 cubic centimetres
1 cubic foot = 28,317 cubic centimetres
1 cubic foot = 6.23 Imperial gal.
1 cubic foot = 28.3 litres
1 cubic yard = 0.765 cubic metres
1 cubic yard = 168 Imp gal.
1 cubic yard = 765 litres
1 Imperial gal. = 4.546 litres
1 Imperial gal. = 277.42 cubic inches
1 Imperial gal. of water = 10 lbs.
1 U.S. gal. = 3.785 litres
1 U.S. gal. = 231 cubic inches
1 Imperial gal. per sq. ft. = 49 litres per square metre
1 Imperial gal. = 1.20 U.S. gal.
1 U.S. gal. = 0.83 Imperial gal.
1 foot pressure head = 304.8 mm pressure head
1 foot pressure head = 0.434 psi
1 psi = 2.301 ft. pressure head
1 psi = 6.894757 kPa

1 kilogram = 2.2046 pounds
1 centimetre = 0.3937 inches
1 metre = 3.281 ft.
1 metre = 1.094 yards
1 metre = 39.37 inches
1 kilometre = 0.6214 miles
1 square centimetre = 0.155 sq. inches
1 square metre = 10.765 square ft.
1 square metre = 1.196 square yards
1 hectare = 2.471 acres
1 hectare = 10,000 square metres
1 square kilometre = 0.386 square miles
1 cubic centimetre = 0.06102 cubic inches
1 cubic decimeter = 0.0353 cubic ft.
1 litre = 0.0353 cubic ft.
1 cubic metre = 1.308 cubic yards
1 cubic metre = 35.3 cubic ft.
1 cubic metre = 220 Imperial gal.
1 cubic metre = 1000 litres
1 litre = 0.220 Imperial gal.
1 litre = 0.264 U.S. gal.
1 kPa = 0.145037 psi
1,000 mm pressure head = 9.807 kPa
1 kPa = 102 mm pressure head
1 kPa = 0.335 ft. pressure head
1 litre per sq. metre = 0.020 Imperial gal. per square foot
1 Litre per sq. metre = 1 mm depth of effluent applied
1 Imperial gal per sq. foot = 1.92 inch depth of effluent applied

Appendix B

Private Sewage Treatment Systems Regulation

Purpose and Scope of the Standard

Private Sewage systems are used to manage and safely treat wastewater from developments not served by large pipe municipal wastewater collection and treatment systems typically used in urban settings. It is the predominant method of managing and treating sewage in most rural developments. The term itself describes the purpose of the system; to treat the sewage.

In the past these systems were often described as Private Sewage Disposal Systems and some of those designs focused mainly on disposal – to get the sewage out of site and out of direct contact with people. Simple disposal is not acceptable as an objective however the purpose of preventing direct contact with the wastewater is still a prime objective of an onsite wastewater system. The wastewater must be adequately treated to prevent negative impacts on water sources and the receiving environment. The wastewater does not just go away, it always returns to the water system of our environment. This standard focuses on the effective treatment and safe return to the sewage to the environment while minimizing the risk of direct contact with the effluent.

These systems are also often referred to as Onsite Sewage Systems. This reflects the design of the system to manage, treat and return the wastewater to the environment on the site of the development.

A key distinguishing feature of an onsite sewage system is that it utilizes the onsite soil to achieve the final treatment of the effluent and uses the soil as the conduit to return the treated wastewater to the receiving environment.

Private sewage systems serve a wide range of development. Although they most commonly serve Residential Development they are also used to serve Campgrounds, Tourism Facilities, Remote lodges, Motels and Hotels, Schools, Restaurants, Gas Stations and Work Camps.

The purposes of a private sewage system include:

- manage and contain the flow of wastewater
- effectively treat the wastewater
- protection of ground waters
- protection of surface water
- minimizing risk to public health (disease)
- provide a reliable method of managing and treating wastewater

These purposes are reflected in the Standard of Practice in Article 1.1.1.1 which describes the intent of the Standard and in Article 1.1.3.1 which sets out the objectives of an onsite wastewater treatment system. These articles are worth repeating here.

Article 1.1.1.1 Intent

1) The intent of this Standard is to set out performance objectives, design standards, prescriptive-based solutions and requirements for materials and equipment related to on-site wastewater treatment system designs regarding the

a) initial treatment of *wastewater*,
b) final treatment of *wastewater* in *soil*,
c) containment of *wastewater* and treated *effluent*,
d) risk of contact with *wastewater* or treated *effluent*,
e) operational control of a system, and
f) structural adequacy of a system,
g) to result in an *on-site wastewater treatment system* that reduces the risk to public health, and
h) the natural environment to a level that is deemed acceptable.

Article 1.1.3.1 General

1) The objective of an *on-site wastewater treatment system* is to treat *wastewater* and return it to the environment so that

a) risks to health are not created,
b) the impact on ground and surface waters is minimized, and
c) the environment is not harmed.

To achieve these purposes and objectives the Standard sets out further treatment objectives, design standards, prescriptive installation requirements and requirements for material. These requirements must be met in the design of any onsite private sewage treatment system. The Standard of Practice is adopted by legislation as a Law in Alberta that sets out the rules for the design and installation of private sewage systems.

Legislative Application of the Standard and Related Legislation

The Private Sewage Systems Standard of Practice (Standard of Practice) (SOP) is developed by the Safety Codes Council (SCC) with advice from a diverse group of stakeholders. The stakeholders included in the development of this standard include are listed on Page **iv** of this Handbook. The development of the Standard of Practice also included reference to scientific papers and advice from scientists from across North America.

Legislative Authority

The Safety Codes Act is the legislative authority for making regulation regarding private sewage systems. The Private Sewage Disposal Regulation AR 229/97, as updated by A/R 264/2009, sets out that this Standard of Practice is the rules in force in Alberta for private sewage systems as defined and limited by that regulation (See pg. **234** for an office consolidation of this regulation) One of the limits set out in that regulation is that the Standard of Practice as the rules for sewage systems serving developments that generate less than 25 cubic meters per day and where the entire system is located on the property. This regulation also requires that a system serving a development that generates more than 5.7 cubic meters per day be designed by a professional engineer or other person acceptable to the Administrator. The Administrator is the person delegated responsibility for the administration of specific aspects of the legislation by the Minister responsible for the applicable Act and Regulations. In this case the Safety Codes Act and Private Sewage Disposal Regulation.

This standard may also used by Alberta Environment in assessing the suitability of private soil based wastewater treatment systems in Alberta that fall under the jurisdiction of Alberta Environment; however, any such system is subject to additional requirements established by Alberta Environment with regard to impact on source waters and the receiving environment. Alberta Environment regulations come into effect when the development served by the sewage treatment system generates more than 25 cubic meters per day, serves more than two properties, or any part of the system crosses property lines whether collection, treatment or discharge to the environment.

Related Safety Codes Act legislation that applies to private sewage systems includes the Certification and Permit Regulation that sets out the qualifications required of person installing private sewage systems. As well the Permit Regulation sets out that a permit is needed for the installation or changes to a private sewage system. A handbook to the permit regulation has been developed and is posted on the Municipal Affairs website.

Legislation under the Health Act also applies; specifically the Nuisance and Sanitation Regulation. The Nuisance and Sanitation Regulation include requirements for separation distances between water wells and components of private sewage systems. These distances are the same as set out in the Standard of Practice. Other requirements, such as not creating a health hazard, are also set out in legislation under the health Act and they apply to private sewage systems. The scope and application of the Health Act is superior to the private sewage systems regulations.

All Alberta legislation including the legislation referenced here can be obtained from the Alberta Queen's Printer.

Web site: http://www.qp.alberta.ca/laws_online.cfm

Mailing address: 5th floor Park Plaza
10611 98 Avenue
Edmonton, AB T5K 2P7
Phone: 780-427-4952

Private Sewage Disposal Systems Regulation

The Office consolidation of the Private Sewage Disposal Systems Regulation is provided below for convenience.
Note: *All persons making use of this consolidation are reminded that it has no legislative sanction, that amendments have been embodied for convenience of reference only, and that the original Regulations should be consulted for all purposes of interpreting and applying the law.*

(Consolidated up to 264/2009)

ALBERTA REGULATION 229/97

SAFETY CODES ACT

PRIVATE SEWAGE DISPOSAL SYSTEMS REGULATION

Table of Contents

Definitions

1 In this Regulation,

(a) "Act" means the *Safety Codes Act*;

(b) "Administrator" means an Administrator appointed pursuant to section 14(1) of the Act with respect to private sewage disposal systems;

(b.1) "holding tank" means a tank designed to retain sewage or effluent until it is transferred into mobile equipment for treatment off-site;

(c) "sewage" means the composite of liquid and water-carried wastes associated with the use of water for drinking, food preparation, washing, hygiene, sanitation or other domestic purposes, but does not include wastewater from industrial processes.

AR 229/97 s1;119/99;264/2009

Paramountcy

2 If there is a conflict between this Regulation and another regulation under a statute of Alberta, the other regulation prevails over this Regulation.

Equipment

3(1) No person may manufacture, install, sell or offer for sale any equipment related to private sewage disposal systems to which this Regulation applies for use in Alberta unless it has been

(a) tested and certified by a certification organization accredited by the Standards Council of Canada, or

(b) inspected and accepted by a certification organization accredited by the Standards Council of Canada, and the equipment bears evidence of having been accepted in the manner authorized by the certification organization.

(c) repealed AR 264/2009 s3.

(2) If a code, standard or body of rules declared in force under the Act with respect to private sewage disposal systems to which this section applies refers to approved or certified equipment, that equipment must meet the requirements of this section.

AR 229/97 s3;119/99;264/2009

Rules

4(1) This Regulation applies to private sewage disposal systems.

(2) The Alberta Private Sewage Systems Standard of Practice 2009 published by the Safety Codes Council is declared in force with respect to private sewage disposal systems that

(a) serve a single property,

(b) are designed to receive not more than $25m^3$ of sewage each day, and

(c) are designed to dispose of sewage either on the property that the system serves or in a holding tank.

(3) The Alberta Private Sewage Systems Standard of Practice 2009 does not apply to two or more systems that serve a single property and, in total, receive more than $25m^3$ of sewage each day.

(4) A private sewage disposal system described in subsection (2) that is designed to receive more than $5.7m^3$ of sewage each day must be designed for its specific site and use by

(a) a professional engineer, as defined in the *Engineering, Geological and Geophysical Professions Act*, or

(b) a person who has qualifications that are acceptable to the Administrator.

(5) A private sewage disposal system that does not meet the requirements of subsection (2) must meet a standard acceptable to the Administrator.

AR 229/97 s4;119/99;264/2009

Expiry

Expiry

5 For purposes of ensuring that this Regulation is reviewed for ongoing relevancy and necessity, with the option that it may be repassed in its present or an amended form following a review, this Regulation expires on May 3, 2014.

AR 229/97 s5;119/99;354/2003;8/2007;264/2009

Coming into Force

Coming into force

6 This Regulation comes into force on November 1, 1997.

Schedule Repealed AR 119/99 s6.

Related Codes under the Safety Codes Act that impact the selection and use of Private sewage Systems:

Required Connection to Sewer

Alberta Building Code 2007:

7.2.1.3. Sewer Hook-up

> **1)** *Building* sewers shall discharge into a public sewage system where such system is available.
>
> **2)** Where a public sewage system is not available, the *building* sewer shall discharge into a *private sewage disposal system*."

This building code requirement must be followed; it is not isolated from the Private Sewage Disposal Regulations and Standard of Practice. It is also a law of Alberta.

Article 7.2.1.3 in the Alberta Building Code requires that where available the building shall be connected to a municipal or public sewer. If public sewer in not available the building shall be connected to an approved private sewage system. The determination that the public sewer is available is made by the municipality or owner of the public sewer system. Municipalities also have bylaws regarding connection to water and wastewater facilities.

The building code requirements are re-enforced by the 2005 National Plumbing Code (as adopted by the Alberta Plumbing Code Regulation) in: Article 2.1.2.1 Sanitary Drainage Systems

> 1) Every sanitary drainage system shall be connected to a public sanitary sewer, a public combined sewer or a private sewage disposal system.

Required Certification of Equipment

Subsection 3 of most sections in the Standard includes requirement for materials and equipment. In addition to setting out specifications for materials it also references standards the material or equipment must meet. In addition section 3.1 of the Private Sewage Disposal Systems Regulation on pg. **234** sets out the equipment must be certified to the referenced standard by a recognized certification body. Piping, septic tanks and secondary treatment plants are examples. A certified product will be labeled as being certified. The label will identify the standard the product is certified to and identify the Certifying Body that tested the product to the standard. If such labeling is not affixed permanently to the product it is not certified.

Standard of Practice Defined Terms; Additional Information

1.1.5.1. Interpretation of Words and Phrases

1) Words and phrases regarding *soils* and *soil* characteristics used in this Standard, including defined terms, shall be interpreted and used in a manner consistent with definitions established under the Canadian System of Soil Classification.[1]

[1] Note: Sentence (2) — Canadian System of Soil Classification definitions can be used to gain more description of the terms and direction on how to identify and classify soils. Additional and more detailed definitions can also be found in the Canadian Soil Information System (CanSIS) Manual for Describing Soils in the Field.

This article clearly sets out the terms used must be those used in the Canadian System of Soil Classification. These terms are used as the basis for determining suitability of the soil for private sewage systems and the assigning of effluent loading rates. Terms, descriptions, and characteristics of the soil used in a typical geotechnical investigation are not appropriate or acceptable for design with this standard.

1.1.5.2 Defined Terms

The defined terms listed in the following are further explained for more clarity.

Limiting condition

Limiting condition means *soil* or site characteristic that reduces efficiency of *soil* treatment or hydraulic conductivity and thus restricts design options for a system. (The condition(s) found in the soil profile within the depth of soil that will most significantly affect the sizing and design of the system is considered the Limiting Design Condition in the soil. It is not a restricting layer as defined below that would stop downward flow the effluent.)

Restricting Layer or Restricting Horizon

Restricting layer or Restricting horizon means a horizon or condition in the *soil* profile or underlying strata that restricts the movement of fluids creating a limiting *soil*/site condition; examples include fragipan, spodic horizons, fine textured *soil* with massive *structure*, or certain bedrock, etc.; *see also* ***limiting condition.*** (The restricting layer is the layer in the soil profile that essentially stops the downward flow of effluent whether by soil conditions or a layer in the soil that is already saturated at times of the year or continuously.)

Treatment Boundary Limits

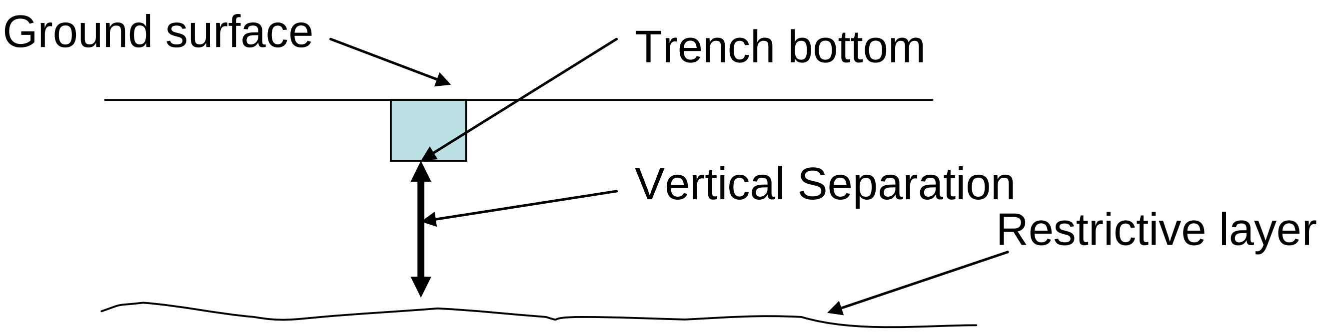
Treatment boundary limits means the limits of the treatment zone in the *soil* as defined by this Standard and as used in a design, such as the *vertical separation* depth required below an infiltrative surface that *effluent* is applied over and at the point the design requires or expects treatment to be achieved.

(This term describes the point at which treatment of the wastewater effluent will be or must be achieved. The standard sets out prescribed limits and distance in which treatment must be achieved but also provides for changes in the treatment boundary limits where justified.)

Vertical Separation

Vertical separation means the depth of unsaturated *soil* between the bottom of an *effluent* treatment component and a *limiting condition (use restricting layer)*, such as a *water table* or an impervious layer of rock or soil that limits hydraulic conductivity such that it would cause a perched water table under the loading of the system.

The graphic below shows the concept as applied to a treatment field trench. It shows the vertical separation is measured from the soil infiltration surface. This concept is applied to all systems.



Water Course

Water course means

a) a river, stream, creek or lake,

b) swamp, marsh, or other natural body of water,

c) a canal, reservoir, or other man-made surface feature intended to contain water for a specified use, whether it contains or conveys water continuously or intermittently but does not include surface water run-off drainage ditches, such as those found at the side of roads, or

d) an area that water flows through or stands in long enough to establish a definable change in or absence of vegetation (See definition of shore pg. **16**).

(The definition of a shore is critical in defining a water course. For example a roadside ditch meant to manage storm water is not a watercourse. The following text and photos help clarify the interpretation of a water course.)

The SOP requires a minimum separation distance between a water course and a private sewage system. Clearly applying the definition of water course is important in deciding where a sewage system can be placed.

Identifying water courses is not always straight forward as there is often no water flowing at the time of the site investigation. The features described in clause d) are significant in identifying a water course. Important in the application of this definition is recognizing the change or absence of vegetation. The consideration of the definition of shore helps identify a watercourse. A water course of concern that affects the allowed location of a private sewage system will have an identifiable shore.

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.

The three photos below assist in identifying a water course.

In this photo a shore cannot be clearly identified in this gully. There is likely a period of time during rainfall or spring snow melt that water flows through this area so it is not a suitable location for a sewage system. However water does not flow through often enough, based on the absence of a definable shore, to class it as a water course. This is not a watercourse as intended in the definition used in the SOP that requires a minimum separation from the sewage system.

The two following photos show a watercourse on a property different than shown above. Both photos below are taken from different perspectives on the same property. There is a defined shore or area where the vegetation is wrested away in the first photo and a dominance of vegetation typical of a watercourse is evident the second of these two pictures. The large constructed culvert helps confirm the significance of the water course but is not needed for the determination of a watercourse.

General Description of a Private Sewage Treatment System

Private sewage systems are made up of two main component groups. First, are the initial treatment components that manage flow and provide a preliminary level of treatment. Second, are the soil based treatment components that make effective use of the soil to achieve final treatment of the wastewater and safely return it to the environment.

Initial Components

Requirements for the selection, design, installation and material requirements of initial treatment components is set out in Sections 2.3 to 6.2 of the Standard of Practice. Their purpose is to achieve flow control and initial treatment of the wastewater.

Flow Control

Initial components control the flow of sewage and treat the sewage to a level that is suitable for the next stage of the system - the final treatment in the soil. The initial components manage flow by providing storage capacity and methods to control the delivery to the final soil based treatment component. This is an important aspect of an effective design for treating wastewater.

Treatment

The initial components also provide a level of treatment of the sewage. A basic septic tank will provide physical separation of the constituents in the wastewater by settling and floatation. A treatment plant or other secondary treatment device will use aerobic conditions to enhance biological treatment of the sewage prior to discharge to the final soil based treatment system.

Final Treatment Components

Final treatment components are those parts of the system that directly utilize the in situ soil (the in place existing soil) to achieve the final treatment of the effluent to a level considered safe for return to the environment. The design of the final treatment components must be such that the soil is not loaded at rate that exceeds the treatment capacity of the soil, that it does not exceed the long term capacity of the soil to receive and move the effluent through the soil out to the receiving environment, and to prevent direct contact with the effluent by people and animals.

Requirements for the selection, design, installation and material requirements of final soil based treatment components are set out in Sections 8.1 to 8.6 of the Standard of Practice. Also applicable to the final treatment components is section 2.6 that sets out requirements for the design of pressure distribution of effluent systems that are used to ensure even distribution of the effluent over the soil based treatment area.

Sections 8.1 to 8.6 address a number of design types for final soil based treatment which include:

- Treatment fields
- Treatment mounds
- Drip dispersal and irrigation systems
- Open discharge systems
- Privies (outhouses)

An anomaly in the final treatment components is the Evaporative Lagoon in that the lagoon does not utilize the soil to achieve final treatment and return to the environment. The lagoon uses evaporation to return the wastewater to the environment. Requirements for Lagoons are set out in Section 9.1 of the Standard.

In order to apply the requirements set out in the Standard for the initial treatment components and the final treatment components, the related design criteria of the facility being served and the soil conditions at the site must first be determined. The critical criteria used in the design of a private sewage treatment system are the volume and strength of wastewater generated by the facility served and the capacity of the soil to receive and treat the wastewater effluent. This is the starting point of a design.

The System Design Starting Point

Determining Wastewater Flow and Capacity of Soil to Treat Effluent

Knowing the flow volume and strength of sewage as well as the treatment capacity of the soil is critical to designing a successful and sustainable private sewage system. The selection and design of the appropriate initial treatment components and final soil based treatment system is based on these criteria. Without knowing that critical information of wastewater flow volumes and strength and capacity of the soil, a private sewage system cannot be designed properly – at best the installed system includes some initial treatment components and final treatment components based on an uneducated guess. The life of the system will be short or the system is over designed and not cost effective.

Section 2.2 of the Standard sets out design requirements and methods of determining wastewater flow volumes, variations in flow volumes, and wastewater strength. Section 7.1 sets out the characteristics of the soil and site constraints that must be evaluated to determine the capacity of the soil to treat received effluent.

Wastewater Flow and Strength; Section 2.2

Wastewater flow and strength both affect the design of a private sewage system. These are two key parameters that are critical in the design of a private sewage system. The volume and strength of the sewage is a starting point in the design of the system.

The amount of water that must flow through the system impacts treatment capacity related to:

- retention time in the treatment system, and
- the ability of the soil to infiltrate and move the water away from the treatment site into the receiving environment.

The strength of the sewage, measured by the concentration of constituents in the waste that must be treated, impacts the treatment capacity of the system related to:

- the capability of the system to remove solids through physical processes of floating and settling.
- The biological capability of the system, both in the initial treatment components and final soil based treatment components, to break down, consume, convert and reduce the contaminants of concern in the sewage.

Wastewater Flow

The volume of wastewater to be treated and returned to the environment through the soil can be estimated based on the characteristics of the development or measured at an existing development of similar purpose and characteristics and the findings applied to the development the design is developed for. These methods are set out in Article 2.2.1.4 of the Standard.

Determine the Design Wastewater Flow Based on Characteristics of the Development

The standard sets out in Article 2.2.2.2 that the design wastewater volume can be determined by applying the values set out in Table 2.2.2.2.A for residential development and Table 2.2.2.2.B for non-residential development.

To utilize these tables the specific characteristics of the development must be determined. This is done by a review of the plans for the development to identify the characteristics that affect wastewater flow volumes. These tables estimate the amount of wastewater flow from a normal or typical development.

In Residential development the Standard requires consideration of the fixture unit loading produced by the plumbing fixtures in the house. When the fixture unit loading exceeds 20 fixture units additional daily flow of 11 gals per fixture unit must be added to the daily peak flow as set out in Table 2.2.2.2.A.

Additional fixtures in a house add to both the total peak daily flow as well as causing higher instantaneous flow. Additional bathrooms in a home are intended to allow the all the occupants to use the bathrooms without having to wait for others. This results in wastewater flows occurring over a shorter time period and stressing the system. Peak flow is increased as the occupants typically choose to spend money on more bathrooms because that convenience and personal hygiene is a part of their lifestyle. They do not practice the weekly bathing of yesteryear.

Each type of plumbing fixture is assigned a fixture unit load in plumbing codes. The fixture unit loading is used to size both water lines and the sewer piping in the building and to the public sewer or private sewage system. The more the fixture units the larger the water supply and sewer pipes need to be.

Table 2.2.2.2.A is supplemented with a list of typical fixtures and the assigned fixture unit load. This information can be used to total the number of fixture units in the house. Although Floor drains are listed, they should only be included when it is expected they will normally receive wastewater flow. A floor drain in the basement for example has the sole purpose of draining water when something goes wrong such as a leak in the water heater. The note to the fixture unit loading values indicates floor drains that are for emergency use do not need to be included in the total fixture unit loading that will be used in determining the need to increase the peak flow volume.

Example of Applying Fixture Unit Loading in Flow Estimates

Assume a 4 bedroom home with a base flow from Table 2.2.2.2.A of 450 gallons per day.
This table also requires that for each fixture unit over a total of 20 in the residence requires 50 L (11 Imp gallons) to be added to the base flow.

Apply fixture unit loading base on fixtures in the residence:

Main bath	6	
Ensuite with shower	6	
Kitchen	1.5	
Laundry stand pipe	1.5	
Floor drain - 4 inch	0	When for emergency use only do not count; see note below fixture unit table.
Bathroom in basement	6	
1/2 bath with toilet (4) and basin (1) 5		
Total	**26**	

The total fixture unit load exceeds 20 by 6 fixture units. This requires 66 gallons (6 F.U. x 11 gallons) be added to base flow which is based on a typical residence. Total flow used for design is 516 gallons for this example.

Using Measured Flow to Estimate Design Flow Volume

The Standard sets out that in addition to using the tables referenced in Article 2.2.2.2, Article 2.2.1.4 sentence (2) allows metered flow to be used to determine the design flow for the wastewater system. Clause b) of that sentence requires that a safety factor of 1.5 be applied to the actual measured flow (see Article 2.2.1.4. (2) (b) for specifics). The safety factor must be added as the safety factor in the design of private sewage systems in this standard is in the predicted flow volumes used for design. Any sound design will include a safety factor and a safety factor of 1.5 is specified by the Standard.

The frequency and time period over which water use meter readings is required is set out in Article 2.2.1.4.(3). This Sentence requires the reading to be taken daily for a minimum period of 30 consecutive days. Readings over 30 consecutive days should help identify variability in flow and peak loading factors that may be needed.

In addition to taking daily meter readings over 30 days consideration must be given to the occupancy loading at the time of the meter readings. If the development was being used significantly under capacity during the time of the meter readings the resulting flow volume would not properly represent flow at high occupancy. For example, if meter readings were taken at a community hall during a 30 day period when no events were held the measure would not be representative of flows. In justifying the flow data collected the designer needs to also consider and document the occupancy load of the development. This scenario could also apply to residential developments. If flow is metered in a 4 bedroom home that only has 2 occupants, the measured flow volume would not reflect the potential occupancy of the home.

Considerations for Water Conservation Fixtures

System design capacity cannot be reduced when using water conserving fixtures as the reduced water flow will increase the wastewater strength requiring sufficient design to handle the increased strength; however, water conserving fixtures are beneficial to private sewage systems. See Article 2.2.1.6 regarding consideration of water saving fixtures and Article 2.2.2.4 regarding flow estimates with water saving fixtures. The reduction in water that needs to be returned to the environment through the soil can reduce the risk of failure and even result in improved treatment in the soil. Treatment in the soil can be improved because with less effluent discharged to the soil the retention time of the effluent is extended in the effective treatment zone below the soil based treatment system. Although treatment retention time within the soil is increased, the total organic loading applied to the infiltration surface remains the same when the system infiltration surface is not reduced in area so the formation of a biomat will be just the same as if water conserving fixtures are not used.

Installing water conserving fixtures in a building with an existing sewage system will not harm the sewage system. It will help the system even though an increase in the concentration of the wastewater will occur. This is because the system was initially designed for the total loading of the waste carried in the water.

Increased Wastewater Strength Due to Water Conservation

Less water being used as a result of water saving fixtures does not directly relate to allowing a reduction of the size of the treatment system. Treatment of the sewage is directed at removing the waste and constituents of concern from the water. When low flow fixtures are used it results in less water volume into the system but not less waste. With less water but the same amount of waste, the concentration of waste in the water increases. Although the concentration of waste increases the mass loading (total amount of waste material) has not increased. Typical wastewater strength is expected to be 220 mg/L BOD_5, 220 mg/L TSS and 50 mg/L oil and grease at the peak wastewater flow volumes set out in the tables of the Standard. If water use is decreased by 20% there will be a corresponding increase in concentration of BOD_5, TSS and oil and grease.

Because the amount of waste in the water is not reduced, the size of the system should not be reduced. The same capacity is needed to treat the waste in the water. Article 2.2.1.6 requires the increased sewage strength caused by low flow fixtures to be considered in the design. Article 2.2.2.4 sets out that where low flow fixtures are used and the prescriptive requirements of the standard are used to determine sizing of the system, the flow volume used for design shall not be reduced from what is set out in the tables for determining flow volumes unless the increased strength is addressed by the design. By maintaining the design based on the peak flow set out in the Standard the system will be able to handle the increased strength of the wastewater.

Allowance for High Flow Water Use Plumbing Fixtures

Use of the tables must also consider the development may include plumbing fixtures that may use more water than found in a typical installation. This required consideration is set out in Article 2.2.1.5.

An example of high volume fixtures is found in many high end homes that are using fixtures such as multi head showers or large fill and drain soaker tubs or hydro massage tubs that affect wastewater flow volumes.

Industry representatives report that some showers installed in homes may discharge 15 to 20 gallons of water per minute, compared to the 2 or 3 gallons per minute expected of a typical shower. This is a 5 to 10 fold increase in the amount of water flowing though the system from such a fixture. Some homes include large soaker tubs or hydro massage tubs that contain much more water than a typical bathtub. A typical bathtub may hold as much as 75 gallons of water. Large soaker tubs may hold 2 to 3 times as much as a typical bathtub.

Instantaneous Flow Problems From High Volume Fixtures

While creating additional volume discharged to the private sewage treatment system Fixtures such as soaker tubs, hydro massage tubs and high flow showers create a large volume instantaneous flow through the sewage system. This causes the wash through of suspended solids from the septic tank or treatment plant into the soil based treatment system that was not contemplated in the design and will likely create failures.

Consider that a soaker tub holding 3 times the volume of a typical tub, approximately 225 gallons, is discharge when the plug is pulled of approximately 10 minutes. For the design flow of a 4 bedroom home estimated at 450 gallons per day this is half the daily (24 hour) design flow moving through the system in 10 minutes. It is obvious that without specific design in the system to deal with this instantaneous flow the system will be compromised.

Article 2.2.2.3 of the standard sets out that where high water use fixtures are installed in the development the system design must consider this additional flow. This article includes a table that requires added flow volumes be considered in the design to address fixtures that can cause increased flow through the system.

The most effective way of managing instantaneous flow from fixtures is to include flow equalization capacity in the system so that these brief periods of high flow can be absorbed and then delivered through the treatment system over the period of the day.

Flow Variation and Flow Equalization

Typical daily wastewater flow patterns for many developments create a diurnal flow pattern (meaning there are two significant flow peaks during a day). In a diurnal flow pattern flow is typically concentrated in the early morning and late in the day at supper time and in the evening. This is anticipated in the requirements set out in this Standard. However many developments may have flow volumes that are very concentrated during specific times of the day due to the characteristics of the development of use of the development. The potential for flow variation needs to be identified at the design stage. Where it is expected the development will produce wastewater volumes that vary significantly over the day, or even from day to day, this needs to be addressed in the design by including flow equalization.

Article 2.2.1.4. sentence (4) and Article 2.2.1.7 set out requirements for equalization when flow varies considerably from day to day and flow variation during the day.

When flow varies significantly from day to day, the total peak flow over a period of days can be equalized using a large equalization tank. This will result is a lesser amount being discharged through the system on the very high flow days and increase the amount discharged to the system on low flow days. This equalization effect will improve the performance of the system and allow some parts of the system to be smaller than if designed for the maximum flow on one day. Article 2.2.2.5 sets out the capacity required for flow equalization and controls required; however the intent of this article is to address situations where the flow varies during the day. When trying to equalize flow from a facility that varies in flow volume from day to day and substantially over the week careful calculations are needed to ensure sufficient capacity. This is particularly true when days of high flow volumes may be the two days of the weekend and then the equalization tank is intend to allow discharge to catch up during the following 5 days.

When flow varies significantly during the day it is important to equalize the flow so that the treatment system is not overloaded due to high instantaneous flow. In homes high instantaneous flow can occur due to large volume tub or high flow showers. In commercial applications a motel or hotel is an example of where flow equalization is needed. Typically in motels and hotels the majority of the flow occurs in the morning from 6 am to 12 pm which is only a quarter of a full day. This high flow rate will overwhelm a system that is designed for the daily peak flow without recognizing that flow occurs during that short period of the day. An equalization tank is needed to store the daily flow and enable timed discharges to the system over the 24 hr period of the day. Article 2.2.2.5 sets out the capacity of tanks needed to equalize flow and requirements for controls when addressing flow variations that occur during the day. This capacity as set out may not be adequate when flow volumes vary from day to day

Typically the equalization tank is put upstream of all other components in the treatment train. A pump in the equalization tank is used to discharge small amounts at a low flow rate to the downstream components using time controlled discharges. During high flow, wastewater is stored in the equalization tank and then the system catches up by continuing to empty the tank during low flow periods.

Equalization is used to control the frequency of dosing effluent to the soil based treatment system so that it is applied to the soil evenly throughout the day. This improves the treatment performance of the soil based treatment system substantially by ensuring large demand effluent doses do not cause periods of saturated flow through the soil at times of high flow from the development. To provide flow equalization, the dosing tank is increased in size to provide capacity to store effluent and a timed dosing controller is used to control the frequency of effluent doses to the soil based treatment system. It should be recognized that if equalization is used upstream of all the treatment components, further equalization in the dose tank will be of little value.

Wastewater Strength Considerations

The strength of the wastewater is measured by the concentration of BOD, TSS and oil and grease. Article 2.2.2.1 sets out the expected strength of raw wastewater. Typical wastewater is also a defined term setting out the expected strength of wastewater. The standard also defines the expected strength of effluent that is treated through a septic tank or various treatment plants. Depending on the strength of the effluent the allowed effluent loading rates on soil infiltration surfaces will vary. The effluent loading rates set out in Table 8.1.1.10 demonstrate this. In Table 8.1.1.10 there are two columns setting out allowed loading rates based on effluent quality; one column for effluent strength between 30 and 150 mg/L BOD and one column for effluent strength of less than 30 mg/L. These are columns 4 and 5 of that table. See pg. **304** for a graphic explaining this table and identifying those columns.

In addition to the volume of wastewater generated by a facility the strength of the wastewater also needs to be considered and is just as important as volume.

Wastewater strength can impact the capacity required of both initial components and final soil based treatment component design. This is referenced in Article 2.2.2.1 sentence (2).

Developments must be reviewed at the time of design to determine characteristics that may cause an increase in wastewater strength. The standard requires that a projection of wastewater strength must be included in a design. This projection needs to be backed up by the findings of the review of the development; there is nothing that would increase strength or there are these characteristics that will increase strength and state the anticipated raw wastewater strength.

A prescriptive requirement in Article 2.2.2.6 regarding the use of Garbage Grinders that are used under the kitchen sink requires an increase of 30% in the wastewater strength along with increased storage capacity for sludge of 50%. This is due to the additional waste being put down the drain but also due to the waste being food that has not been processed by humans. Food that has been consumed by humans has been digested and much of it taken up by the body. What's left after digestion is less than the raw food product. The undigested food puts a much larger organic loading into the system that the micro-organisms must consume.

The standard also sets out methods of projecting wastewater strength in Article 2.2.1.3 and in Article 2.2.2.1 sentence (3) of the standard that sets out minimum sewage strength for design for restaurants, work camps and campgrounds which are common developments served by private sewage systems. Sentence 3) of this Article requires the highest value of either the table, other published information or the measured strength from similar developments be used for design purposes. **A note is included in table 2.2.2.1 that is very important.** This note identifies the values set out in the table are a minimum design value and that actual values are often higher. It is the responsibility of the designer to ensure adequate consideration of the wastewater strength.

Article 2.2.2.1 sentence (5) requires that where the anticipated wastewater strength will exceed typical wastewater strength the effluent discharged to the soil based treatment system must be sampled and tested to ensure the system has achieve the quality intended in the design. This sampling should be undertaken when the system has stabilized. Although not specified by the standard, sampling should be done more than once at appropriate intervals to determine the wastewater quality. One sample in a point in time is hard to use a defensible confirmation that the system has achieved the intended outcome. While sampling is needed to confirm compliance with the Standard, sampling is also important to identify problems that can occur if the system is not serviced properly or conditions change resulting in higher than anticipated wastewater strength that can cause a failure of the soil based system.

Wastewater Sampling

The methods used to collect wastewater samples are critical to obtaining good results from the testing lab. While the lab has set procedures to test the samples, if the sample collected was not representative of the raw wastewater or the effluent, or the sample was not preserved as required the result form the lab will be meaningless.

There are two general types of samples – a grab sample and a composite sample. The grab sample takes a measure in a single spot in a single point in time. A composite sample is a sample collected that represents flow over a period of time; they are often 24 hour composite samples. Composite samples take a small sample at regular intervals through a day and then are combined to provide the composite of the days flow. Often each sample during the day is of differing volumes to adjust for the flow rate at the time to give a flow proportional composite sample.

In an onsite sewage system it is relatively easy to get a composite sample for at least a part of the day as effluent is stored in the dosing tank for a period of time before being discharged. However obtaining a composite of the raw wastewater is not easy in an onsite system. Samples from the first compartment of a septic tank will likely be of wastewater that has had some time for settling as the appropriate place to sample form is below the scum layer and above the sludge layer. Also any grab sample from the inlet sewer line to the tanks will be a strict grab sample and can vary significantly in strength depending on the source of the flow at the time and how many lumps may be collected or missed in taking the sample. Numerous samples should be taken in this case and mixed together to get the best representation possible for the sewage.

When obtaining samples consult the lab that will do the testing to get advice on sampling procedures, suitable containers for storage, stabilizers the must be added to the sample, temperature for the storage of sample during transport to the lab and timelines for getting the sample to the lab.

Private Sewage System Controls

Control systems are used to provide positive control of the wastewater and effluent through the treatment system. Effective control can improve the effectiveness of a system

The amount of effluent pumped in each dose is defined by the volume of sewage received (in most cases per day), the design of the downstream component and the number of doses per day that should be applied to the soil treatment system. Article 8.4.1.10 sets the maximum individual dose at 20% of the average daily flow to a treatment mound. The control systems are used to deliver the specific amount required for the design.

Basic controls include floats that turn pumps on and off to deliver a dose of effluent to the downstream component, typically the soil based treatment system or to activate an alarm in a high water level condition. In place of floats there are other effective means of measuring water levels in the system. These include pressure transducers and ultrasonic measurement.

Demand Dosing of Effluent

Simple systems use floats to turn the pump on when a sufficient amount of effluent accumulates to provide the volume needed for an individual dose of effluent. It then shuts off the pump once the dose is delivered. This is defined as a demand dose. It reacts to the incoming flow volume and rate.

Timed Dosing of Effluent

Timed dosing systems use floats to activate or shut off a controller that is set by the designer to deliver a specific volume per dose at timed intervals. The benefit of timed dosing is that the system is less susceptible to overloading during periods of high wastewater flow. Preventing periods of overload and spreading the wastewater application evenly through the day make more effective use of the treatment processes.

The intent with all systems is to provide positive control of the effluent dose volume. This requires careful consideration of the elevations in the dose tank the float is set at to turn the pump on and off or activate the timed dosing.

When timed dosing volume settings are exceeded by the flow generated the time dosing control will set off an alarm. It is important this alarm not be taken out of service in the programming of the control. This information it provides the owner is important to ensure they appropriately react to the signal. This would include checking their water flow, silencing the alarm knowing it will return to normal when the guests leave that are creating the excess flow or having a service person come to determine the problem and adjust the system if needed.

Alarms and Overrides

Alarms are required to warn of high liquid level conditions in all private sewage systems, except lagoons and privies; see Articles 2.3.1.2.; 2.4.1.3.; and 2.4.1.4.

Alarms must continue to function in the event of a mechanical, electrical or hydraulic malfunction of the system – Article 2.3.1.2 Sentence (3) and 2.4.1.5. This requirement specifically refers to failure of the system. In the case of an overall power outage it is not expected the electrical activated alarm will function and for a typical onsite system the water supply pump will not run either so it is unlikely wastewater will be entering the system. However if the development is connected to a municipal water supply it is possible that water could be used in an overall power outage. In this case the designer should include a battery back up for the alarm system. Articles 2.3.2.3 and 2.4.1.5 set out a requirement for an alarm back up.

Article 2.3.2.3 sets out that the alarm shall be connected to a separate electrical circuit, that is not associated with the system, or have a battery backup. The intent of this is to ensure that if the breaker supplying the sewage system trips the alarm will continue to function. Connecting the alarm supply to a circuit that supplies often used lighting in the development will enable the alarm to function and reliance that the alarm has a power supply. Connecting the alarm to a dedicated power circuit in not required or desirable.

Alarms used in holding tank systems typically are run by battery as no power is needed for other purposes at the holding tank.

Mounting of Water Level Control Devices

The water level control floats or devices must be securely place in the system so they continue to operate as installed. Article 2.3.1.4 requires that the water level indicating devices are mounted in a manner that allows removal and adjustment of the devices without disconnection of other system components so they can be easily re-installed at the same elevation or adjusted as required. Mounting the floats on an independent mast made of PVC piping achieve this. The mast can be easily pulled from the tank to adjust floats and when reinstalled the pipe will always hit the bottom of the tank. See pg. **359** for a graphic of a simple mounting method for floats

Mounting the floats in this way makes the set up of the system much easier. It allows easy adjustment of dosing volumes to meet actual flow from the development and ensures that during maintenance or removal of sludge that the float controls are re-established at the intended levels.

Data Recording Control Devices

Systems that include secondary or better treatment prior to discharge to the soil based treatment system require a control system that will record operational data. Article 2.3.1.5 sets out specific functions and parameters the system control must capture data on. This provides important information needed for the effective operation of the system. Clause (1) (c) of this article sets out that the system must record daily flow volumes. This requires the data captured by the control system enables the determination of the flow in any given 24 hr. period. Simply providing a total count of dose cycles and dividing over the number of days the data was collected is not acceptable as it does not provide useful data on daily peak flows or significant changes in flow from time to time. This is critical information needed to optimize the operation or do trouble shooting of the system. When secondary or better treatment is included in the system there is a high degree of reliance placed on the performance of the system for treatment success and long term operation.

System Controls and Monitoring Systems; Flow over 5.7 m^3 - Section 2.4

This section applies to system where the peak flow from the development exceeds 5.7 cubic metes per day (1250 Imperial gallons). In addition to the control requirements discussed above it includes some additional requirements for controls and components to enable monitoring of the system.

Additional Control Requirements

These include:

- Data recording of operation function is required on all systems.
- Control systems needed to achieve the management of flow variations.

Monitoring Features

The design of larger systems must include the capability to monitor the movement and treatment of effluent in the soil and the quality of the effluent applied to the soil based treatment system.

Effluent Sampling Ports

This includes effluent sampling ports as set out in Sentence (5) of Article 2.4.1.9 that enable sampling of the effluent prior to application to the soil infiltration surface. The design and location of sampling ports or points in the system must be carefully considered to provide representative samples of the effluent. For each system this will vary. The point n the system the sample is taken from must be downstream of any competent that provides treatment. The design of the sampling port must enable the collection of a "fresh" sample. Often the sampling point can be the dosing tank which also helps provide a somewhat composite sample of the wastewater flow.

Groundwater Monitoring Wells

Article 2.4.1.9 sets out requirements for monitoring wells and monitoring ports to monitor the effectiveness of the soil based treatment system. These include shallow monitoring wells to measure the depth of unsaturated soil below the soil infiltration surface, deeper monitoring wells to measure the impact of the applied effluent of impacted ground water, and monitoring ports to measure ponding of effluent on the infiltration surface. Groundwater monitoring wells are developed to the depth of the underlying groundwater and are used to measure the impact applied effluent has on underlying groundwater that may be impacted. They are required in two situations.

1. The development produces wastewater of more than 5.7 cubic meters (1250 gallons) peak flow per day and where there is underlying groundwater that is likely to be impacted by surface infiltration (GUWDI) and there is sufficient quantity to meet the definition of a domestic use aquifer (DUA). This is set out in Article 2.4.1.9 Sentence (2). The definitions of ground water under the direct influence (GUWDI) pg. **11** and Domestic Use Aquifer (DUA) pg. **7** need to be referenced in applying this requirement.

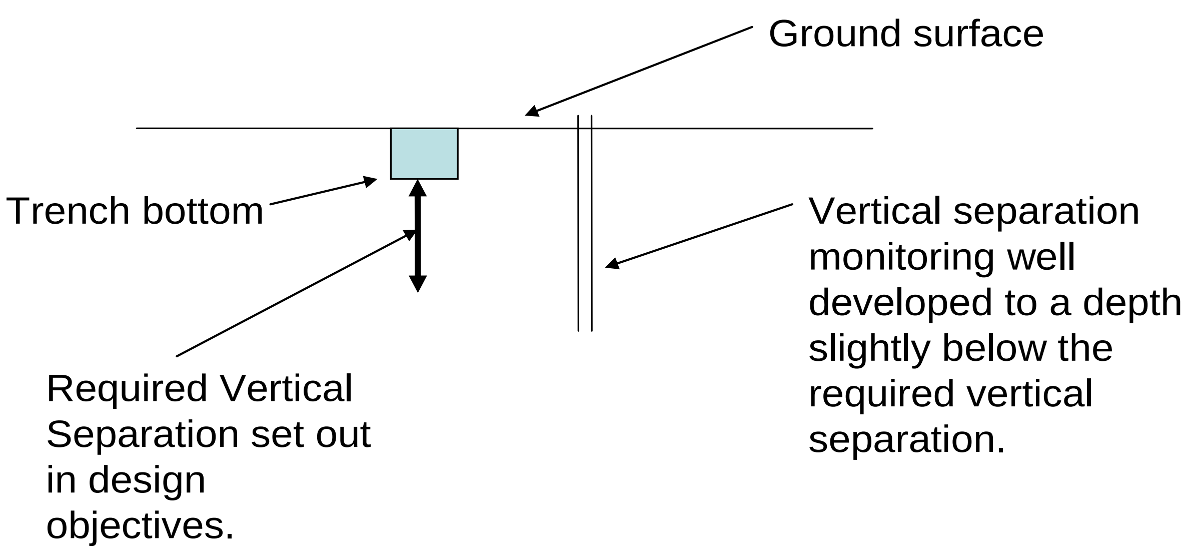
2. The development produces wastewater in excess of 9 cubic meters (1980 gallons) peak flow per day and the system is located within 2 kilometers of a lake, river, stream, or creek which is set out in Article 2.4.1.9 Sentence (3).

In addition to providing the monitoring wells, the location of the monitoring wells must be selected to provide measurement of the impact from the wastewater systems. That requires one monitoring well located up-gradient and at least one located down-gradient of the system based on groundwater flow direction. Three ground water monitoring wells are required to accurately determine groundwater flow direction. The location of the wells should not be well outside the immediate area of the soil based treatment system. The specific location needs to be justified by the designer to provide good measurement of un-impacted ground water and the down gradient well in a location most likely to intercept the impact on the groundwater.

Vertical Separation Wells

Vertical separation monitoring wells are used to determine that saturated conditions have not risen to within the depth of vertical separation required by the design. They are located within the area of the soil infiltration surface. The location should not be within a treatment field trench or sand layer of a mound where it may be affected directly by the applied effluent. They should be located between trenches or immediately adjacent to the infiltration surface. The vertical separation monitoring well should extend from surface to a depth of approximately 300mm (1 ft.) below the required vertical separation depth. This provides the ability to recognize increasing saturated soils before the system is compromised. These wells are required in systems receiving more than 5.7 cubic meter of wastewater per day as required by Article 2.4.1.9. (1).

Figure: Vertical Separation Well



Piping: Section 2.5

Piping used in systems must be certified to recognized standards set out in the Standard of Practice. Sub-Section 2.5.3 sets certification requirements of the piping used in pressure applications and gravity flow applications. It also set out that joints in piping shall be made using appropriate fittings and methods. Table A.5.A also sets out various piping types and certification for various applications within the system. For pressure applications, a piping certified for a pressure application must be used.

Building Drain

The building drain is the piping which conducts the sewage from within the building to a point 1 m (3.25 ft.) outside the building. The building drain is connected to the building sewer that is outside the building and conveys the sewage to the private sewage system or a public sewer. As set out in the definition of a private sewage system the system starts at a point 1800mm (6 ft.) upstream of the first component of the private sewage system. In many cases, the building drain connects directly to the septic tank, sewage holding tank or packaged sewage treatment plant.

Building Sewer

The building sewer starts at a point 1 m (3.25 ft.) outside the building. A 75 mm (3 inch) building sewer should be graded at not less than 2% (1/4 inch per foot). A 100 mm (4 inch) building sewer should be graded at not less than 1% (1/8 inch per foot). If the length of the building sewer, is more than 30m (100 ft.) extended "Y" cleanouts must be installed at intervals to accommodate cleaning. The maximum distance between cleanouts is 26 m (85 feet) for a 100 mm (4 inch) building sewer. Requirements for the Building Sewer are provided in the National Plumbing Code and are not addressed in the Private Sewage Systems Standard of Practice. Refer to the National Plumbing Code for specific requirements.

Effluent Sewer

The gravity effluent sewer may connect to the outlet of a siphon type septic tank, packaged sewage treatment plant or sand filter and conveys effluent to the final effluent treatment component. A gravity effluent sewer may be 75 mm (3 inch) or 100 mm (4 inch) pipe. It is laid on an even continuous grade of not less than 2% (1/4 inch per foot) for 75 mm (3 inch) pipe, and 1% (1/8 inch per foot) for 100 mm (4 inch) pipe. See Article 2.5.2.5 that sets out these requirements.

Piping Connection to Tanks

The piping used within 1.8 m (6 feet) of a connection to a tank must be pipe certified as D.W.V. piping (Drain Waste or Vent) which has a 1/4" wall thickness or is schedule 40 weight pipe.) See Article 2.5.2.8. This is to minimize the chance of settlement and breaking over the excavated portion beside the tank. It must be supported over the distance from the tank to undisturbed ground. See Article 2.5.2.7. This article also requires that the connection to the tank be water tight and flexible. The connection must be flexible to allow for the eventual settlement between tank and the piping so the joint does not begin to leak. Tank manufactures typically include such a connection in the tank.

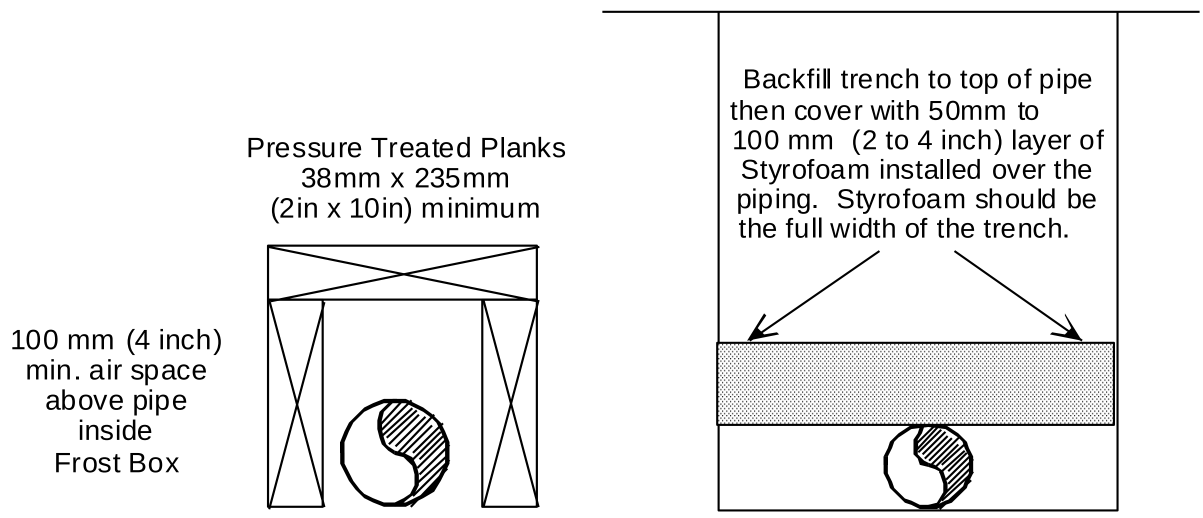
Effluent Line

An effluent line is a pump discharge line. This line carries effluent from a pump chamber to the next treatment component which is most often the final soil based treatment system. This piping must be certified for pressure applications. Polyethylene pipe or PVC Schedule 40 rigid plastic piping is typically used for the effluent line; ABS pipe and fittings are not certified for pressure so cannot be used. Fittings used with polyethylene piping are most often nylon or stainless steel and clamps should be of all stainless steel construction. If the effluent line is not buried below frost level is must be graded to enable it to drain so it does not freeze between pump cycles.

Protection of Piping From Freezing

All gravity sewer piping located under a driveway, road, path, or bare yard, with less than 1.2 m (4 feet) of earth cover, should be protected by a "frost box." See Article 2.5.2.3, and the following figure. All pressure piping that is not installed below the frost line must be sloped to drain between dosing of effluent. Frost protection as used on gravity sewers is recommended for shallow lines in similar locations.

Figure: Piping Frost Protection



Laying Buried Pipe

All gravity sewer piping must be graded and water-tight. Pressure piping that must drain to protect from freezing must also be graded. Lay pipe on a firm and even trench bottom to prevent settling, and carefully compact the backfill on the sides of the piping to prevent the piping from becoming oval shaped or breaking under the weight of the backfill above it. Maintain an even and constant rate of fall. Sags cause blockages in the pipe and the potential for freezing. See pg. **354** for graphic of buried piping support.

Effluent Distribution Piping

Gravity Weeping Lateral Pipe

Gravity weeping lateral piping is rigid lengths of perforated piping used in treatment field trenches. Certified perforated piping is labeled or identified so that when the labeling is at the top centre when the pipe is installed the two rows of weeping holes will be in the proper position. Plastic piping may be smooth as in the case of ABS or PVC piping certified as complying with the CAN/CSA B182.1 standard or, it may be corrugated polyethylene complying with CGSB-41-GP-31. In both cases these are rigid length of piping. Flexible piping intended for foundation drains cannot be used. Gravity perforated piping is always installed level, and always installed in gravel or other equivalent weeping lateral trench media. See pg. **313** for a graphic of a weeping lateral trench and Article 8.2.2.4 setting out specific requirements for the weeping lateral pipe. Also see typical treatment field trench layout graphics on pg. **360** and pg. **361**.

The design considerations for gravity distribution of effluent are set out further in Section 8.2 where it is used for treatment fields. Effective distribution to each weeping lateral trench is very important. Effluent must be delivered in dosed volumes as required by Article 2.1.1.5. This assists in achieving equal distribution and helps prevent freezing of the system. Trickle systems are not allowed by this Standard.

Pressure Distribution Lateral

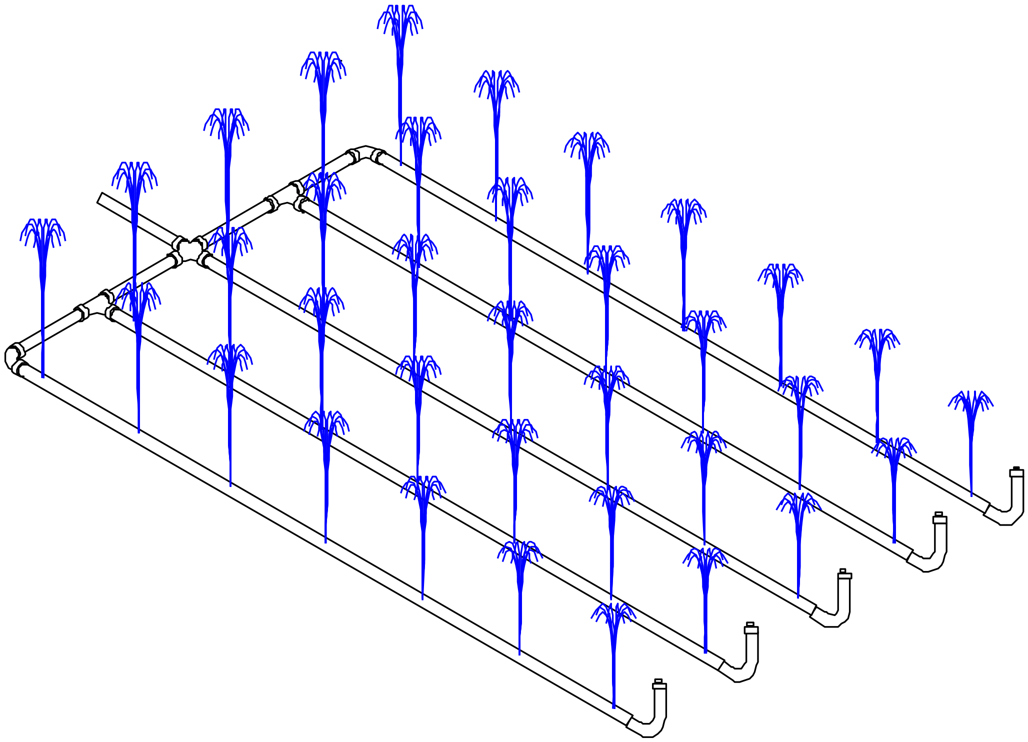
Pressure distribution laterals are usually PVC schedule 40 plastic piping not smaller than 19 mm (3/4 inch) or larger than 50 mm (2 inch). The orifices in the laterals are drilled as required for the particular installation and are not smaller than 3.2 mm (1/8 in.). The spacing of the orifices is dependant upon the requirements of the system the effluent is applied to. The required size of the pipe is determined by the number and size of orifices, the pressure at the orifices and the total length of the distribution lateral measured from the point the effluent is supplied to the lateral to its far end. See Table A.1.A in Appendix A, pg. **195**, for effluent distribution lateral sizes. See pg. **199,** Table A.1.B, for the discharge rate from orifices at various head pressures. A graphic showing the use and application of Table A.1.A is shown on pg. **259**.

Pressure distribution is considered much more effective at utilizing the treatment capability of the soil as it provides positive control of the effluent application over the surface of the soil infiltration area. The design requirements of a pressure effluent distribution system are set out in Section 2.6 of the standard.

Pressure Effluent Distribution Systems; Section 2.6

A pressure effluent distribution system is network of pressure effluent distribution laterals laid out over an effluent infiltration surface. Effective distribution of the effluent utilizes all areas of the required infiltration surface. This prevents saturation or some areas and underutilization of other areas of the infiltration surface. Systems using pressure distribution will provide better treatment of the wastewater effluent.

Pressure distribution is required on some soil types (sandy soils) and when applying secondary treated effluent. As well, a reduction in the required effluent infiltration area is allowed for pressure distribution when applying primary treated (septic tank) effluent due to it being more effective at spreading out the organic loading from the primary treated effluent over the entire infiltration surface. The following Articles set out where pressure distribution is required and where it allows a reduction in infiltration area: Articles 8.1.1.8 (required for secondary treated effluent and coarse textured soils); 8.2.1.8 (allowed reduction in treatment field area) 8.2.2.2 (required on coarse textured soils in treatment fields); 8.4.1.11 (pressure distribution required for treatment mounds).



The purpose of a pressure effluent distribution system is to provide positive control of the amount of effluent applied over an effluent infiltration surface such as in a treatment field, treatment mound, intermittent sand filter or re-circulating gravel filter as set out in Article 2.6.1.1. The design of the system must result in the volume discharged from each orifice per dose event does not vary by more than 10% along the length of a lateral and not more than 15% throughout the entire distribution system. See Article 2.6.1.2 for this requirement.

The objective of the design (see Article 2.6.1.3) is to effectively distribute the effluent so the soil moisture measured at a depth of 77 to 175 mm (3 to 7 inches) does not vary by more than 20%. If the design of the pressure distribution system follows the design requirements set out in the standard it can be assumed this objective is met.

Squirt Test to Confirm Effective Design

To test the design of the pressure distribution lateral a squirt test is used. See pg. **369**, for a graphic of a squirt test and further direction on carrying out a squirt test. The variation in volume discharged per dose must be checked. This is done by collecting the effluent discharged from the orifice nearest the supply and the orifice farthest from the supply. The volume of effluent discharged from the orifices must not vary by more than 15% in the entire system and not more than 10% on any individual lateral. The height of the squirt should also not vary by more than 20% to achieve an orifice discharge rate (GPM) that does not vary by more than 10%.

Pressure Distribution Basic Components and Design Requirements

The Following design requirements are set out within Section 2.6

- The piping used in the pressure distribution system must be certified for pressure applications.
- The length of distribution laterals shall not exceed 65 ft. from the point of supply to the last orifice.

- The laterals shall be elevated at least 4 inches above the infiltrative surface to prevent effluent that may pond on the infiltration surface from draining back in to the laterals when the pump is shut off.
- The piping shall be rigid PVC schedule 40 pressure rated piping supported at intervals not exceeding 4 feet.
- The end of each effluent pressure distribution lateral shall be easily accessed from ground surface to enable flushing of the laterals and checking of residual head pressure.
- Orifices shall not be smaller than 1/8" in dia.
- The effluent shall be filtered to exclude particles 1/8 in. in diameter before entering the pressure distribution system.
- Pressure head at the orifices shall not be less than 2 ft. for orifices larger than 3/16 inch and not less than 5 feet for orifices 3/16 or less in diameter.

Pressure Distribution Detailed Design

Starting points for the detailed design of a pressure distribution system include determining conditions it is designed for and the requirements of the system the effluent is applied on. These factors are determined during the site evaluation and early stages of the overall design.

During the site evaluation two conditions specific to the pressure distribution design must be determined;

1 the elevation difference from the bottom of the dose tank to the distribution laterals must be determined to know the distance the pump must "lift" the effluent

2 the distance the supply piping must run from the dose tank to the start of the laterals supply effluent to the infiltration surface.

Other factors determined during the site evaluation that are required for the design of the pressure distribution system include:

1. The peak and average flow per day the system will be design to treat.
2. The soil characteristics that will determine the type and size of the required soil based treatment system and any specific characteristics such as coarse textured sandy soil that have specific requirements for pressure distribution and orifice spacing. See Article 8.1.1.8 for specifics on these requirements.
3. Slopes at the site of the soil based treatment system may require each of the effluent pressure distribution laterals to be at differing elevations. This situation requires special consideration to ensure equal pressure head between laterals and equal distribution over the entire treatment field; see pg. **269** pressure distribution on sloping ground.

Once the effluent lift elevation, supply piping layout and length, the length and number of laterals needed, and orifice size, spacing and orifice head pressure are determined the design of the pressure distribution lateral system can be completed using the Pressure Distribution Work Sheet on pg. Error! Bookmark not defined..

Pressure Distribution Lateral System Sizing

Selecting the correct size of distribution laterals is accomplished by referencing Table A.1.A, Pressure Distribution Lateral Pipe System Tables, pg. **195.**

The required distribution lateral pipe size is dependant on:

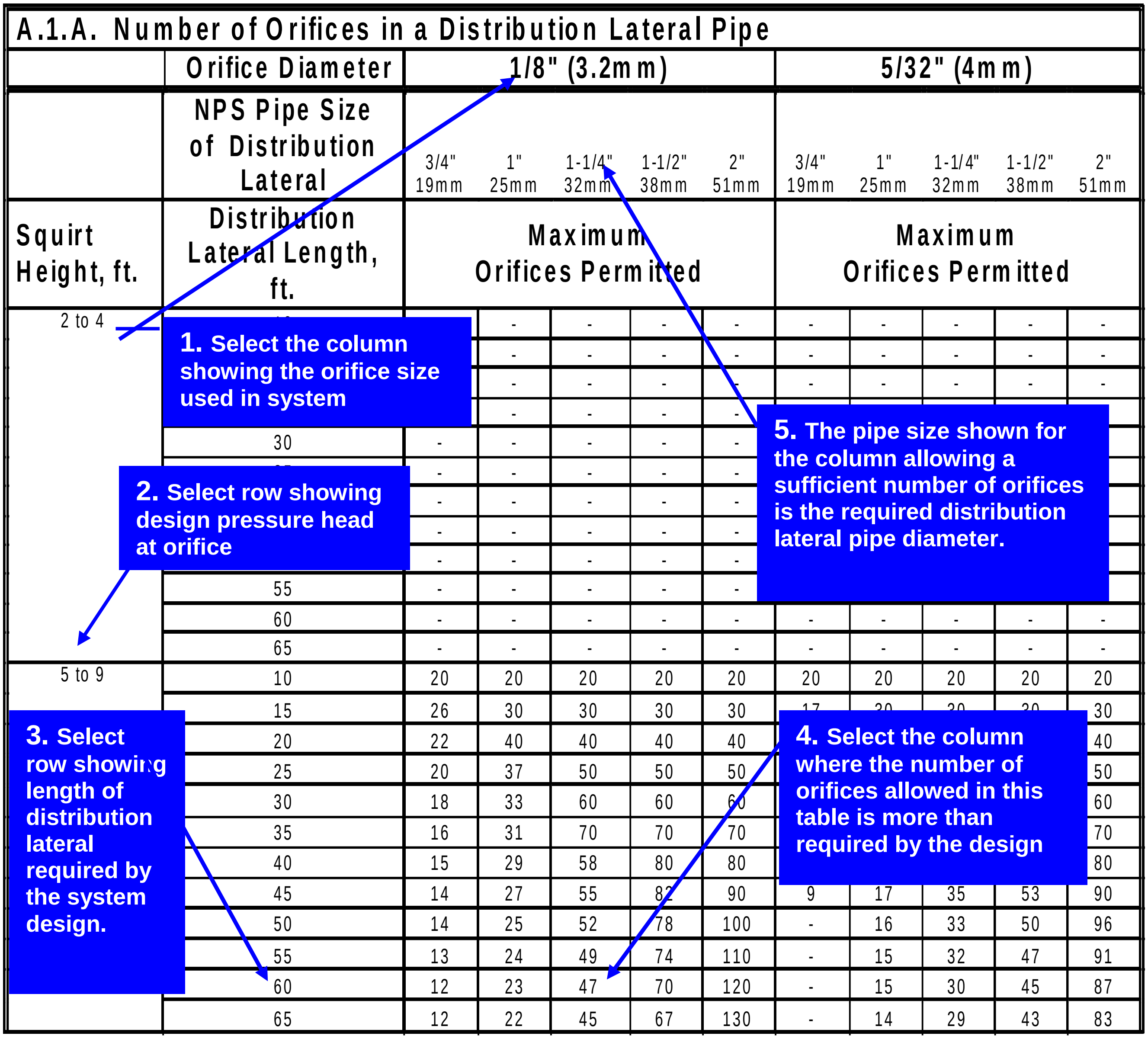
- Orifice diameter.
- Head pressure at the orifice (squirt height).
- Length of distribution lateral from the supply header to the last orifice in the lateral.
- Number of orifices in the lateral which is a result of the orifice spacing selected.

This information must be known prior to determining the required diameter of the effluent distribution lateral.

Below is an extract of Table A.1.A that is used to determine the required pressure distribution lateral diameter. The steps 1 to 5, which can be applied in all situations, apply the following distribution lateral design conditions as an example:

> **1/8 inch orifices** are chosen for the design. A **squirt height of 5 ft** is required by the standard for 1/8 in. orifices. The **distribution lateral is 65 ft. long** to extend the length of the treatment mound sandlayer using a center fed pressure distribution lateral layout. An orifice spacing of 2.5 feet is required to achieve one orifice for every 5.5 sq ft. of sand layer in the treatment mound as required by the standard. This results in **26 orifices in the lateral** (65 ft. long divided by 2.5 foot orifice spacing.)
>
> These criteria result in 1.25 inch pipe being required. Note the 1 inch distribution lateral pipe is too small for the conditions set in this example as it allows only 22 orifices at a 65 foot lateral length.

Figure: Distribution Lateral Pipe Sizing, Use of Table A.1.A.



Orifice Discharge Flow Rates

Orifice discharge volume rates (GPM or Liters per second) are determined using Table A.1.B. on page **199**. The extract from Table A.1.B below shows an example of determining the discharge rate from a 5/32 inch orifice with a design pressure head of 5 feet at the orifice.

Figure: Table A.1.B.1 – Orifice Discharge Rate Example of Use

A.1.B.1. Orifice Discharge Rate in Imperial Gallons per Minute

Pressure Head, ft.	Orifice Diameter, Inches								
	1/8	5/32	3/16	7/32	1/4	9/32	5/16	11/32	3/8
2.0	-	-	-	0.66	0.87	1.10	1.36	1.64	1.95
2.5	-	-	-	0.74	0.97	[illegible]	[illegible]	[illegible]	[illegible]
3.0	-	-	-	0.81	1.06	[illegible]	[illegible]	[illegible]	[illegible]
3.5	-	-	-	0.88	1.15	[illegible]	[illegible]	[illegible]	[illegible]
4.0	-	-	-	0.94	1.23	[illegible]	[illegible]	[illegible]	[illegible]
4.5	-	-	-	1.00	1.30	[illegible]	[illegible]	[illegible]	[illegible]
5.0	0.34	0.54	0.77	1.05	1.37	1.74	2.14	2.59	3.09
5.5	0.36	0.56	0.81	1.10	1.44	1.82	2.25	2.72	3.24
6.0	0.38	0.59	0.85	1.15	1.50	1.90	2.35	2.84	3.38
6.5	0.39	0.61	0.88	1.20	1.56	1.98	2.45	2.96	3.52
7.0	0.41	0.63	0.91	1.24	1.62	2.06	2.54	3.07	3.65
7.5	0.42	0.66	0.95	1.29	1.68	2.13	2.63	3.18	3.78
8.0	0.43	0.68	0.98	1.33	1.74	2.20	2.71	3.28	3.91
8.5	0.45	0.70	1.01	1.37	1.79	2.26	2.80	3.38	4.03
9.0	0.46	0.72	1.04	1.41	1.84	2.33	2.88	3.48	4.14
9.5	0.47	0.74	1.06	1.45	1.89	2.39	2.96	3.58	4.26
10.0	0.49	0.76	1.09	1.49	1.94	2.46	3.03	3.67	4.37
10.5	0.50	0.78	1.12	1.52	1.99	2.52	3.11	3.76	4.48
11.0	0.51	0.80	1.15	1.56	2.04	2.58	3.18	3.85	4.58
11.5	0.52	0.81	1.17	1.59	2.08	2.63	3.25	3.94	4.68
12.0	0.53	0.83	1.20	1.63	2.13	2.69	3.32	4.02	4.78

Discharge rate from a 5/32" orifice at a 7 ft. pressure head

Table A.1.B below has been extended to show the discharge rates at up to a 50 foot pressure head. Knowing these discharge rates at high pressure heads is helpful to determine the discharge rate of an orifice drilled in the supply piping in the dose tank to allow draining of the supply line to prevent freezing (the drain back hole).

Figure : Orifice Discharge Flow Rates to 50 foot Pressure Head

A.1.B. Orifice Discharge Rate in *Imperial Gallons per Minute (EXTENDED)*

Pressure Head, Feet	Orifice Diameter Inches								
	1/8	5/32	3/16	7/32	1/4	9/32	5/16	11/32	3/8
2.0	-	-	-	0.66	0.87	1.10	1.36	1.64	1.95
2.5	-	-	-	0.74	0.97	1.23	1.52	1.83	2.18
3.0	-	-	-	0.81	1.06	1.35	1.66	2.01	2.39
3.5	-	-	-	0.88	1.15	1.45	1.79	2.17	2.58
4.0	-	-	-	0.94	1.23	1.55	1.92	2.32	2.76
4.5	-	-	-	1.00	1.30	1.65	2.03	2.46	2.93
5.0	0.34	0.54	0.77	1.05	1.37	1.74	2.14	2.59	3.09
5.5	0.36	0.56	0.81	1.10	1.44	1.82	2.25	2.72	3.24
6.0	0.38	0.59	0.85	1.15	1.50	1.90	2.35	2.84	3.38
6.5	0.39	0.61	0.88	1.20	1.56	1.98	2.45	2.96	3.52
7.0	0.41	0.63	0.91	1.24	1.62	2.06	2.54	3.07	3.65
7.5	0.42	0.66	0.95	1.29	1.68	2.13	2.63	3.18	3.78
8.0	0.43	0.68	0.98	1.33	1.74	2.20	2.71	3.28	3.91
8.5	0.45	0.70	1.01	1.37	1.79	2.26	2.80	3.38	4.03
9.0	0.46	0.72	1.04	1.41	1.84	2.33	2.88	3.48	4.14
9.5	0.47	0.74	1.06	1.45	1.89	2.39	2.96	3.58	4.26
10.0	0.49	0.76	1.09	1.49	1.94	2.46	3.03	3.67	4.37
10.5	0.50	0.78	1.12	1.52	1.99	2.52	3.11	3.76	4.48
11.0	0.51	0.80	1.15	1.56	2.04	2.58	3.18	3.85	4.58
11.5	0.52	0.81	1.17	1.59	2.08	2.63	3.25	3.94	4.68
12.0	0.53	0.83	1.20	1.63	2.13	2.69	3.32	4.02	4.78
12.5	0.54	0.85	1.22	1.66	2.17	2.75	3.39	4.10	4.88
13	0.55	0.86	1.24	1.69	2.21	2.80	3.46	4.18	4.98
13.5	0.56	0.88	1.27	1.73	2.26	2.85	3.52	4.26	5.07
14	0.57	0.90	1.29	1.76	2.30	2.91	3.59	4.34	5.17
14.5	0.58	0.91	1.31	1.79	2.34	2.96	3.65	4.42	5.26
15	0.59	0.93	1.34	1.82	2.38	3.01	3.71	4.49	5.35
16	0.61	0.96	1.38	1.88	2.46	3.11	3.84	4.64	5.52
18	0.65	1.02	1.46	1.99	2.60	3.30	4.07	4.92	5.86
20	0.69	1.07	1.54	2.10	2.75	3.47	4.29	5.19	6.18
22	0.72	1.12	1.62	2.20	2.88	3.64	4.50	5.44	6.48
24	0.75	1.17	1.69	2.30	3.01	3.81	4.70	5.69	6.77
26	0.78	1.22	1.76	2.40	3.13	3.96	4.89	5.92	7.04
28	0.81	1.27	1.83	2.49	3.25	4.11	5.08	6.14	7.31
30	0.84	1.31	1.89	2.57	3.36	4.26	5.25	6.36	7.56
32	0.87	1.36	1.95	2.66	3.47	4.39	5.43	6.56	7.81
34	0.89	1.40	2.01	2.74	3.58	4.53	5.59	6.77	8.05
36	0.92	1.44	2.07	2.82	3.68	4.66	5.75	6.96	8.29
38	0.95	1.48	2.13	2.90	3.78	4.79	5.91	7.15	8.51
40	0.97	1.52	2.18	2.97	3.88	4.91	6.07	7.34	8.73
42	0.99	1.55	2.24	3.05	3.98	5.03	6.22	7.52	8.95
44	1.02	1.59	2.29	3.12	4.07	5.15	6.36	7.70	9.16
46	1.04	1.63	2.34	3.19	4.16	5.27	6.50	7.87	9.37
48	1.06	1.66	2.39	3.26	4.25	5.38	6.64	8.04	9.57
50	1.09	1.70	2.44	3.32	4.34	5.49	6.78	8.21	9.77

Discharge rates from orifices are based on
q = 16.37Cd2h1/2
where
q = Imperial gallons per minute flow
C = coefficient of discharge (0.60)
d = orifice diameter in inches
h = pressure head in feet

Use A Minimum 5.0 ft. (1500 mm) Pressure Head for orifices 3/16" or less in diameter
Use A Minimum 2.0 ft. (600 mm) Pressure Head for orifices larger than 3/16"

Note: Most pump manufacturers rate pump capacities in US gallons. Selecting the pump will require converting the pump rating in US gallons to Imperial gallons or converting the results from this table to U.S Gallons.

U.S. Gallons = Imperial Gallons x 1.2

Imperial Gallons = US Gallons x 0.83

Figure: Pressure Effluent Distribution Design Worksheets

Pressure Effluent Distribution Design Worksheet

System owner: ____________ **Location:** ____________

Designer: ____________

Developed by Alberta Municipal Affairs and the Alberta Onsite Wastewater Management Association.

The completed system must comply with Alberta Private Sewage Standard of Practice 2009.

This worksheet does NOT consider all of the mandatory requirements of the Standard.
It is intended for use by persons trained in private sewage system design.

Page numbers refer to the Private Sewage Systems Standard of Practice 2009.

Step 1) Select the pressure head at the orifices:

Minimum pressure at the orifice:
3/16" or less orifice = 5 ft. Minimum - 2.6.2.5 (1), (p 48)
larger than 3/16" orifice = 2 ft. Minimum - 2.6.2.5 (1) (p 48)

Design pressure at lateral orifices [ ] **ft.** **P1**

Note: *worksheet will not provide an adequate design if laterals are at different elevations. Differing elevations will result in a different pressure head and volume of discharge at the orifices in each lateral. Additional considerations must be made f*

Step 2) Select the size of orifice in the laterals:

Minimum size: 2.6.1.5. (1)(e) p. 46 1/8"

Orifice Diameter selected [ ] **in.** **P2**

Note: larger orifices are less likely to plug.

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

Length of Distribution Lateral From system design drawings		**Orifice Spacing**			**Total number of orifices per lateral**	
[ ] ft.	÷	[ ]	ft.	=	[ ]	**P3a**

Select a spacing of orifices to attain even distribution over the treatment area:
Maximum spacings are determined for :
* 5 ft. Primary treated effluent: 2.6.1.5 (e) (pp. 46 - 47)
* 3 ft. Secondary treated effluent: 8.1.1.8 & 2.6.2.2 (c) (pp 98 & 47 - 48)
* 3 ft. On sandy textured soils: 8.1.1.8 (p. 98)

[ ]	X	[ ]	=	[ ]	**P3b**
From P3a		Number of Laterals		Total Number of Orifices in All Laterals	

If laterals are of differing lengths, calculate each separately and add the number of orifices together.

Step 4) Determine the minumum pipe size of the distribution laterals:

Enter the system design information into the 3 boxes below. If distribution laterals are of differing lengths, each lateral must be considered separately.

Orifice Diameter		**Length of Distribution Lateral**		**Total Orifices Each Lateral**
	in.		ft.	
From P2		From System Design Drawings		From P3a

Use Table A.1.A. (pp 140 - 143) when applying the information entered in this step to determine the minimum size of the distribution lateral pipe.

Pressure head at orifices to apply table A.1.A ______ ft.

Size of Distribution Lateral Pipe from Table A.1.A ______ in. **P4**

Step 5) Determine the total flow from all orifices:

Total Number of Orifices in all laterals		**Gal/min for each Orifice at pressure head used in design**			**Total flow from orifices in all laterals**		
	X		Imp. gal /min.	=		Imp. gal /min.	P5
From P3b		From Table A.1.B. (pp 144 & 145)					

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

Use Tables A.1.C.1 to A.1.C.4 (pp 146 - 149) to aid in decision. A larger pipe will reduce pressure loss.

Type of pipe used for effluent delivery line	Pipe size selected		
		inch - NPS	P6

Choose a friction loss from Tables A.1.C.1 to A.1.C.4 in between the bolded lines to ensure a flow velocity between 2 to 5 feet per second. The pipe size selcted will affect the amount of friction loss the pump must overcome to deliver effluent.

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

Use page 5 of this worksheet to determine total equivalent length resulting from fittings

Equivalent Length of All Fittings ______ ft. **P7**

For Pressure Loss

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

Length of Piping (ft)		Equivalent Length of Fittings (ft)		Length of Pipe for Friction Loss (ft)	
	+		=		P8
Length from pump to farthest end of distribution header supplying laterals.		Equivalent fitting length from **P7.**		Used to determine total pressure head loss due to friction loss in piping.	

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

Total Length of Pipe for Friction		Friction Loss per 100 feet of pipe			Delivery Piping Pressure Head		
	Divide by 100 ft.		ft.	=		ft.	P9
From P8							
Don't forget to divide the length by 100 feet to match the factors in the tables.		Use Tables A.1.C. On pp 146 - 150 using flow volume from **P5.**					

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

Delivery piping pressure loss		ft.	From **P9**
+			
Lift distance of effluent from effluent level in tank to orifices		ft.	Measure from lowest effluent elevation in dose tank
+			
Design pressure at orifices		ft.	From **P1**
+			**Explain Pressure Loss Allowed if Applied**
Head loss allowed if an inline filter is used in pressure piping		ft.	
+			
Add 1 ft to allow for pressure loss along the distribution lateral	1	ft.	
Total minimum pressure head pump must provide at Imp. gal/min required to supply orifices		ft.	**P10**

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:

Size of Drain Back Orifice		Determine flow from Drain Back Orifice			Flow from orifices in all laterals			Total Imp. Gallons per Minute required from pump		
	in.		Imp. gal	+		Imp. gal /min	=		Imp. gal	P11
		Use pressure head from P10 to find flow from Extended Table A.1.B.1			From P5					

Step 12) Details of the pump specifications required:

Required Flow Rate (Imp. gal/min)		Required Pressure Head (ft)
	@	
From P11		From P10

Select the appropriate pump by reviewing the pump curve of available pumps. Select a pump that exceeds the requirments set out in this step by approximately 10% considering both pressure head and volume.

Imp. gal (P11) multiplied by 1.2 = U.S. gallons

Required Flow Rate (US gal/min)

Step 13) Consider the pumping demands of the system. If they are considered excessive, redesign the pressure distribution system and recalculate the pump demands.

Pressure Distribution Worksheet supplement; Determine Equivalent Length of Pipe allowed in in system design to allow for friction loss through Fittings.

	Number of Fittings		Friction loss per fitting Table A.1.C.5 or 6 (p. 150)		Total
90° Elbows		X		=	
					+
45°Elbows		X		=	
					+
Gate and Ball Valves		X		=	
					+
Tee-on-Branch (TOB)		X		=	
					+
Tee-on-Runs (TOR)		X		=	
					+
Iron pipe Adaptors (MIP or FIP)		X		=	
					=

Total Equivalent Length of pipe to allow for fittings in piping system **(Enter this total, Box P7)** [ ]

Pressure Effluent Distribution Systems; Additional Design Considerations

Effluent Volume per Dosing Cycle and Required Flow Rate

The maximum effluent volume per dosing cycle is set out in the Standard of Practice in sections that apply to the specific treatment system type.

- For treatment mounds it is a maximum 20% of the daily volume per dosing cycle, (Article 8.4.1.10)
- For treatment fields the number of doses per day must be maximized by the design, (Article 2.6.1.5.(f) intent statement)
- For sand filters it is a maximum 20% of the field capacity of the sand media per dosing cycle when using demand dosing, (Article 5.3.1.5) this results in a very small individual dose. Ten doses or more per day based on expected flow will result.

In all cases smaller doses of effluent with equal resting periods between doses is preferable.

The capacity of the effluent tank or dosing chamber needs to be selected so it has the ability to deliver the required volume per dose to the downstream soil based treatment system. Determining the needs of the soil based treatment and design requirements of the pressure effluent distribution system is what determines the required dose tank capacity. The tank must have sufficient capacity to store the volume of effluent needed per dose to satisfy the design of the soil based treatment system. The volume per dose required for a system can vary widely depending on the design requirements created by the flow and the soil based system.

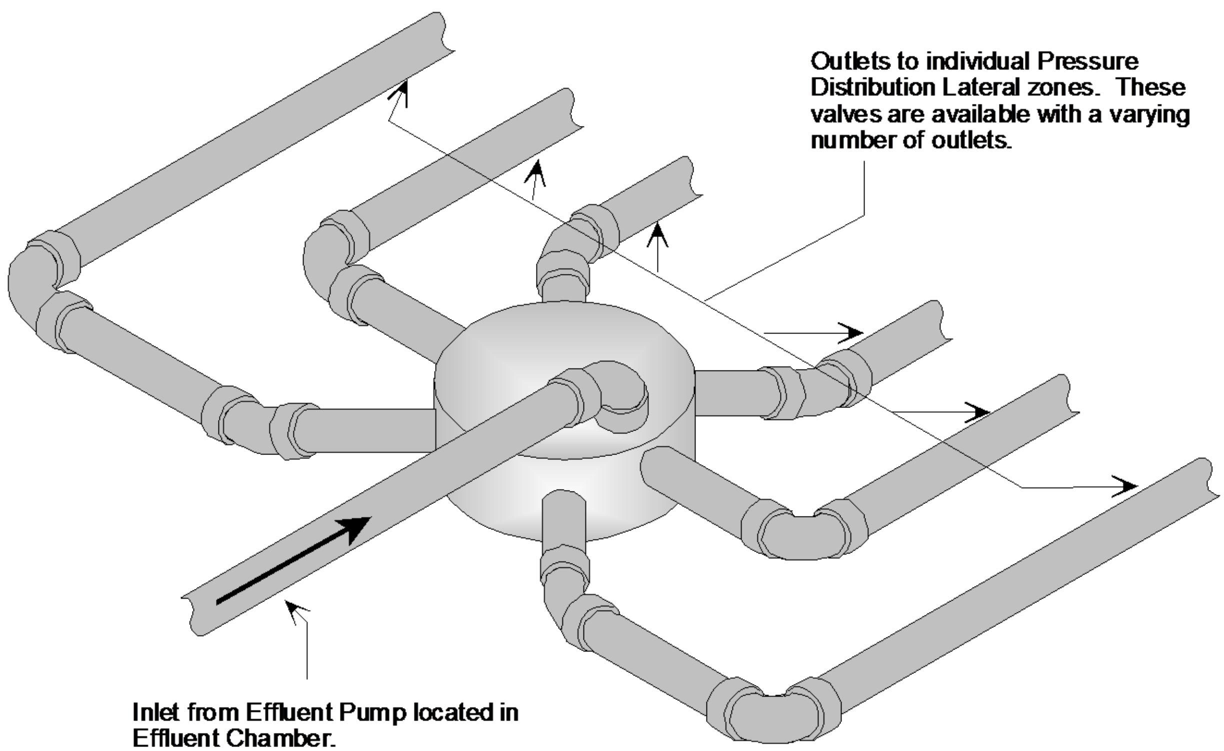
High Flow Rate Considerations

In some larger systems, residential or commercial, the large pressure distribution system needed to cover a large infiltration surface may result in a high volume pump and large diameter piping being needed to meet the demands of the system. More cost effective design and more effective distribution of the effluent can be achieved by splitting the pressure distribution system into zones with the use of automatic sequencing valves. These sequencing valves change the discharge from on zone to the next with each dose event. They can serve 2, 3, 4 or more zones. The following 2 figures show the automatic sequencing zone valve and piping layout.

Figure: Pressure Distribution Sequencing Zone Valve

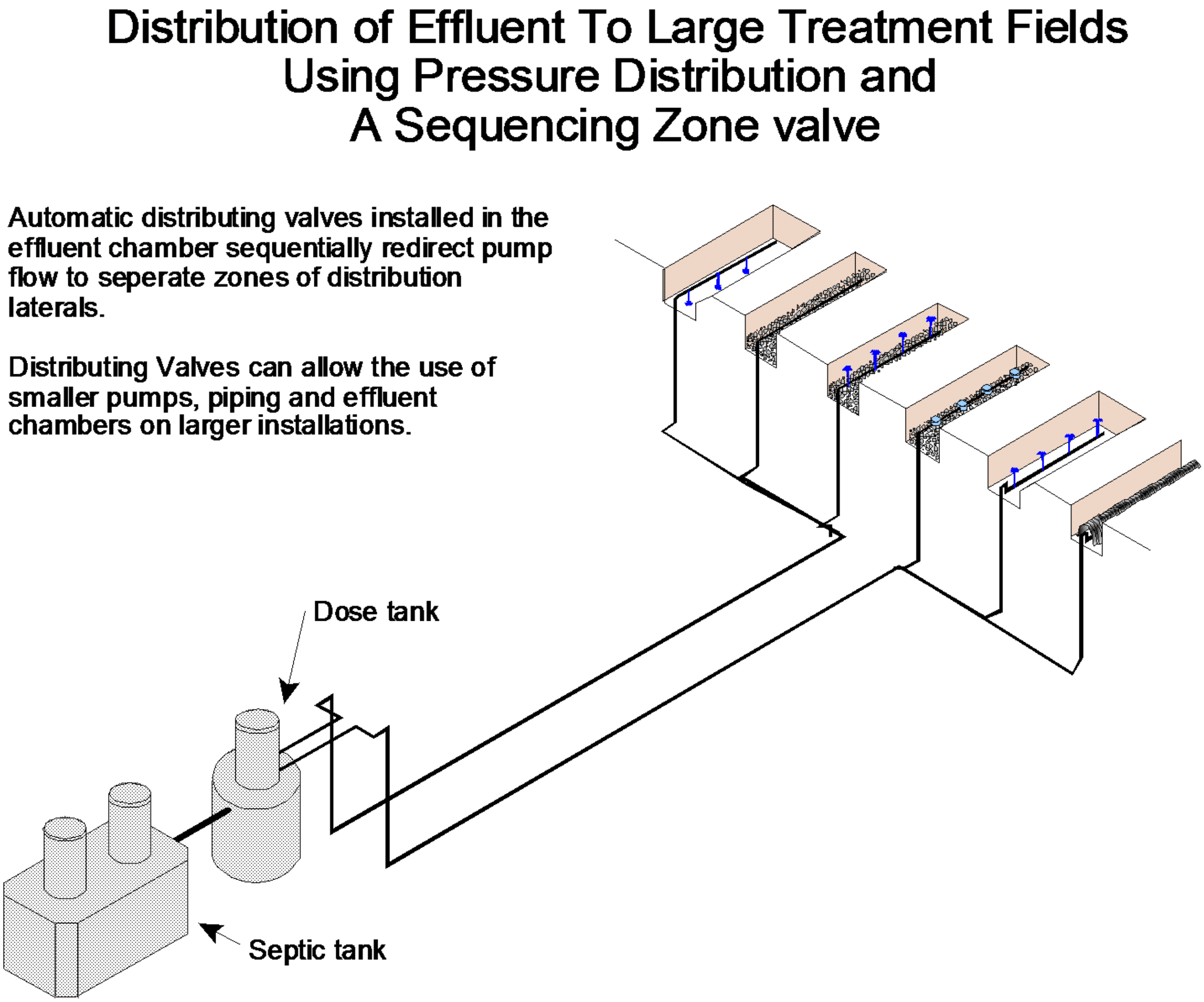
Pressure Actuated Automatic Sequencing Valve for Zoning of an Effluent Pressure Distribution System

(Other designs may also be acceptable)



These distributing valves sequentially redirect pump flow to multiple distribution laterals zones which offers the advantages of smaller pumps and smaller supply piping which reduces cost and the amount of effluent required to fill supply piping and the drainback at the end of the dose.

Figure: Zoned Pressure Effluent Distribution Field

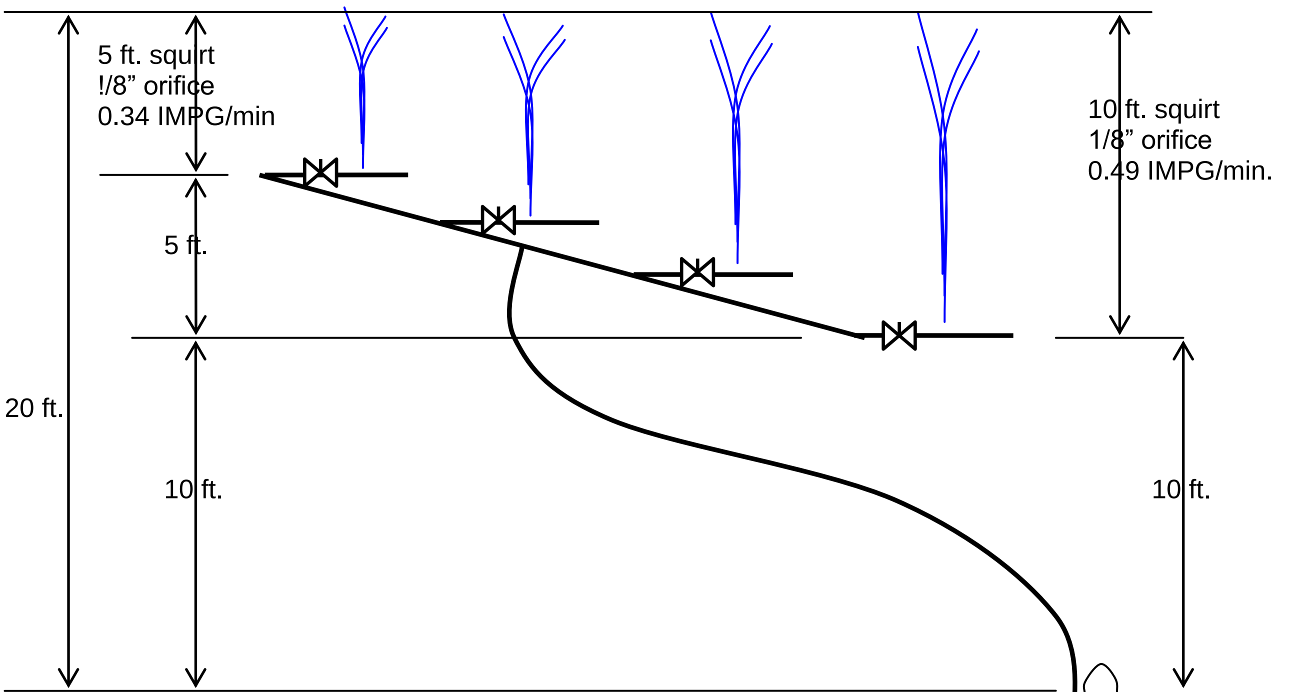


Pressure Distribution Systems on Sloping Ground

When using pressure distribution laterals, or a simple pressure distribution header feeding gravity weeping laterals, to supply effluent to the trenches in a treatment field on sloping ground additional considerations are required in the calculation of the system. When each lateral is at a different elevation, the pressure head in each lateral will be different in an amount equal to the change in elevation between laterals. **Laterals at different elevations can cause a significant difference in the volume of effluent discharged from an orifice in one lateral to an orifice in another lateral at a different elevation. This results in uneven distribution of effluent in the system.**

Figure: Pressure Distribution Lateral on Slope – Squirt Height Variation

Pressure Distribution Laterals on a Slope – **squirt height varies** – make provisions to correct squirt height differences and the volume discharged per dose to each lateral.



The squirt height in the upper lateral is 5 feet while in the lowest lateral it is 10 feet. Additionally the lowest lateral will be squirting a 5 feet head before there is any pressure at the upper lateral. The same difference will occur when the pump shuts off. Adjusting the balancing valves will equalize the pressure in each lateral once the entire system is pressurized but will not address the differences in squirt start and stop in the laterals,

For the example shown in the graphic above; assume one lateral is 5 feet lower than another and 1/8" orifices are used in each lateral. The higher orifice at 5 ft pressure head would discharge 0.34 gals/min and the lower orifice, at 10 ft pressure head (5ft. Squirt + 5ft. the difference in elevation), discharges 0.49 gals/min. This is a 30% difference in effluent discharge rate. If this difference is not considered and addressed in the design, the lower laterals will be overloaded. Varying the orifice size or including flow control devices, such as balancing valves, at each lateral can be used to address the elevation differences between orifices. The time difference between the starting and ending of the effluent discharge in each lateral also must be considered. When the system starts pumping the lowest lateral will begin discharging before the upper laterals and the lower lateral will continue to discharge after the pump is shut off as the laterals drain from highest to lowest again causing more effluent to be delivered to the lower laterals. The design on slopes requires complex considerations.

A source for methods of calculating designs for these types of systems can be found with some manufactures of on-site sewage treatment equipment and systems.

A squirt test will quickly test the design and should always be performed on any pressure distribution or pressure distribution lateral system when installed.

Orifice Orientation and Orifice Shields

There are advantages and disadvantages to locating the orifice in the top or bottom of the pipe. Holes located in the top of the pipe are less prone to plugging as sludge and bacterial growth in the pipe tends to accumulate on the bottom of the pipe. Holes in the bottom of the pipe may clog quicker because of this. Holes in the top of the distribution lateral allows the air to escape from the pipe faster so there is less delay in the time between discharge from the first orifice to the last orifice. Holes at the bottom of the pipe provide the advantage of allowing the pipe to drain completely. In systems that require, or it is chosen to have, the orifices point up it is acceptable to have a few orifices pointing down to drain the pipe completely between doses to prevent freezing.

When the distribution laterals are installed in chambers, the orifices must be in the top of the distribution lateral and the upward pointing orifice do not need orifice shields. Some orifice may point down to provide drainage and they must be provided with orifice shields.

When the distribution laterals are installed in gravel, the orifices may be drilled into the top or bottom of the laterals and must be provided with a device (an orifice shield) to prevent the gravel from covering and blocking the orifice.

See Article 2.6.2.2 for orifice orientation and required orifice shields

Septic Tanks

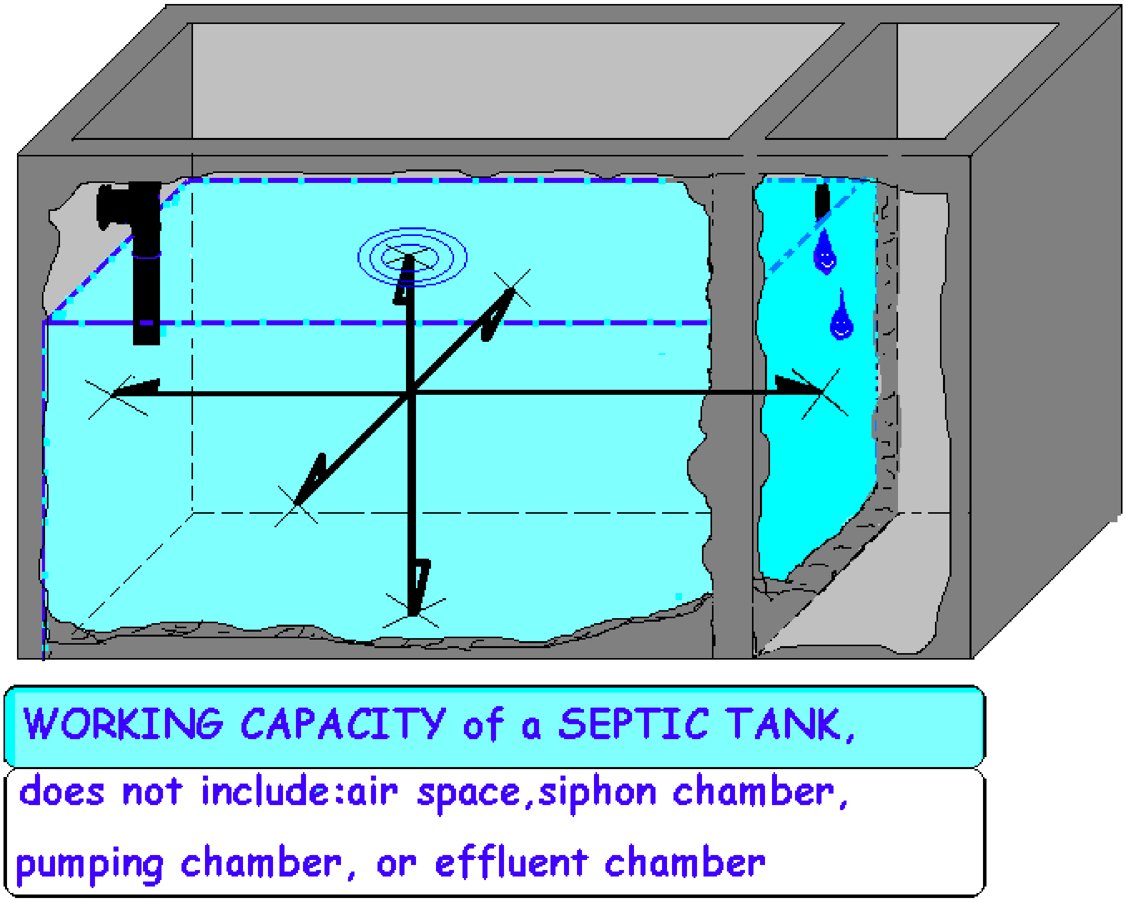
Septic Tanks – General

Septic tanks must be certified to the CAN/CSA-B66-M90 Standard by a recognized testing and Certification Body. Septic tanks sometimes have one or more septic chamber. Tanks used in Alberta often include an integral effluent chamber for dosing of the effluent. The volume of the effluent chamber does not make up part of the working capacity of the septic tank. When the tank does not have an integral dosing chamber, a separate tank is used for dosing of effluent. All systems must have an effluent tank so the effluent can be sent to the soil based treatment system in dosed volumes either by pump or siphon. Trickle discharge to the soil based treatment system in not allowed. For various tank configurations See pg. **355** and pg. **356**.

Working Capacity of the Tank

The "working capacity" of the septic tank is the liquid volume of sewage that is retained in the septic chamber(s) when the tank is in normal use. It does not include the air space or effluent chamber. When a reference is made to the working capacity of a septic tank in this standard it is important to know this definition of the working capacity when selecting the appropriate septic tank. Also see the definition of working capacity on pg. **24**.

Recognize that the model number used by septic tank manufactures does not necessarily reflect the working capacity of the septic tank. The model number used often reflects the total volume of the tank including the effluent chamber.



Purpose of the Septic Tank

The septic tank is used to reduce the strength of the raw wastewater discharged from the development. The clarified effluent is then discharged to the soil based treatment system or other downstream component for additional treatment. The effluent discharged from a septic tank is far from safe; in fact the effluent may have more pathogens than the raw wastewater. The septic chamber is a water-tight storage container into which raw sewage is discharged and retained for 24 hours or more. While the sewage is retained, solids in the sewage to settle out (sludge) or float (scum) clarifying the sewage. The clarified liquid portion of the sewage flows into the effluent chamber or a separate effluent dosing tank. The sludge and scum retained in the tank and must be pumped out periodically. As the sludge is stored in the tank it is digested by micro-organisms which convert some of the solids into liquids that then move through with the effluent. During this process the microorganisms also produce gases.

How the Septic Chamber Works

Wastewater Clarification process

The septic chamber largely accomplishes its purpose through providing retention time of the sewage in a zone of little movement of the wastewater. In this quiet slow flow area, solids settle and oil, greases and soap scum floats to clarify the wastewater. For this to work effectively inlet and outlet fittings designed for the tank must be in place.

Septic Tank Inlet and Outlet Fittings

The inlet fitting directs the flow of wastewater downward to minimize the chance it will flow directly across the surface of the wastewater in the tank and over to the outlet. This fitting or attached pipe extends to a depth of not less than 75mm (3 inch) and not more than 125mm (5 inch) below the liquid level of the septic chamber. This may be a TY fitting or an elbow.

The outlet fitting must extend below the liquid level in the working chamber not less than 25% and not more than 40% of the liquid depth. This is required so that the effluent that exits the septic chamber is drawn for the clear zone which is below the scum layer and above the sludge layer.

It is critical that these inlet and outlet devices or fittings are installed and remain in place. It is the installer's responsibility to ensure these are installed. In many cases they are provided by the manufactured but must be installed by the installer.

Sludge Digestion

Anaerobic bacteria digest the sludge in the tank. These anaerobes are present in body wastes. They thrive in an environment which is warm, wet, dark and devoid of fresh air. Because the required anaerobes are present in our body waste digestion is well established in a tank receiving normal household sewage providing temperatures are not extreme and the proper environmental conditions exist. Dead chickens and other supplements do not need to be added to the tank to help establish the bacterial breakdown of solids in the tank. Tanks that must be put into use in cold weather should be partially or totally filled with hot water to help prevent freezing of the tank and downstream soil based system at start up. Once in operation the flow of warm water from the house on a regular basis should prevent freezing of the system.

Septic Tank Location Considerations

The prime considerations in locating a septic tank are:

a) Protection of the potable water supply. The septic tank is considered a water-tight component of the sewage system, however piping connections, access opening extensions, etc. could leak after installation due to settling of the tank or other reasons. Because of this possibility a separation distances is required from water supplies (wells and cisterns) and other features as set out in Article 4.2.2.1

b) The depth of bury over the septic tank. The maximum depth of bury over a septic tank is specified by the tank manufacturer. Locating the septic tank a remote distance from the house may avoid excessive depth of bury

c) Access for cleaning and servicing, see Article 4.2.1.2. The general planning should be to locate the septic tank where it is readily accessible for cleaning. Keep in mind that the septic tank must be cleaned periodically and must be accessible to a vacuum truck. Do not place it where it may be covered by a deck that may be built in the future.

d) Manhole access lids must be brought above ground surface to allow easy access for maintenance. See Article 4.2.2.3. Make sure the location of the risers will be acceptable to the owner and not susceptible to damage.

e) The tank cannot be buried to a depth that exceeds the lifting limits of a vacuum truck. The tank must be located where the vacuum truck can get close enough and not be so deep as to exceed the lifting limits of a vacuum truck. The available vacuum lift changes with the elevation above sea level. At Calgary's elevation, with a 100 feet of hose attached, the limit is reached if the truck is parked about one story above the top of the tank. The vertical limit is about 27 feet in ideal conditions with very short horizontal distances from truck to tank.

Determining the Required Working Capacity of the Septic Tank

The minimum "working capacity" of a septic tank is based on the peak daily flow from the development and the rate of sludge and scum accumulation.

Article 4.2.1.1 sets out the requirements for determining the working capacity of the septic tank. The tank must have the capacity to store 3 years of sludge and scum accumulation in addition to providing the capacity to store the peak daily volume of wastewater the development is expected to produce.

For single family dwellings and duplexes Table 4.2.2.2 has been included in the standard setting out the required minimum working capacity of the septic tank. If the assessment of wastewater flow requires additional capacity for wastewater flow that volume must be added to the capacity set out in this table.

Note: *Manufacturer's model number designation of their septic tanks do not necessarily indicate the "Working Capacity" of their products, therefore, caution must be exercised when selecting a septic tank to meet the working capacity required by the design.*

For other than single family dwellings or duplexes Article 4.2.1.1 must be used. Table A.6.A provides sludge accumulation rates for many different types of development which is also needed to determine the required working capacity of the septic tank in addition to the daily peak wastewater flow.

To accommodate waste from garbage grinders, the amount of sludge that must be stored will increase. The septic tank capacity must be increased by 50% of the sludge storage capacity required. This is set out in Article 4.2.1.1 sentence (2). This extra capacity is for the added sludge produced and does not address the higher wastewater strength the garbage grinder will cause.

Types of Septic Tanks

Numerous prefabricated septic tanks are available in various types and sizes suitable for domestic use:

(a) Single chamber trickle tanks, **Note:** Single chamber trickle tanks may not be used alone, but may be used in conjunction with other septic tanks. The system must be able to dose effluent to the downstream treatment components.
(b) Double chamber, pump (a septic chamber and an effluent chamber that accommodates a pump),
(c) Double chamber, syphon (a septic chamber and an effluent chamber that contains a syphon)

Tank shapes are often a rectangular box; however, they may be a horizontal or vertical cylinder, or a sphere. They are manufactured from durable materials such as concrete, fiberglass, polyethylene and steel. Tanks must be certified as meeting the CAN/CSA B66 standard.

The types and styles of septic tanks are shown in the graphics on pg. **355** and pg. **356**.

Effluent Chambers and Tanks: Section 6.1

Effluent tanks must be certified to the CAN/CSA-B66-M2005 Standard by a recognized testing agency. See Article 6.1.3.1. The storage capacity of the effluent dose chamber or tank is determined by the requirements of the downstream soil based treatment system and requirements of the overall design of the system. Where demand dosing is used the tank only requires the capacity to store the design dose volume plus and additional amount allowed for emergency storage and the amount of effluent remaining below the installed pump. In more advanced and larger treatment systems where timed dosing is used, the effluent chamber needs to be of a size capable of storing the equivalent of at least the expected peak volume of sewage per day. See Article 2.2.2.5 for flow equalization capacity required.

Excavations for Tanks and Trenches

Care must be taken in the excavation for the septic tank, sewage holding tank, or other tanks to ensure the excavation has a flat, undisturbed base to support the weight of the tank and it's contents. If the excavation is dug too deep and the tank is installed on un-compacted fill, the tank will settle excessively and damage the connecting piping as shown on pg. **358** , Fig. Tanks Excavation and Support. If a siphon type septic tank is used, the operation of the siphon may also be severely impaired because of the outlet piping is not properly graded if the tank settles.

Excavations for Tanks and Piping – Safety

Alberta Occupational Health and Safety, General Regulations Extract

The following is an extract from Alberta Occupational Health and Safety Act, General Safety Regulations regarding excavations and trenches. These procedures must be followed to assure safe excavation and trenching practices

Part 10, Trenching and Excavations

EXCAVATIONS, TRENCHES, TUNNELS AND UNDERGROUND SHAFTS

169 In this Part,

(a) excavation means any dug out area of ground other than a trench, tunnel, underground shaft or an open pit mine;
(b) "hard and compact", in relation to soil, refers to soil that can only be excavated by machinery and shows no sign of cracks after excavation;
(c) spoil pile means material excavated from an excavation, trench, tunnel or underground shaft;
(d) temporary protective structure means a structure or device designed to provide protection in an excavation, trench, tunnel or underground shaft from cave-ins, collapses or sliding or rolling materials, and includes shoring, bracing, piles, planking or cages;
(e) trench means an elongated dug out area of ground whose depth exceeds its width at the bottom. AR 448/83 s169

170 This Part does not apply where a professional engineer has certified that the ground formation is and will remain throughout the use of the excavation, trench, tunnel or underground shaft stable, free from cave-ins and sliding or rolling materials and other hazards associated with the workings and which may compromise the safety of workers. AR~. 448/83 s170

171 A worker shall not enter an excavation, trench, tunnel or underground shaft that does not comply with this Part. AR 448/83 s171

172(1) Where the freezing of soil by artificial means, grouting or any other process intended to stabilize the soil is

(a) designed by a professional engineer to control soil conditions, and
(b) performed in accordance with the professional engineers specifications,

Note: The freezing, grouting or other process is acceptable as an alternative to the shoring of an excavation, trench, tunnel or underground shaft or to the cutback of an excavation or trench.

(2) An employer shall ensure that the specifications required by this Part for a temporary protective structure that is to be used in an excavation, trench, tunnel or underground shaft

(a) show the size and specifications of the structure, including the type and grade of materials for its construction,
(b) show the loads for which the structure is designed, and
(c) are certified by the professional engineer.

(3) An employer shall ensure that temporary protective structures referred to in subsection (2) are installed, maintained and dismantled in accordance with the specifications of a professional engineer and remain in place as long as workers are in the excavation, trench, tunnel or underground shaft.

(4) Before the commencement of work on an excavation, trench, tunnel or underground shaft, an employer shall establish the location of all underground pipelines, cables and conduits in the area where the work is to be done and shall have their location adequately marked.

(5) Where an operation that includes the disturbance of soil within 600 millimetres of an existing pipeline or 300 millimetres of an existing cable or conduit is to be undertaken, the employer shall ensure that the pipeline, cable or conduit is exposed by hand digging by a competent worker before work is allowed to progress within those distances.

(6) Notwithstanding subsection (5), if a cable or conduit has been de-energized and grounded, other excavating methods may be used if the power authority operating the cable has previously been notified of the operation. AR 448/83 s172.

173(1) Before a worker begins working in an excavation more than 1.5 metres in depth and closer to the wall or bank than the depth of the excavation, his employer shall ensure that the worker will be protected from cave-ins or sliding materials by

(a) the cutting back of the walls of the excavation to reduce the height of the remaining vertical walls, if any, to not more than 1.5 metres,
(b) the installation of temporary protective structures, or
(c) a combination of cutting back of the walls and the installation of temporary protective structures

(2) Where the cutback method is used, the walls must be cut back

(a) in hard and compact soil, to not less than 30 degrees from the vertical, and
(b) in other soils to not less than 45 degrees from the vertical,

(3) An employer shall ensure that

(a) temporary protective structures in an excavation 3 metres or less in depth are constructed of materials of sufficient strength to prevent the walls of the excavation from caving in or otherwise moving into the excavation;
(b) temporary protective structures in an excavation over 3 metres in depth are designed and certified by a professional engineer;
(c) where a foundation may be affected by an excavation, the foundation is supported before proceeding with the work by a temporary protective structure designed, constructed and installed in accordance with the specifications of a professional engineer;
(d) loose materials are scaled or trimmed from the sides of an excavation where workers are or will be present;

(e) the spoil pile is piled so that
  (i) it is kept at a distance of at least 1 metre from the edge of the excavation, and
  (ii) the slope of the spoil pile adjacent to the excavation is at an angle of not less than 45 degrees from the vertical.

(4) When workers are carrying out an excavation in the vicinity of an overhead power line, their employer shall ensure that the work is carried out in a manner that will not reduce the original support provided for the power line poles.
AR 448/83 s173;348/84

Trenching

174(1) Before a worker enters a trench more than 1.5 metres in depth, his employer shall ensure that the worker is protected from cave-ins or sliding materials by
(a) the cutting back of the walls of the trench to reduce the height of the remaining vertical walls, if any, to not more than 1.5 metres,
(b) the installation of temporary protective structures, or
(c) combination of cutting back of the walls and the installation of temporary protective structures.

(2) Section 173(2), (3)(c) to (e) and (4) apply to a trench as they apply to an excavation.

(3) An employer shall ensure that
(a) shoring, stringers and bracing used in a trench between 1.5 and 6 metres deep are constructed of lumber and comply with Schedule 1 to this Part;
(b) temporary protective structures used in trenches are designed and certified by a professional engineer, except where shoring, stringers and bracing have been installed in accordance with clause (a);
(c) where a cage is used in a trench, it is designed by a professional engineer to provide adequate protection against sliding, caving or rolling materials;
(d) where machinery or a heavy object is placed or is working within a distance from a vertical line drawn from the near edge of the bottom of the trench equal to the depth of the trench, or if the trench is adjacent to or abutting a building or other structure, additional protection certified by a professional engineer is used in the trench to compensate for the stress or weight of the machinery, object, building or structure;
(e) where the vertical walls of the square-cut portion of a trench are 1.5 metres or more in height, the vertical walls are shored or braced or a cage used.

(4) Notwithstanding subsection (3)(a),
(a) screw jacks, hydraulic equipment or other apparatus may be used as shoring, stringers or bracing, if it is at least equivalent in strength and reliability to the shoring, stringers or bracing described in Schedule 1 to this Part, and
(b) for trenches less than 2.4 metres deep in hard and compact soil, stringers need not be used.

(5) When installing shoring, stringers or bracing, a worker shall use a ladder and work downward from the top of the trench, installing each brace in descending order.

(6) When removing shoring, stringers or bracing, a worker shall use a ladder and work upward from the bottom of the trench, removing each brace in ascending order.

(7) An employer shall ensure that a worker complies with subsections (5) and (6).

(8) Where the quality of the ground in which a trench has been dug has deteriorated during operations to the extent that it would be unsafe to use the method of removal required by subsection (6), the employer shall ensure that the shoring, stringers or bracing is removed by a method which does not require the worker to enter into any portion of the trench.

(9) Subsection (1) does not apply where a trench is constructed in solid rock throughout the entire trench.
AR 448/83 s174;348/84


EXCAVATIONS MORE THAN 1.5 METRES
IN DEPTH MUST BE PROPERLY
SHORED OR CUT BACK.

Figure: Excavation and Trenches

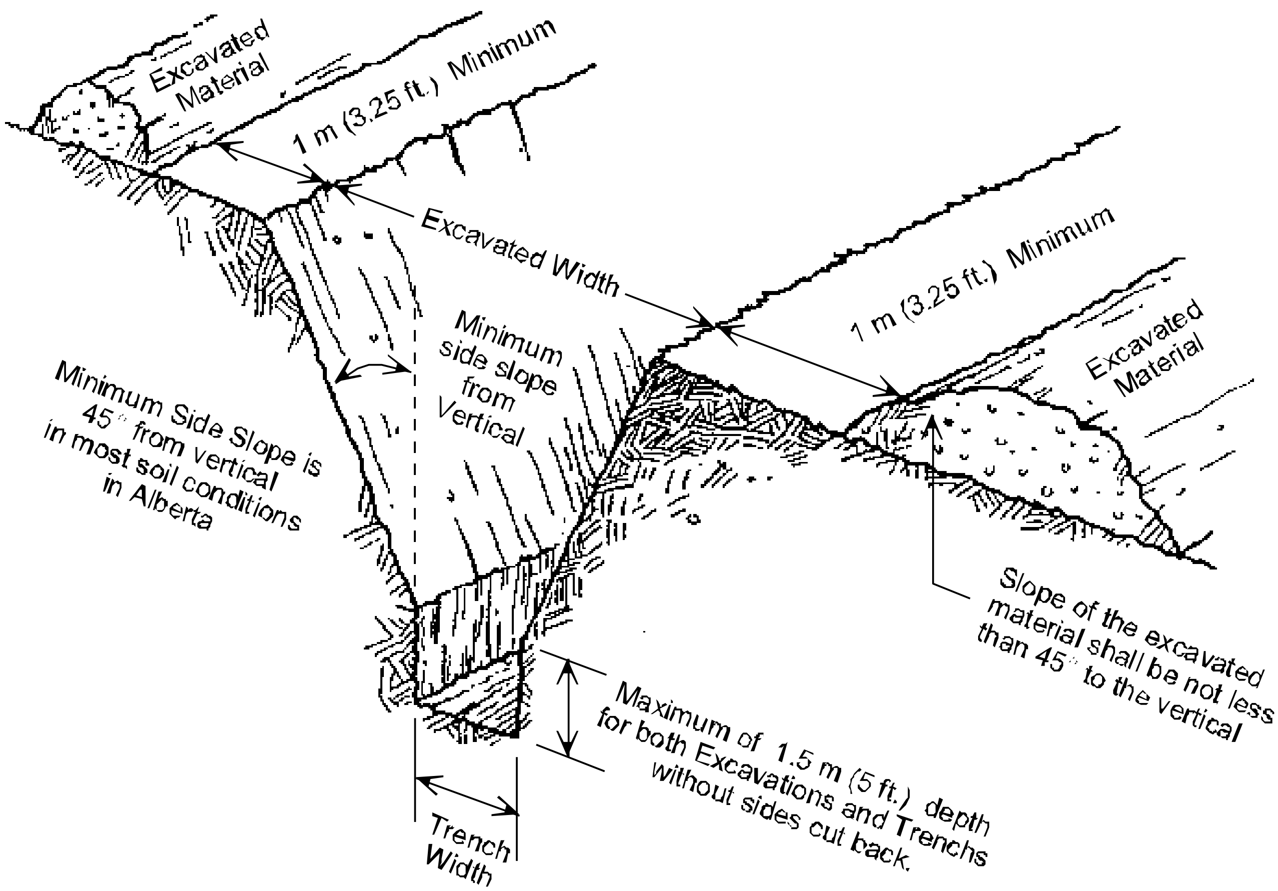
Excavation - any dug out area of ground other than a trench.

Trench - An elongated dug out area of ground whose depth exceeds its width.

When in hard , compact and other similar soils:

In an ***excavation*** where a worker is to be closer to the wall or bank than the depth of the excavation, the excavation shall have:
Vertical walls not more than 1.5 meters,
Cut-back slope not less than 30 degrees from vertical in hard compact soil.

In other soils cut-back to not less than 45 degrees from vertical.



In a ***Trench*** where a worker is closer to the wall or bank than the depth of the Trench, the trench shall have:
Vertical walls not more than 1.5 meters
Cut-back slope not less than 30 degrees from vertical in hard compact soil

Hard Compact soil refers to soil that can only be excavated by machinery and shows no sign of cracks after excavation.

In other soils cut-back to not less than 45 degrees from vertical.

Maintaining and Cleaning the Septic Tank

The septic chamber should be checked each year for the amount of accumulated sludge and scum in the tank and that all components are effectively working. A septic chamber with approximately one third of its storage depth filled with sludge it needs to be cleaned. It is not necessary to thoroughly scrub and flush the septic chamber until it is visibly clean. The small amount of sludge that remains on the floor and walls will re-seed the septic tank and contribute to the re-establishment of its normal operation. Vacuum-pumped sewage hauling trucks need to be used to clean septic tanks. This equipment is capable of doing an excellent cleaning job without spillage.

The tank should only be pumped out when the sludge and scum have accumulated to a level that starts to impact the treatment effectiveness of the tank. Pumping out the tank before it is needed causes increased cost and more impact on wastewater receiving facilities where the sludge is hauled to. Each year the tank should be inspected for integrity, signs of water infiltration and continued working of the inlet and outlet piping. Filters will also require servicing and cleaning.

Effluent Filters

Effluent filters are important in a system. The filter provides further reduction of the strength of effluent and protection of the system during periods of high flow rates. These filters need to be maintained and remain in the system. All systems require a filter as set out in Article 2.1.1.6.

Management and Disposal of Sludge

What is Septage?

Septage is the solid material that collects in the septic tank and includes the sludge and scum and liquid waste in the tank at the time of pumping. The sludge is made up of inorganic materials (grit, hair, rags, plastic, and dirt) and organic materials that is hard to break down (coffee grounds, toilet paper, feminine hygiene products, and some food preparation wastes such as peelings etc. The scum contains oils, greases and other materials in the wastewater that are lighter than water and do not break down easily.

The septage contains high levels of nutrients (phosphorus and nitrogen), pathogenic organisms, and solids, both organic and inorganic, all of which can harm surface and groundwater quality. The contents and concentrations require that the septage be managed and treated effectively to ensure it does not create health risks or cause harm to ground waters and surface waters.

How Much Septage Accumulates in a Year?

The amount of septage that accumulates depends on system use, and system design. Estimates of sludge and scum accumulation rates have been made. The estimates are that in 90 percent of cases the accumulation rate should not exceed 30 gallons per person per year. An estimated average is 20 gallons per person per year over the first two years and then it drops to 10 gallons per person in years 3 & 4. The drop in accumulation in years 3 & 4 is in large part attributed to a higher level of sludge breakdown by organisms that become better established in the tank over time.

How Often Should the Septage be Removed?

There is no single answer to how often your septic tank needs pumping. Each system will be different. The number of people using the system, the size of the septic tank and the habits of the people using the system will affect how often the septage should be removed. Estimates vary from every year to every four years.

The septic tank should be inspected every year for the amount of sludge and scum accumulation to maintain effective operation of your system and minimize the risk of an expensive failure. Yearly inspections allow you to accurately determine when you need to have the tank pumped. Remember that as the sludge accumulates the tank loses efficiency and can give the impression the sludge is not accumulating very fast. After a number of yearly inspections you can better estimate the amount of time between pump-outs. You may be able to reduce the inspection frequency. For a new system the tank should be pumped out in the first year to ensure any building material waste is removed (drywall dust, dirt, waste from washing paint brushes etc.) Article 2.1.2.7 requires construction waste be removed prior to starting a system.

All the septage you produce and that accumulates in your tank does not magically disappear after the hauler removes it from your tank. Once the septage is removed from your septic tank proper treatment and disposal is required.

Importance of Proper Septage Disposal?

Septage hauled from you tank must be effectively treated and disposed of using approved methods. Should septage be disposed of improperly, or should a septic system fail, various pollutants, such as bacteria, disease causing viruses, and other pathogens, can enter the groundwater and surrounding lakes and streams. This can potentially affect the surrounding ecosystem, harming aquatic life, animals, and people. When septage is disposed of properly potential environmental impacts and health risks to humans and animals are minimal.

It is important to hire a professional and reputable septage hauler when pumping your septic tank. Ask questions as to where and how they dispose of your septage to ensure your waste does not cause environmental or public health concerns.

Source: Alberta Environment

Sewage Holding Tanks – Section 3.1

In areas where minimum separation distances cannot be provided for soil based treatment systems or the soil conditions are limiting, it may be necessary to install a water tight sewage holding tank and haul all sewage away for treatment in another suitable manner.

The high cost of operation dictates that this method be used only where absolutely necessary.

The Standard sets a minimum capacity of holding tanks for a residential development at 4,500 L or 1000 gallons; see Article 3.1.1.1. This volume is often insufficient for homes and larger tanks should be used. The appropriate capacity depends on:

- water use
- the frequency desired for pump out intervals
- the capacity of the truck to haul sewage and
- the desired emergency storage capacity above the high water alarm that is required by the Standard.

Packaged Sewage Treatment Plants – Section 5.2

There are many different makes and models of packaged sewage treatment plants. To be acceptable for installation in the Province of Alberta, wastewater treatment plants must be certified to the National Sanitation Foundation (NSF) International Standard NSF 40 1996, the NSF Standard for Wastewater Treatment Systems. Treatment plants certified to this standard achieve a Level 2 treatment level as set out in Table 5.1.1.1. of the Standard of Practice.

This NSF standard is a U.S. standard, all units are rated in U.S. gallons and this must be taken in to consideration when selecting a packaged treatment plant for use in Alberta. See Article 5.2.1.2. regarding treatment capacity and Subsection 5.2.3 regarding certification of treatment plants and the tanks they are installed in.

Packaged sewage treatment plants are aerobic treatment plants that use various methods, depending on their design, to expose the sewage to oxygen. Increased levels of oxygen in the sewage provide the conditions needed for the establishment of large aerobic bacteria populations. These aerobic bacteria populations accelerate the decomposition of the suspended solids in sewage.

Packaged 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 suitable to the wastewater received so there is a balance between the bacteria population, the amount of organic load discharged to the packaged sewage treatment plant, which the bacteria use as food, and the amount of oxygen available to the bacteria to metabolize the organic load received. If there is a sudden increase in the amount of organic loading (BOD_5 and TSS), there may be a decrease in the quality of effluent discharged from the packaged sewage treatment plant until the bacteria population increases to consume the increased organic load. Some treatment plants include within their design, or the design developed by the installer or designer will include methods that equalize small fluctuations in flow through the day and thus organic loading. In any installation, methods to equalize flow should be considered and included in the design to prevent excess flow through the plant that may wash out the bacterial population or go through so fast the bacteria do not have time consume the organic loading of the wastewater.

During an extended holiday, a reduction in the bacteria population due to the lack of sewage that the bacteria use as food will occur. This may result in a decreased effluent quality when use resumes until the bacteria population increases again to match the volume and strength of the sewage discharged to the unit. Bacterial populations can be maintained by providing alternative organic matter to the system, thereby providing an alternative food supply for the bacteria until normal sewage flow is again established.

Maintenance of Wastewater Treatment Plants

A packaged sewage treatment plant requires maintenance. As a certification requirement of the NSF 40 Standard, a 2-year initial service policy shall be furnished to the owner by the manufacturer or the authorized representative and the cost of the initial service policy shall be included in the original purchase price. The initial policy shall contain provisions for four inspection/service visits (scheduled once every 6 months over the 2-year period) during which electrical, mechanical, and other applicable components are inspected, adjusted, and serviced. The plant needs to be maintained at intervals of not more than 6 months following the initial two year period as well.

Soils Evaluation

Critical Design Information

The evaluation of the soils used for an onsite sewage treatment system to determine the soil characteristics that impact design is the most important design criteria along with determining wastewater flow volume and strength. Without this information the design of a successful system cannot be completed.

The following information is not intended to provide the reader with sufficient knowledge to undertake a soils investigation for the design of an onsite sewage treatment system. It points out the main soil characteristics related to onsite sewage system design. There are many other characteristics a trained person needs to be aware of and able to identify when looking at a soil profile in the field. Most of the characteristics needed for design must be determined in the field by observation of the soil profile. These characteristics cannot be determined by sending a sample of the soil to a laboratory. The investigation of the soil profile needs to be done by a trained individual to obtain accurate results.

This Standard requires the use of the Canadian System of Soil Classification be applied in the assessment of soil suitability and the design basis of private sewage systems. Using the Canadian System of Soil Classification is superior to a geotechnical evaluation based on the Unified Soil Classification System for determining the suitability of soil for an onsite sewage system and for the successful design of an onsite sewage system. An evaluation based on geotechnical procedures and terminology is not acceptable for design.

Percolation tests are not accepted as design criteria. Such testing of the ability of the soil to accept and move water characterizes only a small amount of soil in the immediate area of the test. It will not identify other characteristics that are outside its small area of influence that may very well cause a system failure. Also, sources of error in the field permeability test are well documented in literature. Erroneously high values can be caused by the existence of macropores or small scale soil characteristics that allow water movement.

Two soil test pits must be excavated in the area proposed for the septic system to describe the soil profile that affects the design choices for the system. The depth of the soil investigation must be adequate to show the required vertical separation for a particular type of system is available. It also must be to a sufficient depth to show that liner loading limitations are not a concern. For systems over 5.7 cubic metes per day the investigation must go tot depth needed to provide the information needed to model ground water mounding potential. A proper characterization of the soil profile in each test pit, including a determination of the texture, structure, consistence, and the presence of redoximorphic features for each horizon is essential for determining the suitability of the site and design criteria applied to the system. See Section 7.1 which sets out site evaluation requirements.

Key characteristics of the soil that affect the long term success of systems include soil texture and structure which significantly affects water movement in the soil; saturated or seasonally saturated soil conditions indicated by redoximorphic conditions, and depth to any restricting layers of soil that will severely limit the downward movement of water.

Soil texture is determined by the mix of sand silt and clay in the soil (particle size distribution). Soils with a high percentage of clay restrict the movement of effluent through the soil. Sandy soil allows the effluent to move through the soil quickly. Characterization of the soil texture must include characterization of the particle size of sand when the general soil texture is sandy loam, loamy sand or sand. Fine or very fine sands in these soil textures will result in significantly lower long term effluent loading rates compared to medium or coarse sands or sandy loams. The medium and coarse sands, loamy sands and sandy loams have reduced treatment capacity as these textures allow the effluent to rapidly travel through the soil profile.

Soil Structure is the formation of soil into consolidated peds ("clumps") and cracks form between the structured peds. These cracks provide a route for the applied effluent to move into and through the soil. Generally a lack of structure (no structure or weak structure) will impede water movement through the soil; however some types of structure will impede the movement of water through the soil (platey structure which is characterized as having a long horizontal width that blocks downward movement of effluent.

Saturated soil are identified by redoximorphic features in the soil. These characteristics are recognized in agricultural soil sciences and are very valuable in predicting seasonal high water tables. This is much more effective than a single point in time measurement of the water table often applied in a geotechnical evaluation. A single groundwater depth measure does not reflect seasonal variation in water tables and is not acceptable as an effective indicator of the near surface water table. However, redoximorphic features are sometimes difficult to detect in sandy soils. In these situations wells to determine the near surface water table can provide additional valuable information if readings are taken at different times of the year and at times of expected high groundwater.

Restrictive layers are either saturated soils or soils that have significant clay content and little structure. If the soil characteristics do not allow a loading rate for secondary treated effluent as set out in Table 8.1.1.10, they should be considered a restricting layer. The depth from the infiltration surface to the limiting layer is a critical design consideration.

Soil Texture

Soil texture affects the movement of water in the soil and wastewater treatment capacity of the soil.

The soil texture classification is one of the factors used in determining the allowed effluent loading rate in litres per square metre (gallons per square foot) on the in situ soil. The soil texture is a classification determined by the relative amounts of sand, silt and clay in a soil (the mineral portions of the soil). How coarse (sandy) or fine (clayey) the soil is, affects the ability of the soil to transmit air and water as well as treating the effluent.

The mineral portion of the soil is divided into three size fractions: Sand (S) with particle sizes between 2.00 and 0.05 mm, Silt (Si) with particle sizes between 0.05 and 0.002 mm, and Clay (C) with particle sizes less than 0.002 mm. Mineral fragments (gravel) with a mean diameter larger than 2 mm are excluded from the texture classification. These large particles are classed as coarse fragments. A large percentage of course fragments in sandy soil require a reduction in the effluent loading rate. See Article 8.1.2.4.

Soil texture refers to the relative percentage of sand, silt, and clay in a soil, i.e., particle size distribution. The texture of a soil is expressed as a class name formed by combining the terms of sand, silt, clay and loam. For example, if the clay fraction dominates the properties of the soil, the soil class name would simply be "clay." However, if this soil contains enough sand to appreciably modify the properties imparted by the clay, then the class name would be "sandy clay." When the percentage of sand and clay are known, the class name can be determined from the textural triangle shown following Table 8.1.1.10. Methods use in the Laboratory can provide an accurate classification of the soil texture as well as determine the percentages of Sand sizes in the soil sample when needed. Article 7.1.1.2.(3)(c) requires a sample of the most limiting layer (the layer the soil evaluator thinks is most important to the design) be submitted to an accredited lab for analysis. The lab uses both hydrometer methods and sieve particle sizing where required to determine the sand fraction sizes. The test procedures the lab uses must follow the Canadian System of Soil Sciences recognized practices.

Particle or Grain Size Analysis Test

A Particle or Grain Size analysis test is a laboratory procedure performed on a soil sample to establish the amounts of sand, silt and clay in the sample. The procedures may include sieving, pipette sampling or hydrometer methods. Once the amounts of sand, silt and clay have been established, a soil texture can be determined.

Hand Texturing of Soil

Hand texturing is used in the field to make estimates of soil texture and is based on the "feel" of a moist soil sample.

To **hand texture**, use the steps below or those in the following graphic illustration.

1. Place about a teaspoon of soil in the palm of your hand and moisten the soil by slowly adding water. Knead the soil and add water until it has the consistency of moist putty (not soup).
2. To estimate the textural class, use the following guidelines:
    (a) pure clay will feel very slippery and very sticky
    (b) pure silt will feel smooth and slippery but not sticky
    (c) pure sand will feel very gritty.

    The soil is most often made up of various amounts of each soil particle size so the combined feel of the above is considered to estimate the soil texture as described in the soil texture triangle.

3. Press and rub the moistened soil between your thumb and forefinger to estimate the gritty and slippery feel, then pull the two fingers apart to estimate stickiness.

This is an example procedure for hand texturing of a soil sample. Be advised that this is presented as an additional example of a qualitative field technique and that accuracy improves with experience (often many years are required). By obtaining a number of known soil texture samples you can practice with these to help you calibrate your fingers to do the manual texturing of soils.

Figure: Hand Texturing of Soil

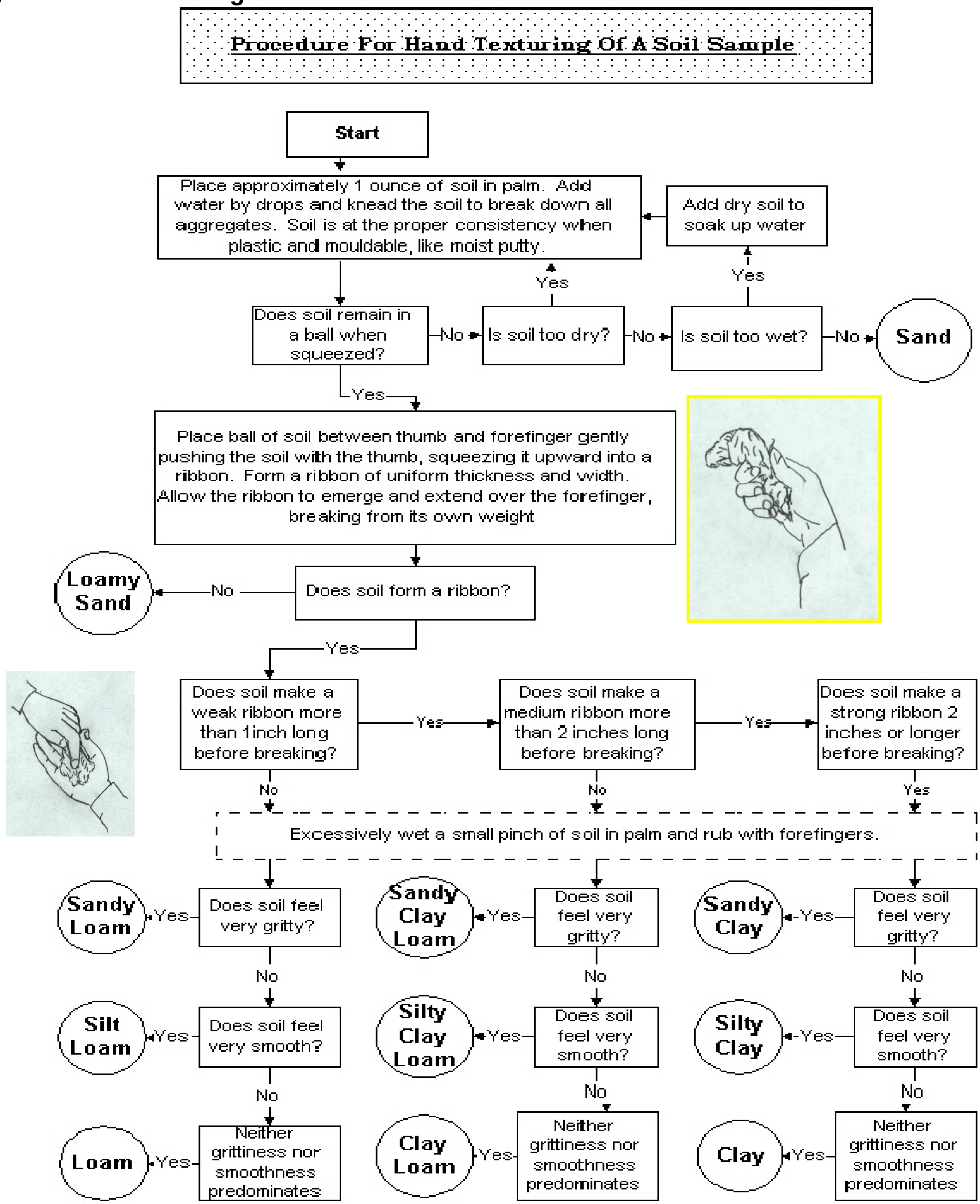
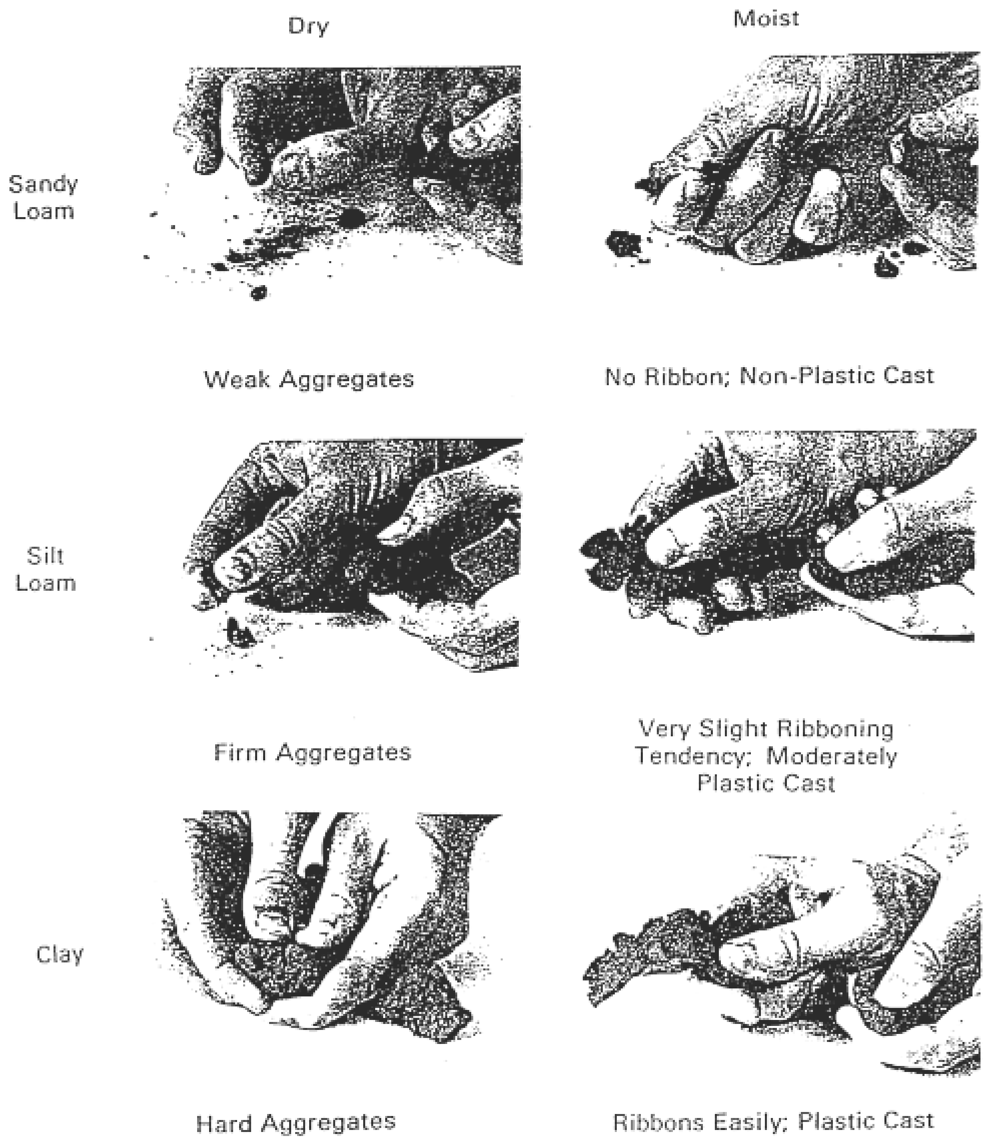


Table: Textural Properties of Dry and Wet Mineral Soils

Soil Class	***Feeling and Appearance*** ***Dry Soil***	***Moist Soil***
Sand	Loose, single grains which feel gritty. Squeezed in the hand, the soil mass falls apart when the pressure is released.	Squeezed in the hand, it forms a cast which crumbles when touched. Does not form a ribbon between thumb and forefinger.
Sandy Loam	Aggregates easily crushed; very faint velvety feeling initially but with continued rubbing the gritty feeling of sand soon dominates.	Forms a cast which bears careful handling without breaking. Does not form a ribbon between thumb and forefinger.
Loam	Aggregates are crushed under moderate pressure; clods can be quite firm. When pulverized, loam has velvety feel that becomes gritty with continued rubbing. Casts bear careful handling	Cast can be handled quite freely without breaking. Very slight tendency to ribbon between thumb and forefinger. Rubbed surface is rough.
Silt Loam	Aggregates are firm but may be crushed under moderate pressure. Clods are firm to hard. Smooth, flour-like feel dominates when soil is pulverized.	Cast can be freely handled without breaking. Slight tendency to ribbon between thumb and forefinger. Rubbed surface has a broken or rippled appearance.
Clay Loam	Very firm aggregates and hard clods that strongly resist crushing by hand. When pulverized, the soil takes on a somewhat gritty feeling due to the harshness of the very small aggregates which persist.	Cast can bear much handling without breaking. Pinched between the thumb and forefinger, it forms a ribbon whose surface tends to feel slightly gritty when dampened and rubbed. Soil is plastic, sticky and puddles easily.
Clay	Aggregates are hard; clods are extremely hard and strongly resist crushing by hand. When pulverized, it has a grit-like texture due to the harshness of numerous very small aggregates which persist.	Casts can bear considerable handling without breaking. Forms a flexible ribbon between thumb and forefinger and retains its plasticity when elongated. Rubbed surface has a very smooth, satin feeling. Sticky when wet and easily puddled.

Figure : Dry and Wet Feel of Various Soil Textures



Soil structure is observed in the field as the face of a soil test pit is examined. Soil Structure cannot be determined in a sample sent to a laboratory. As defined in the CanSIS glossary, soil structure is:

"The combination or arrangement of primary soil particles into secondary particles, units, or peds. These peds may be, but usually are not, arranged in the profile in such a manner as to give a distinctive characteristic pattern. The peds are characterized and classified on the basis of size, shape, and degree of distinctness into classes, types, and grades."

Soil Structure

The grade of the structure is defined in the CanSIS glossary as:
"A grouping or classification of soil structure on the basis of inter- and intra- aggregate adhesion, cohesion, or stability within the profile. Three grades of structure designated from 1 to 3 are:

1. *weak poorly formed, indistinct peds barely evident in place.*
2. *moderate well-formed distinct peds, moderately durable and evident, but not distinct, in undisturbed soil.*
3. *strong durable peds that are quite evident in undisturbed soil, adhere weakly to one another, withstand displacement, and become separated when the soil is disturbed."*

Source: http://sis2.agr.gc.ca/cansis/glossary/s/index.html Accessed Jan 10, 2011.

The shape of the structure and grade of the structure are key characteristics, along with the soil texture, applied in determining appropriate effluent loading rates on the soil. The shape and grade of the soil structure are identified in the second and third column of table 8.1.1.10 and table A.1.E.1 which is used to determine the appropriate effluent loading rates. Without the information gained by a soil characterization that includes the soil structure, an effluent loading rate cannot be selected from the table or reasonably justified.

The photo on the following page provides a clear look at soil structure. In the center of the picture the soil structure is columnar. This columnar structure is very well defined and easy to see. It also can be pulled from the soil column and holds together well in that shape when removed. Those two characteristics indicate it is a "Grade 3" (strong) columnar structure. At the top of the photo the structure is blocky. This structure is not so easily seen but is still well defined when pulled form the soil profile. It would be a "Grade 2" (moderate) blocky structure.

The columnar structure is indicative of a solenetz soil that is impacted by sodium. It is not well suited to soil based treatment systems as the top of the columnar structure creates a restrictive layer that will stop the downward movement of effluent. This is due to the columnar structure swelling as it is wetted and closing all macros pores between the shapes of the structure.

The graphic on the following page shows the various soil structure shapes found in soil and assists in correct identification of soil structure. The graphics on this page showing a circle with dots within the circles and titles "Percent Areas" assists with estimating the amount of coarse fragment (gravel) in the soil.

Figure: Soil Structure Photo

Columnar soils structure at center of photo, blocky structure at top of photo. This soil is a solenetz soil that is not well suited to onsite sewage systems. A restrictive layer is created at the top of the columnar structure due to swelling of the soil once it is wetted. Ground surface is approximately 100 mm (4 inches) above the top of this photo. The top of the columnar structure is approximately 450 mm (18 inches) below ground surface.

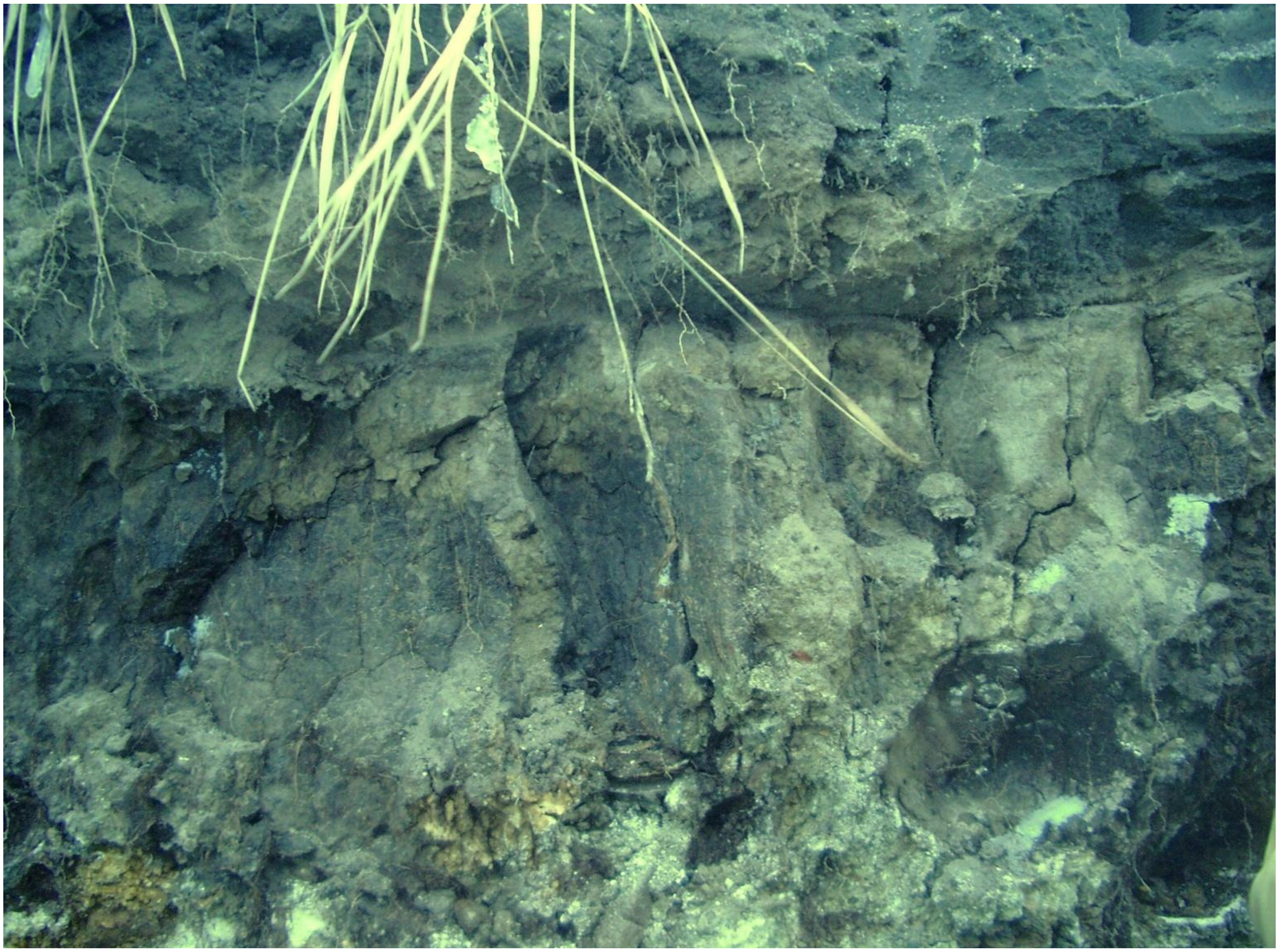
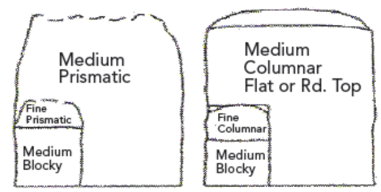


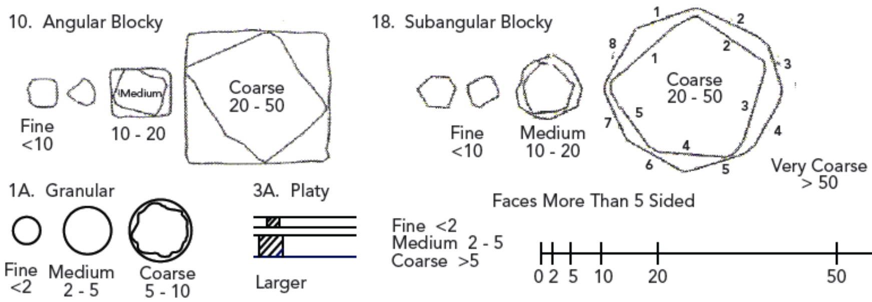
Figure : Soil Structure Shapes and Estimating Coarse Fragment Percentage

Structure

Grade		Class		Kind	
w	Week	vf	Very fine	sg	Single grained
wm	Weak to moderate	f	Fine	ma	Massive
m	Moderate	m	Medium	bk	Angular block
ms	Moderate to strong	c	Coarse	sbk	Subangular block
s	Strong	vc	Very coarse	gr	Granular
				pr	Prismatic
				col	Columnar

Prismatic & Columnar





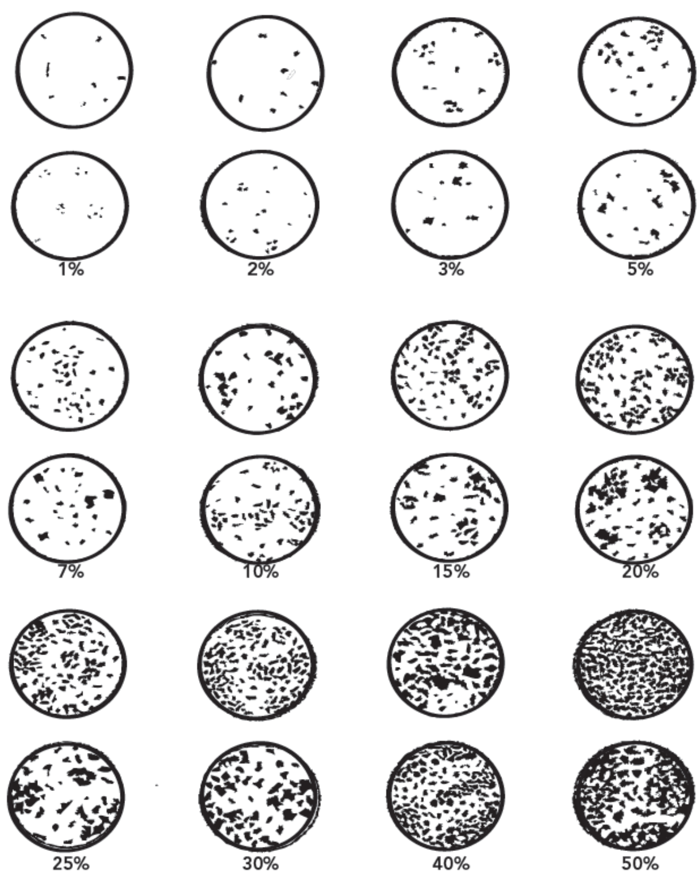
Fine	< 20
Medium	20 - 50
Coarse	50 - 100
Very Coarse	>100

Fine <2
Medium 2 - 5
Coarse >5
Scale in MM
0 2 5 10 20 50 100

Slope Classes of Local Landings

Class & Slope	Aprx°	Description
1 0 - 0.5	0	level
2 0.5 - 2.5	0.3 - 1.5	nearly level
3 2 - 5	1 - 3	very gentle slopes
4 6 - 9	3.5 - 5	gentle slopes
5 10 - 15	6 - 8.5	moderate slopes
6 16 - 30	9 - 17	strong slopes
7 31 - 45	17 - 24	very strong slopes
8 46 - 70	25 - 35	extreme slopes
9 71 - 100	35 - 45	steep slopes
10 >100	>45	very steep slopes

Percent Areas



Surface Stones

	Surface Area	Distance Apart (cm)
S0 non-stony	<0.01%	>30
S1 slightly stony	0.01-0.1%	10 - 30
S2 moderately stony	0.1- 3 %	2 - 10
S3 very stony	3 - 15%	1 - 2
S4 exceedingly stony	15 - 50%	0.1 - 5
S5 excessively stony	50%	0.1

Slope Position

c	cret
u	upper slope
m	mid-slope
l	lower slope
t	toe
d	depression
l	level

Drainage

VR	Very Rapidly
R	Rapidly
W	Well
M	Moderately Well
I	Imperfectly
P	Poory
VP	Very Poorly

Smectitic Clays

Smectitic clays shrink when dry and swell when wet which reduces pore size between particles. The swelling and shrinking of soils that leave large cracks on the surface is particularly noticeable in soils containing large amounts of Montmorillonite clay which is very fine clay. As a consequence, much larger absorption areas must be utilized for the same given amounts of effluent and time.

Montmorillonite clay is found throughout Alberta in varying amounts. See Soil Montmorillonite Map, Appendix A.3.C. Montmorillonite clay has a mineralogy makeup that is affected by sodium that may be in the water supply and consequently the effluent. These expandable clay soils are referred to as smectite clays. High sodium in a wastewater can cause the dispersion or separation of the individual clay particles destroying structure that exists in the soil. The individual particles that separate and swell will close pores in the soil that are relied on to move the effluent through the soil.

A chemical water analysis of the proposed water supply will help evaluate the potential impact on soils that include Smectite clays.

Particle Dispersion in Clay Soils

Dispersion of clays can occur when effluent is applied to the soil in a private sewage system. Dispersion of clays can result in hard-setting dense soils that can change and severely limit the hydraulic conductivity of the soil. The dispersion of clays can be caused by the soil already being impacted by sodium accumulations or by effluent that has a high SAR. The high SAR of the effluent is a result of the water used in the development; it is not a result of the waste carried by the water. High SAR may be a characteristic of the ground water source used or the result of a water softener using sodium salts. See pg**. 297** for more detail and understanding of SAR. Evaluating the soil's susceptibility to dispersion can be done using the procedure described in the following ASWAT soil stability test that is used on Australia in considering the suitability of soils for onsite sewage treatment systems. The source water at the development should preferably be used for this test. That test is described in the following.

Soil Dispersion Assessment

The ASWAT soil stability test
Adapted from Field, McKenzie and Koppi 1997 (AJSR 35, pp 843-52)
ASWAT = **A**ggregate **S**tability in **WAT**er

Preamble: This test method is used to examine the dispersive properties of soils. Dispersion of clays is a much more serious matter than slaking of soils. It can result in hard-setting dense soils. The following procedure assesses the dispersion character of soil samples on a 17-point scale, and uses simple equipment. This test can also be conducted using the source water or effluent at a location to assess the impact on the soil of sodium in the source water or wastewater.

1 Use air-dry 3-5mm natural soil aggregates. Immerse at least 4 aggregates into rain water contained in a petri dish, by lowering in carefully.
2 Observe the degree of milkiness, which signifies dispersion, around the aggregates after 10 mins. For no milkiness whatever, score 0; for slight milkiness, score 1; for obvious milkiness, score 2; for

considerable milkiness, score 3 and for complete dispersion (sand grains in a cloud of clay) score 4. To be sure about detecting dispersion, use a solution of 0.01M calcium chloride as a check (1.47g $CaCl_2.2H_2O$ per litre). No soil will disperse in that solution. View and photograph against a dull black background. Note that it is dispersion that we are looking at here, not slaking (see par 8 below).

3 Retain these samples undisturbed and repeat the observations at 2 hrs, scoring in exactly the same way.

4 For only those samples that scored 0, wet a small soil sample (about 1 teaspoon) slowly with a fine water spray whilst mixing and moulding with a spatula, or do it in a clean, gloved hand, working the soil into a bolus as though doing a standard soil texture assessment. The right water content is when you can roll the just-moist soil into about a 3 mm rod and it falls apart into 10 mm lengths (is, not very plastic). Be careful to wet up slowly. Do not slosh the water in and need to add more soil! The glove is to prevent any sodium from sweat adding to the sample.

5 Test these moist, moulded samples in the same way as steps 1 to 3, scoring in the same way.

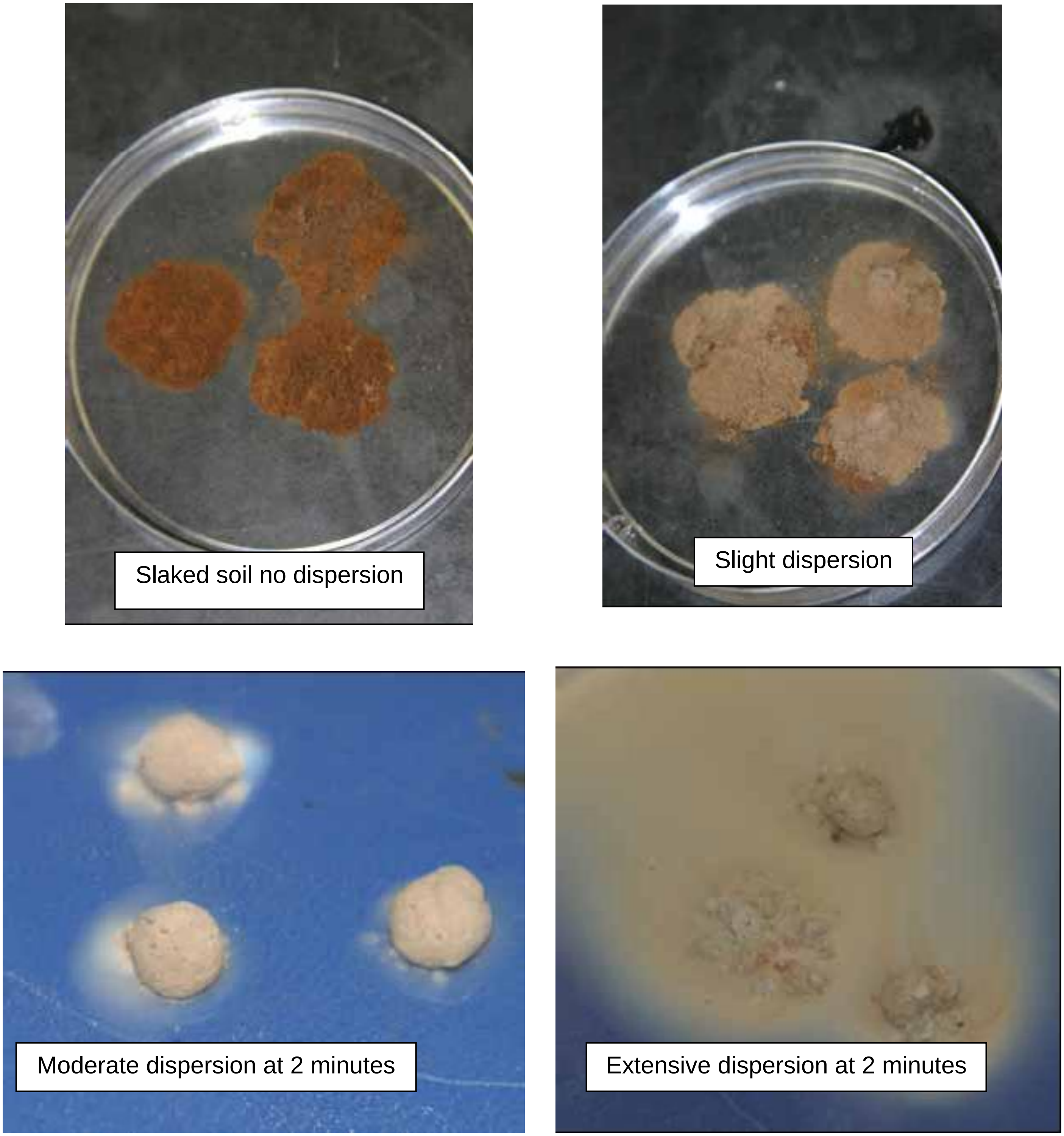
6 For the full score:
   (a) for soils that showed some dispersion in steps 1 to 3, add the 10-min score to the 2-hr score and then add to 8, giving a score ranging from 9 to 16.
   (b) For soils that scored 0 in steps 1 to 3, add the remoulded scores for 10-min and 2-hr together, giving a score between 0 and 8.
   (c) The total score for all samples is therefore 0 to 16, a 17-point scoring system.

7 If the samples slake but do not disperse, the soil can be amended by organic matter incorporation alone.

8 The critical threshold value for soil dispersion in the field is 6. There is a good relationship with ESP, but the ASWAT test also integrates other factors associated with soil stability. Gypsum alone is the best ameliorant at pH values of 6 and above. For soils with pH's less than 5.5, lime (calcium carbonate) can have a long-term synergism with gypsum.

The dispersion results are shown in the photos on the following page.

Figure: Soil Dispersion Photos



Slaked soil no dispersion

Slight dispersion

Moderate dispersion at 2 minutes

Extensive dispersion at 2 minutes

Also see these sources for more information on soils affected by sodium:
http://www.lanfaxlabs.com.au/papers/P47-mysteries.PDF

Explaining the Mysteries of Salinity, Sodicity, SAR and ESP in Onsite Practice

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Presented as an oral paper to Conference On-site '01. Advancing On-site Wastewater Systems 25-27th September 2001. Held at University of New England, Armidale. Coordinated by Lanfax Labs Armidale

http://crcleme.org.au/Pubs/Monographs/regolith2005/Bennett_et_al.pdf
DEVELOPMENT OF A LABORATORY TEST FOR RESPONSIVENESS OF SODIC SOIL STABILITY TO AMELIORANTS: LIME ($CaCO_3$), GYPSUM ($CaSO_4.2H_2O$) AND LIME/GYPSUM COMBINATIONS
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http://www.lanfaxlabs.com.au/papers/Technical%20Sheet%20Sodicity-aug06.pdf
Technical Sheet Reference: 01/7
Status: Final
Publication Date: July 2006
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Lanfax Laboratories, Armidale

Soil Structure, Porosity, and Water Movement

Structure is the formation of larger soil peds (clumps of soil) that are made up of individual sand, silt, and clay particles. The porosity of the soil is affected by the size and number of spaces or pores between the structured peds or aggregates. A soil which has a well-defined structure will transmit water much more rapidly than a soil where there is no structure or the structure has been destroyed by compaction or smearing.

The type of structure and grade (how well the structure is established) of the structure affects the dominant direction of the pores and hence, water movement in the soil. Well-structured soils with large voids between peds (clumps of soil) will transit water more rapidly than structure-less soils of the same texture. Fine-textured, massive soils (soils with no structure) severely limit the movement of water.

Platy structures resist vertical movement of water because cleavage faces are horizontally oriented. Often vertical flow is so restricted that the upper soil horizons saturate, creating a perched water table. Soils with granular, blocky, or prismatic structures enhance flow both horizontally and vertically. Columnar structured soil, with rounded tops, is often an indicator of Solenetz soils that limit downward movement of soil at the top of the columnar structure found in the soil profile.

Structure is a soil characteristic that is easily altered or destroyed. Structure is very dynamic, changing in response to moisture content, chemical composition of soil solution, biological activity, and management practices. Soils that shrink and swell appreciably, such as montmorillonite clays, show particularly dramatic changes in structure as soil moisture changes. When the soil peds swell upon wetting, the large pores become smaller and water movement through the soil is reduced.

Mechanical equipment used during construction can also alter soil structure by causing compaction or smearing of the soil at the infiltrative surface and into the depth of the soil. This will result in reduced hydraulic conductivity in the soil as the structure is compromised. Care must be taken to ensure traffic is kept off the system area and that construction techniques do not compromise soil structure by carrying out work when the soil is wet.

Research shows that strong soil structure can compensate for high clay content in the soil and result in a soil with suitable permeability.

Identifying Seasonally Saturated Soils and High Water Tables

Adequate vertical separation must be provided between the point of entry of effluent into the soil and the saturated soil to assure proper treatment of the effluent. The evaluation of the soil must identify whether saturated soils exist at times of the year that will compromise the system. Standing water may not be evident in the soil at the time of site investigation as the depth to saturated soil will change during the year and from year to year. Evidence other than standing water must be looked for to determine the existence or absence of saturated soil zones. A bright consistent soil color indicates a well drained soil. If a soil is consistently saturated for a substantial period of the year, year after year, mottling and gleying of the soil will occur. Mottled soil will have blotches of rust coloured soil or blotches of grey. Gleyed soil is a washed out grey to blue grey colour.

Mottled or gleyed soil is the result of periodic, recurring water logged soil conditions; an anaerobic environment, over a long period of time. It encourages the reduction of iron compounds by anaerobic microorganisms and often causes mottling of soil into a patchwork of gray and rust colors. The process is known as gleying.

The Affect of Sodium on Soils and Vegetative Growth

Sodium Absorption Ration (SAR)

This measurement is one indicator that a problem could be caused by sodium in the water. Excess sodium, in relation to calcium and magnesium concentration in effluent can destroy the structure of montmorillonite clay particles reducing permeability of the soil to water and air. Excess sodium in the effluent can also result in a build up of sodium in the soil when the effluent is used for irrigation by drip dispersal systems allowed in section 8.5 of the Standard. A build up of sodium in the soil can occur as the vegetation uses the soil water while leaving the sodium behind. This will eventually result in high sodium levels in the soil which will restrict the ability of the vegetation to take up water and nutrients. Specific limits to the SAR of the effluent are set for drip dispersal systems used for the purpose of Irrigation in Article 8.5.1.3.

Both Alberta Environment and Environment Canada publish guidelines for irrigation with municipal wastewater.

Water Quality for Irrigation Suitability

From Alberta Environment's publication "A Practical Guide to Municipal Wastewater Irrigation".
Because an equilibrium exists between the soil and the soil water, irrigation with a wastewater with unsatisfactory chemistry will result in an unacceptable change in soil chemistry. An effluent with an SAR over eight is considered unsatisfactory while an EC of 250 millisiemens per metre (mS/M) or greater should be considered unsatisfactory unless the soil is well drained.

Environment Canada's "Manual for Land Application of Treated Municipal Wastewater and Sludge" provides Table B-3 for standard rate irrigation and Table B-4 for high rate irrigation.

Table: Recommended Wastewater Chemistry Criteria for Standard Irrigation Rates

	Degree of Problem		
Irrigation Problem	No Problem	Increasing Problem	Severe Problem
Salinity EC (mS/cm)*	< 1.3	1.3 - 3.0	> 3.0
**Permeability SAR ** **	**< 6**	**6 - 9**	**> 9**
Boron (mg/L)	< 0.7	0.7 - 2.0	> 2.0
pH	Normal Range 5.5 - 9.0		

* Assume a well drained soil and leaching fraction of 0.15
** Suggested for fine and medium textured soils, SAR limits can be relaxed if soils are course textured (LS and S).

Important: The above guidelines are superseded by provincial regulations or guidelines

Table: Recommended Wastewater Chemistry Criteria for High Rate Irrigation

	Degree of Problem	
Irrigation Problem	No Problem	Increasing Problem
Salinity (dS/m)	< 4	4 +
Permeability* SAR	**< 6**	**6 +**
Boron (mg/L)	< 1.0	1 +
pH	Normal Range 5.5 - 9.0	

* Assume a very well drained soil and a leaching Fraction of 1.0.

The limits placed on water quality by Alberta Environment as set out in the above tables focus on the use of the wastewater for irrigation so do not directly relate to subsurface effluent dispersal systems where uptake by plants will not be significant but show there is concern. If high SAR municipal waste water (from a sewage lagoon) is not considered suitable to use as irrigation water during the summer months of the year only, because of the potential of changing the permeability of the soil, discharging high SAR effluent from a private sewage system into the soil every day of the year, every year, will also likely negatively affect the permeability of the soil.

Water with a high SAR (Sodium Adsorption Ratio), may be natural soft water from a well, or a high SAR can be a result of using a sodium based water softener. Water with a high SAR may be detrimental to a sub-soil effluent dispersal system under certain circumstances. Generally, the higher the SAR of the potable water, the greater the salinity and EC of the water; this combined with discharge into soils having a higher content of smectitic clays in the soil creates a greater risk of sewage system failure. In coarse textured soils that do not contain smectitic clays, a high SAR effluent has little negative impact on the soil.

SAR of the Potable water supply may be obtained from a chemical water analysis report. Some labs provide it as a routine item, others do not. If the SAR is not provided it may be calculated. It is important to realize that chemical water analysis reports usually provide information in ppm or mg/l, and neither of these units of measurement may be used. As there are three different elements used in the calculation, they must be converted into a common denominator in accordance with their atomic weights. This common denominator is referred to as me/l, and may be obtained by dividing sodium by 23, calcium by 20 and magnesium by 12. The numbers obtained from these three calculations may then be applied to the formula:

$$SAR = \frac{Na}{\sqrt{\frac{Ca \pm Mg}{2}}}$$

Note: Cations are expressed in me/l

If the SAR of the potable water supply is greater than 6, and the salinity of EC of the potable water is greater than 250, it is highly recommended that a saturation percentage test of the soil be done.

There are many variables in water quality and chemistry, soils and soil chemistry, vegetation and use of the private sewage system that may have an effect on the life and operation of a system. There has been a great deal of research done regarding water and soil chemistry for irrigation purposes, but very little research has been done regarding private sewage systems.

Note: These tests at this time have no direct relationship in regards to sizing of a soil based treatment system. Increasing the size of the system may delay problems. Adding other minerals to the effluent may help reduce the impact. Professional evaluation should be sought when this is a concern.

Water Softeners

A water softener that uses sodium chloride as a regeneration agent may cause problems for a treatment and dispersal system. The sodium chloride will increase the SAR of the potable water used in the building fixtures and thus the wastewater entering the onsite sewage treatment system. The increased sodium is not a result of only the backwash water from the softener; the softener puts sodium into the water used in the building plumbing fixtures. The softener works by exchanging sodium into the water while removing calcium and magnesium found in the hard water. The removed calcium and magnesium is discharged in the regeneration waste of the water softener along with some excess sodium used in the regeneration process. Redirecting the regeneration water will not avoid the sodium being sent into the sewage system as it is already in the water used in the building. If a water softener must be used, a softener that uses Potassium Chloride can avoid the problems of a sodium based softener. Also, avoid the installation of water softeners that automatically backwash at preset intervals of time rather than automatically by measuring water volume used. Softeners that regenerate based on time intervals regardless of the amount of water processed will discharge unneeded volumes of water and concentrations of salt into the sewage system.

Soil Based Treatment and Dispersal Systems

Design Considerations Based on Soil Considerations: Section 8.1.

Section 8.1 sets out requirements that apply to all soil based final treatment and dispersal components of a private sewage system. These requirements are used to determine the area of the soil infiltration area required to treat and disperse the effluent from the development.

Article 8.1.1.2 sets out the design considerations needed in determining the area required for dispersal and treatment of the wastewater effluent. These are addressed in other articles in section 8.1. Article 8.1.1.2 is repeated here for convenience.

8.1.1.2 Infiltration Area

1) In determining the soil infiltration surface area required for a soil-based effluent treatment system the following shall be considered in the design:
   a) hydraulic loading capabilities of the soil profile,
   b) linear loading rate limitations of the soil profile,
   c) organic loading on the soil infiltration surface resulting from the effluent strength,
   d) treatment capability of the soil profile,
   e) depth of suitable soil required to achieve treatment objectives, and
   f) achievement of treatment objectives at a depth that does not exceed 2.4 m (8 ft.), or a lesser depth as required by the site conditions and intended *treatment boundary limits*.

Hydraulic Loading Capacity of the Soil

Table 8.1.1.10 is the key part to determining effluent loading rates on the soil and the linear loading capacity of the soil. Table 8.1.1.10 is also provided in Table A.1.E.1 in Imperial measurements on pg. **206.**

Effluent Loading on In Situ Soil

Effluent loading rates on the in situ soil are selected from this table knowing the soil texture, the soil structure shape, the grade of the soil structure and knowing the quality of effluent applied. The third column of the table sets out effluent loading for primary treated effluent (septic tank effluent) and the fourth column sets out effluent loading for secondary or better treated effluent. Effluent loading rates are used to determine the area of the trench bottom of a treatment field, the area covered by a treatment mound, and the area required for drip dispersal systems.

Linear Loading on In Situ Soil

Linear loading rates that must be considered when the depth to a limiting layer below the infiltration surface (titled infiltration depth in the table) is shallow and will require horizontal flow of the effluent are set out based on soil texture, soil structure, grade of the soil structure, infiltration depth below the infiltration surface, and the slope of the ground. Linear loading is used to determine the length of area used to infiltrate effluent so that linear loading limitations are not exceeded.

The concept of effluent loading on a trench bottom and the linear loading from treatment fields and mounds is presented in the following graphics.

Figure : Treatment Mound Linear Loading Concept

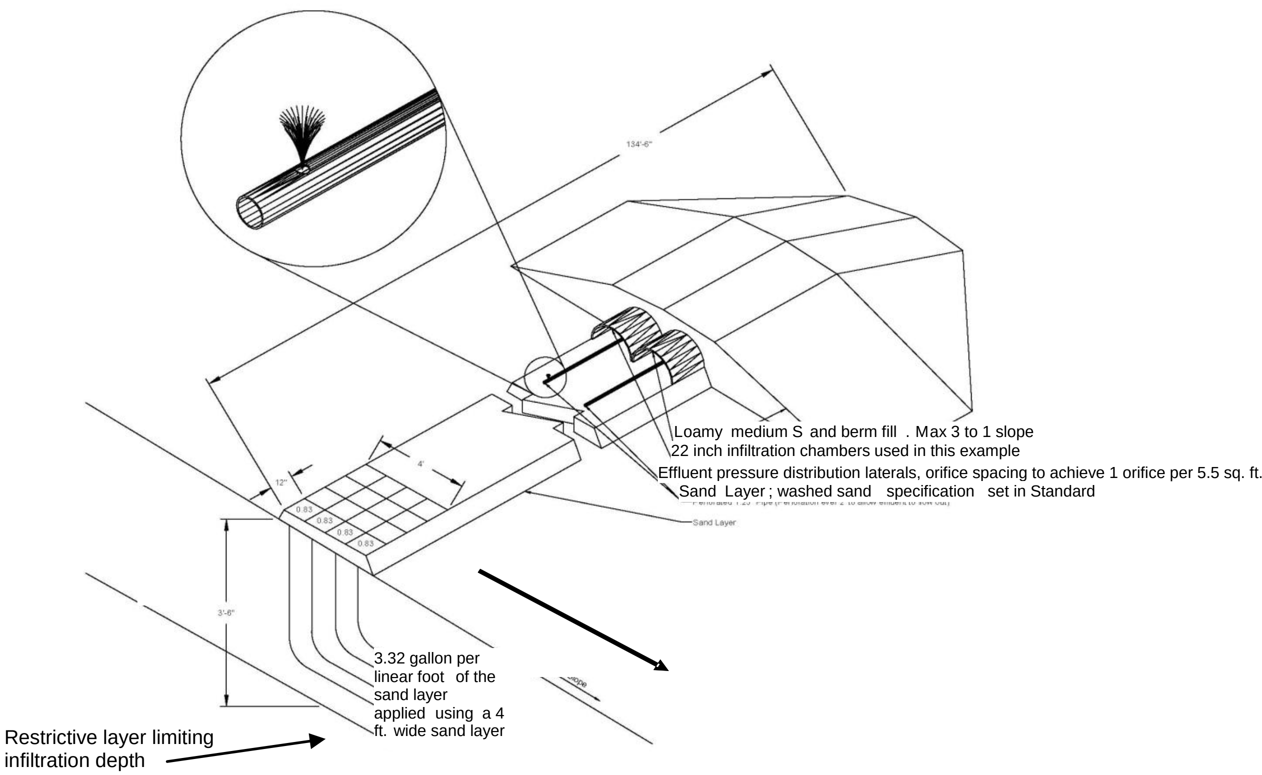
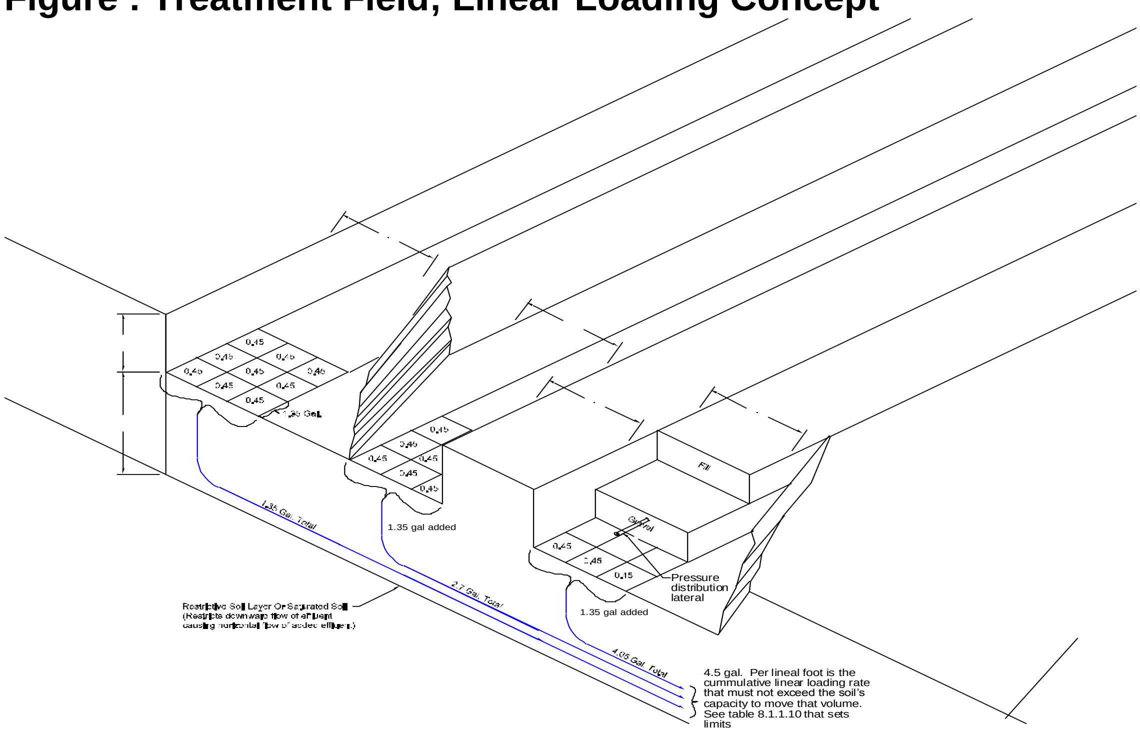


Figure : Treatment Field; Linear Loading Concept



Use of Effluent Loading Rate and Linear Loading Rate Table: 8.1.1.10 and A.1.E.1

The use of these tables is shown in an example applied in Table A.1.E.1 below. This table is used to select the appropriate effluent loading rate and linear loading rate. Two columns provide loading rates which differ based on the organic loading of the effluent (septic tank or secondary treated effluent). The columns on the right hand side of the table provide linear loading rates.

Figure: Graphic Illustration of Using Table A.1.E.1 Effluent Loading Rates

Table A.1.E.1. Effluent Soil Loading Rates and Linear Loading Rates (Imperial Gallons)

Soil characteristics			Infiltration loading rate: gal/day/ft²		Hydraulic Linear Loading Rate, gal/day/ft — Slope of land: 0 - <4%			4% - 9%			> 9%		
Texture	Structure: Shape	Structure: Grade	Effluent Quality: 30 – 150 mg/L	Effluent Quality: <30 mg/L	Infiltration distance, in.[1] 8 – 12	12 – 24	24 – 48	Infiltration distance, in.[1] 8 – 12	12 – 24	24 – 48	Infiltration distance, in.[1] 8 – 12	12 – 24	24 – 48
COS[2], MS, LCOS, LMS Requires pressure distribution	—	0SG	0.3	0.3	4.0	5.0	6.0	5.0	6.0	7.0	6.0	7.0	8.0
FS,VFS,LFS,LVFS Requires pressure distribution	—	0SG	0.4	0.5	3.5	4.5	5.5	4.0	5.0	6.0	5.0	6.0	7.0
COSL, MSL Requires pressure distribution	—	0M	0.2	0.6	3.0	3.5	4.0	3.6	4.1	4.6	5.0	6.0	7.0
	PL	1	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	3.6	4.1	4.6	4.0	5.0	6.0
		2,3	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	2.2	2.7	3.2	2.4	2.9	3.4
	PR/BK /GR	1	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	4.0	5.0	6.0	5.0	6.0	7.0
		2,3	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	4.0	5.0	6.0	5.0	6.0	7.0
FSL,VFSL	—	0M	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	2.4	2.7	3.0	2.7	3.2	3.7
	PL	1	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	2.4	2.7	3.0	2.7	3.2	3.7
		2,3	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	2.2	2.7	3.2	2.4	2.9	3.4
	PR/BK /GR	1	0.18	0.45	3.0	3.5	4.0	3.3	3.8	4.3	3.6	4.1	4.6
		2,3	0.32	0.63	3.3	3.8	4.3	3.6	4.1	4.6	3.9	4.4	4.9
L	—	0M	0.18	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	2.7	3.0	2.7	3.2	3.7
	PL	1	0.3	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	3.8	4.3	3.6	4.1	4.6
		2,3	0.0	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	2.7	3.2	2.4	2.9	3.4
	PR/BK /GR	1	0.3	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	3.8	4.3	3.6	4.1	4.6
		2,3	0.45	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	4.1	4.6	3.9	4.4	4.9
SIL	—	0M	0.0	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	2.7	3.2	2.4	2.9	3.4
	PL	1	0.0	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	2.7	3.2	2.4	2.9	3.4
		2,3	0.0	0.0	—	—	—	—	—	—	—	—	—
	PR/BK /GR	1	0.3	0.45	2.4	2.7	3.0	2.7	3.0	3.3	3.0	3.5	4.0
		2,3	0.45	0.63	2.7	3.2	3.7	3.0	3.5	4.0	3.3	3.8	4.3
SCL, CL, SICL, SI	—	0M	0.0	0.0	—	—	—	—	—	—	—	—	—
	PL	1	0.0	0.15	1.2	1.7	2.2	1.4	1.9	2.4	1.6	2.1	2.6
		2,3	0.0	0.0	—	—	—	—	—	—	—	—	—
	PR/BK /GR	1	0.18	0.27	2.0	2.5	3.0	2.2	2.7	3.2	2.4	2.9	3.4
		2,3	0.27	0.45	2.4	2.9	3.4	2.7	3.2	3.7	3.0	3.5	4.0
SC, C, SIC	—	0M	0.0	0.0	—	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	PL	1,2,3,	0.0	0.0	—	—	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	PR/BK /GR	1	0.0	0.0	—	—	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
		2,3	0.14	0.20	2.0	2.5	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
HC	—	0M	0.0	0.0	—	—	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	PL	1,2,3,	0.0	0.0	—	—	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	PR/BK /GR	1	0.0	0.0	—	—	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
		2,3	0.09	0.16	1.6	2.1	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

Septic tank effluent (→ 30 – 150 mg/L)

Secondary treated effluent (→ <30 mg/L)

Septic Tank Effluent Loading Rate on the in situ soil based on the following soil characteristics:

Clay Loam soil texture
Structure is blocky
Structure is Grade 2 – moderate

Secondary Treated Effluent Loading Rate on the in situ soil based on the following soil characteristics:

Clay Loam soil texture
Structure is blocky
Structure is Grade 2 – moderate

Linear Effluent Loading Rate on the in situ soil based on the following soil characteristics:

Slope at soil based treatment site is 5.5 %
Infiltration depth below infiltration surface to restrictive layer is 3 ft. 6in.
Clay Loam soil texture
Structure is blocky
Structure is Grade 2 – moderate

Effluent Loading Limitations on Coarse Textured Soils

The following articles apply where the soil texture falls within the categories ranging from coarse sand to medium sandy loam. These are the soil textures reflected in the first three rows of soil texture categorization in Table 8.1.1.10 or the imperial equivalent Table A.1.E.1.

Article 8.1.1.3. (2)	(limitations regarding effluent application on course sand textured soils)
Article 8.1.1.8. (2)	(spacing of orifices on sandy soils)
Article 8.1.2.2	(maximum actual loading rates on sandy soils)
Article 8.1.2.4	(reduction of loading rates on sandy soils with coarse fragment content exceeding 35%.

Further explanation of the Articles follows.

Article 8.1.1.3. (2) (limitations regarding effluent application on course sand textured soils)

Sentence (2) of this article restricts the application of effluent on coarse sand textured soils due to their limited treatment capability of these course textured soils. However, if there are finer textured soils in the profile through the depth required for treatment effluent may be applied to the soil. The finer textured soils in the profile depth must be of sufficient thickness to achieve treatment based on achieving a 7 day travel time to the treatment boundary depth.

Article 8.1.1.8. (2) (spacing of orifices on sandy soils)

When applying effluent on sandy soils, as listed in the first three rows of the effluent loading rate table, pressure effluent distribution is required and the orifice spacing cannot exceed 0.9 m (3 ft.). Also see Article 8.2.2.2(2) as applied to treatment fields.

Using effective pressure distribution is important to achieving effective treatment. If the effluent is applied by gravity distribution in the treatment field trenches, it is likely the effluent will quickly infiltrate into the soil and flow in saturated conditions down through a small area of the entire design area of the treatment field. The purpose is to treat the effluent not dispose of it into the ground and underlying water table. Positive control of where the effluent is applied so the entire area is utilized is very important in regard to treatment.

Article 8.1.2.2. (2) (maximum actual loading rates on soils)

This article sets maximum loading rates on soils within three groups. The purpose is to ensure adequate travel time to the vertical separation and achieving effluent treatment. The groups include courser sands to loamy medium sand soils, max 0.3 gallons per square ft. (row one of Table 8.1.1.10) or Table A.1.E.1 the equivalent table in imperial gallons; finer sandy soils to medium sandy loam textures, max 0.6 gallons per square ft. (row 2 and 3 of table 8.1.1.10); and fine sandy loam to clay textured soils max 0.83 gallons per square ft. (row 4 and below in table 8.1.1.10). Theses maximum loading should not be exceed so the travel time to the required vertical separation is achieved.

These maximum loading rates will have the most impact on applying credits for pressure distribution or chambers on the sandy to sandy loam textured soils set out in clause (2) (a) and (2) (b) of this article. It also comes into play when treatment mounds are used where the soils are sandy causing the loading rate on the sand layer of the mound to be reduced as set out in Article 8.4.1.4 and 8.4.1.5.

Where Table 8.1.1.10 sets out a lesser loading rate for textures within these groups the lesser amount must be applied.

Article 8.1.2.4

Sandy soils that include a significant amount of coarse fragment have reduced treatment capacity. Soils having a texture from coarse sand to loamy medium sand require a reduction in the effluent loading rate because of the reduced treatment capacity of the soil. These are the soils in the first row of Table 8.1.1.10.

If the coarse fragment volume in the soil is 35% to 60% the max loading rate on these soils is 0.2 gal. per sq. ft., and from 60% to 75% the max loading rate is 0.15 gal. per sq. ft.; if the coarse fragment volume is more than 75% the soil is unsuitable for treatment.

Coarse fragments refer to mineral particles that are larger than 2mm in size. In common terms gravel is the coarse fragments. See the soil description manual for direction on estimating the volume of coarse fragment in a soil which must be done in observation of the in situ soil profile. It cannot be done by a lab by analyzing a soil sample.

Vertical Separation

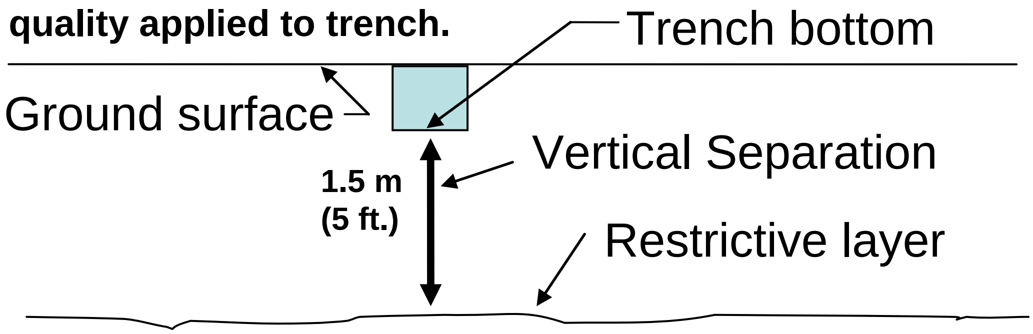
Articles 8.1.1.4 and 8.1.1.5 set out requirements for the minimum vertical separation. These vertical separations consider the quality of the applied effluent and the depth of suitable soil needed to achieve a 7 day travel time to the treatment boundary.

The vertical separation required for primary treated effluent (septic tank effluent) is 1.5m (5 ft.).
The vertical separation required for secondary treated effluent (treatment plant effluent) is 0.9m (3 ft.).

For a treatment mound receiving primary treated effluent on the sand layer the vertical separation as measured from the bottom of the 300mm (1 foot) thick sand layer is 3 feet. Secondary treated effluent is expected at the bottom of the required sand layer depth.

Figure : Vertical Separation Related to Effluent Quality

Primary Treated Effluent; BI
30 - 150 mg/L $CBOD_5$ and 30 – 100 mg/L TSS
quality applied to trench.



Secondary Treated Effluent; BII
25 mg/L $CBOD_5$;30 mg/L TSS or better
quality applied to trench.

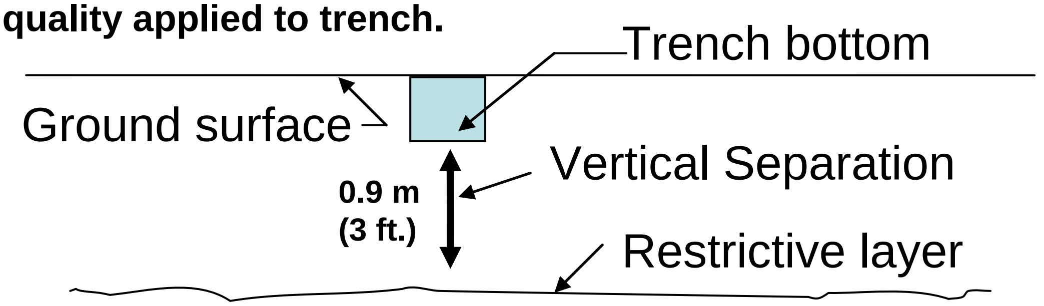
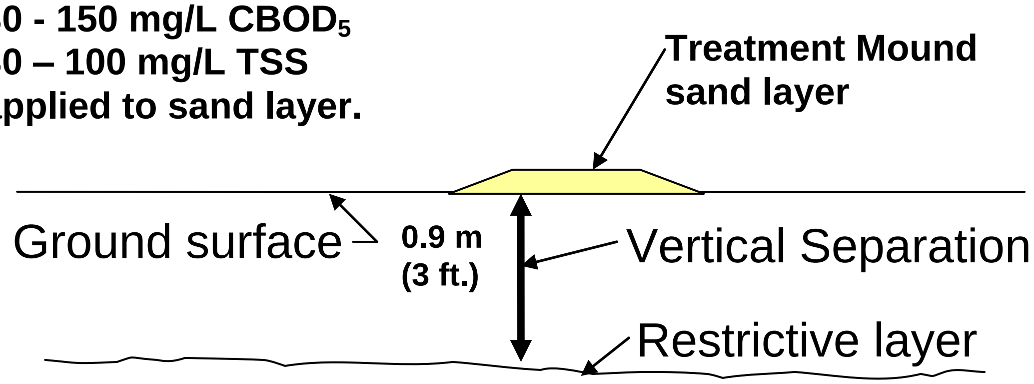


Figure: Vertical Separation Treatment Mound

Primary Treated Effluent; BI
30 - 150 mg/L $CBOD_5$
30 – 100 mg/L TSS
applied to sand layer.



Adjusting Prescriptive Effluent Loading Rates and Vertical Separations

Article 8.1.1.5 provides conditions under which the vertical separation can be adjusted to be less or more depth below the infiltration surface.

The vertical separation can be reduced in certain circumstances to as little as 600mm (2 ft.) as set out in 8.1.1.5.(2). These circumstances include:

- the effluent applied meets the quality set out for Level 3 – DIII (15 mg/L $CBOD_5$ and TSS and less than 200 CFU/100mL), and
- the system is not located within 2 km of a lake, river, stream, or creek, and
- it is not located over a GWUDI domestic use aquifer, and
- the 7 day travel time in the reduced vertical separation is still achieved through the vertical separation.

This article also allows the designer to increase the loading rate on soils that have the hydraulic capacity to accept the effluent over the long term and the site provides additional depths of suitable soil beyond what is required by the minimum vertical separation set out. The entire treatment depth of soil available at the site can be used. However the maximum depth below ground surface the vertical separation treatment boundary can be set at is 1.8m (8ft).

This adjustment to increase effluent loading rates is limited to application on sandy soils that have the capacity to transmit the effluent and treat the organic loading that forms the biomat. The soil categories in the first three texture rows of Table 8.1.1.10 are the soil textures this may be used on with limitations regarding allowable long term effluent loading considering the soil texture and structure.

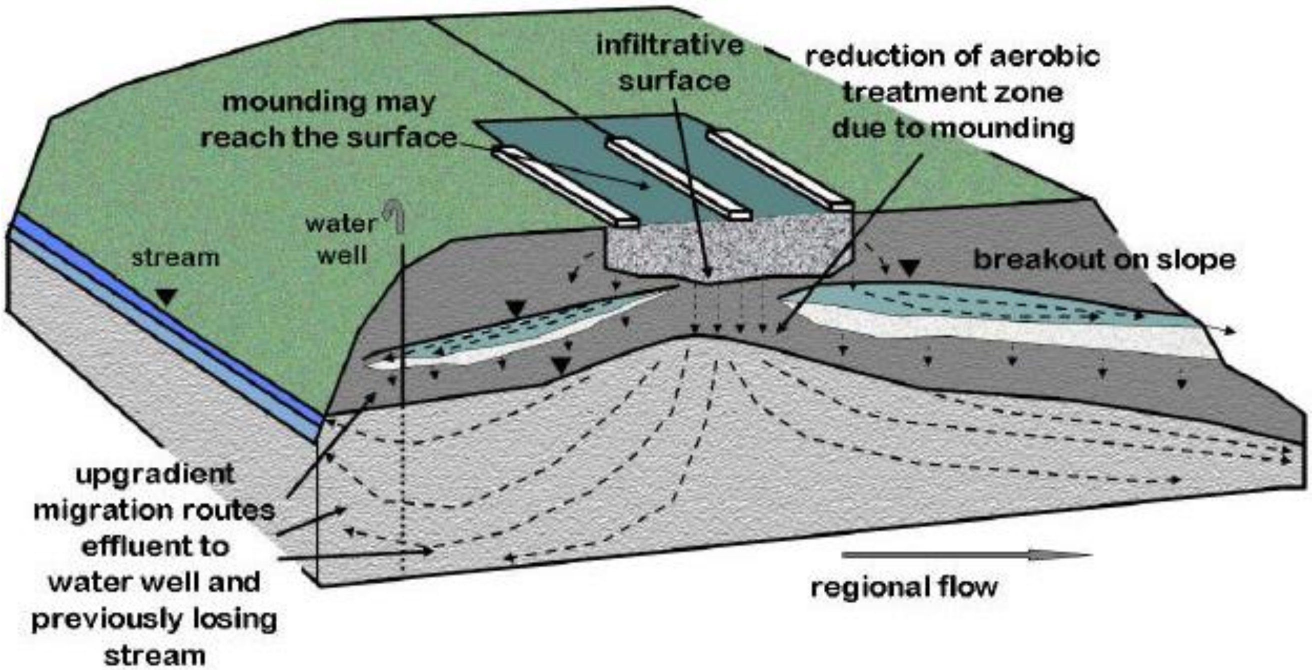
For example a Loamy medium Sand (single grained structure) has a long term loading rate for secondary treated effluent of 0.9 gallons per sq. ft. based on the 1999 Alberta standard of practice which is similar to standards in other provinces and states. The hydraulic capability is there in these soils to infiltrate that amount of effluent but the treatment capacity is limited. The minimum vertical separation is 3 ft and a loading rate of 0.3 gallons per sq. ft. is allowed based on achieving a 7 day travel time to the 3 ft. depth for the purpose of treatment. If there is 6 feet of vertical separation available at the site, the effluent loading rate could be doubled to 0.6 gallons per sq. ft. and the 7 day travel time would still be achieved, which is required for meeting treatment objectives.

Groundwater Mounding Considerations

The mounding of a groundwater table or the creation of a perched water table that will mound up in elevation under a treatment system may occur due to the addition of the effluent.

Mounding of the groundwater or creation of perched water table will reduce the depth of available vertical separation below the effluent infiltration surface. If the groundwater mound rises to the extent that the required vertical separation is compromised the treatment effectiveness of the system is reduced and may result in failure of the infiltration surface due to anaerobic conditions being present. The following graphic displays the concepts.

Figure: Groundwater Mounding



Source: Poeter E., J. McCray, G. Thyne, and R. Siegrist. 2005. *Guidance for Evaluation of Potential Groundwater Mounding Associated with Cluster and High-Density Wastewater Soil Absorption Systems*. Project No. WU-HT-02-45. Prepared for the National Decentralized Water Resources Capacity Development Project, Washington University, St. Louis, MO, by the International Groundwater Modeling Center, Colorado School of Mines, Golden, CO. Page: Title page.

This concept can be applied both to a small system on a localized basis and on the large scale for large volume systems or many smaller system is a high density development.

Article 8.1.1.9 of the standard requires ground water mounding investigation and modeling for all systems over 5.7 cubic meters per day.

This document referenced in the above graphic and in Article 8.1.1.9 provides a number of methods of predicting groundwater mounding. The intensity of the investigation and varies with each method. Selecting the appropriate method for a site is related to the risk of mounding and risk of system failure due to mounding.

Level of Investigation Required for Ground Water Mounding Potential

The following is extracted from that document and sets out the principles applied in determining the level of investigation required. While there are other methods that may be suitable these are a very good reference. Any method used must be justified as adequate considering the potential for ground water mounding and the risk and impact of system failure.

> *Evaluation of the potential for groundwater mounding and break-out on the surface or side slopes requires different levels of effort depending on the characteristics of the subsurface and the consequences of system failure. The phased approach indicates more investigation as the risk of mounding increases and the consequences of failure due to mounding become more severe. A flowchart guides preliminary assessment and indicates subsequent steps, based on preliminary site*

investigation to determine depth to groundwater and soil types (Figure ES-2). Specific sections of the report elaborate on these steps. Page x.

Sites with hydraulic conditions that indicate risk of mounding, and where the consequences of mounding are severe, require more intense field investigations (Chapter 2, sections 2.5 and 2.6) and sophisticated numerical models to estimate mound height (Chapter 3, section 3.5.5 for evaluation of vadose zone mounding of water on low hydraulic conductivity layers; and section 3.6.5 for mounding of the water table based on flow in the saturated zone). Advanced assessment is particularly important for sites where mounding has serious consequences, and sites that exhibit strong heterogeneity and/or anisotropy, sites with complicated boundary conditions, and those with significant time-varying hydraulic conditions. Page xi

Treatment Fields

Treatment Fields – General

The objectives of a treatment field are set out in Article 8.2.1.1. It is repeated here for convenience.

8.21.1 General
2) A treatment field shall meet the following objectives:
a) provide temporary storage of the effluent until it is able to infiltrate into the soil,
b) break down the organic loading contained in the effluent,
c) provide an area of soil over which the effluent is spread to reduce the hydraulic and organic loading on each part of the soil infiltration surface,
d) spread the effluent over a suitably sized area to enable sufficient oxygen to be transferred through the soil to achieve treatment objectives and long term utilization, and
e) introduce the effluent into the soil and be constructed in a manner that minimizes the risk of effluent breakout through the material covering the soil infiltration surface area that provides a barrier against direct contact with the effluent.

The biological microorganisms in the soil that perform the breakdown of the organic loading in the effluent are **"aerobic,"** meaning they require the presence of available oxygen for life. Their natural habitat is the near surface layers of the soil. This is why well aerated soils and comparatively shallow Treatment fields are the most efficient for effluent treatment. To take advantage of the treatment provided by these microbes weeping lateral trench bottoms cannot be deeper than 900 mm (3 feet) below the ground surface. Shallower trenches can provide better treatment and longer life.

The intermittent dosing of effluent, even distribution of effluent, the rest period required between doses and the use of sufficient infiltration area to allow a thin application of the effluent, all help in keeping the soil based treatment system **"aerobic."**

If the effluent infiltration area is too small causing it to be constantly saturated, the oxygen is driven out of the soil and the aerobic organisms die. If this occurs, the system becomes anaerobic, inefficient, a danger to health and may ultimately fail.

Weeping Lateral Trenches, Gravity or Pressure Effluent Distribution

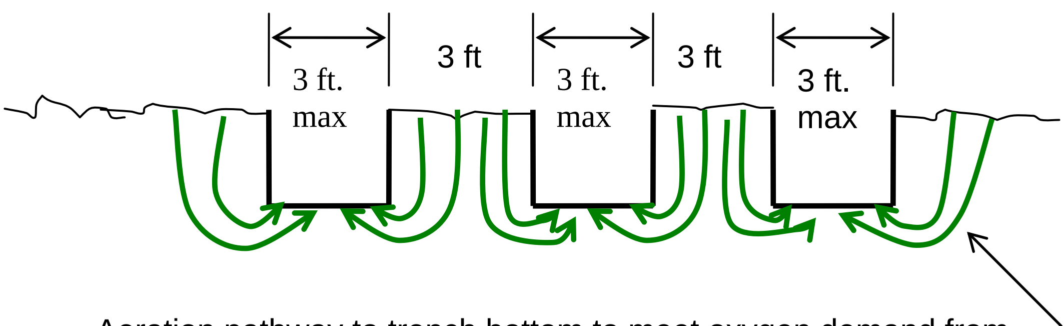
Separation of Trenches and Aeration Pathways

Although the Standard of Practice requires a minimum of 900 mm (36 inches) of earth between weeping lateral trenches, a distance of 3 m (10 feet) is recommended for ease of installation. See Article 8.2.2.3 (2).

Separation of the trenches is important to ensure adequate oxygen supply if provide to the infiltration surface and the vadose zone below the system in which treatment occurs. The following graphic illustrates the re-aeration routes to trenches in a treatment field. Very little if any re-aeration can be attributed to the infiltration surface as it is typically saturated or even ponded with effluent. Diffusion of oxygen into standing water or saturated soil is very limited to non-existent.

Figure: Re-aeration Path of Weeping Lateral Trenches

Trenches for weeping laterals must be 0.3 m (12 in.) minimum width and 0.9m (36 ") maximum width. The maximum depth of the trench is 0.9m (36 "); see Article 8.2.2.3(1) There is no minimum depth but a soil cover of 300mm (12") has shown, over time, to be adequate protection from frost for the weeping lateral trench. The required depth to prevent freezing may be less depending on the type of soil and protection from surrounding trees and winter snow cover which will vary from site to site. The gravity weeping lateral perforated piping is installed with the top of the pipe even with the top of the gravel in the trench. See pg. **313**.



Aeration pathway to trench bottom to meet oxygen demand from effluent application. A sufficient width between trenches is required to allow the required supply of oxygen to the underlying soil. As the depth to the infiltration surface increases the transmission of oxygen through the soil to that depth decreases. A wider separation of trenches should be applied as the depth increases.

Credit for Pressure Distribution of Primary Treated Effluent

Using pressure effluent distribution laterals in gravel weeping lateral trenches allows the trench bottom infiltration area to be reduced by 20% as set out in Article 8.2.1.8. This reduction applies only when applying primary treated effluent (septic tank effluent). The reduction does not apply to trench bottoms receiving secondary treated effluent. As Article 8.1.1.8(1) requires pressure distribution of all secondary treated effluent the loading rates set in Table 8.1.1.10 have set anticipating pressure distribution. Also see pg. **255** Pressure distribution systems.

Limits on Credit for Pressure Distribution of Primary Treated Effluent – Gravel Trench

The credit applied when using pressure distribution laterals in gravel trenches has limitations similar to those applied to chamber systems. Specifically, the credit applied for pressure distribution in gravel trenches when applying primary treated effluent cannot result in the credited width exceeding 0.9 m (3 feet) of trench width.

For clarity the following method is followed when applying the credit for pressure distribution in a gravel trench as allowed by Article 8.2.1.8.

When pressure effluent distribution laterals are used in gravel or acceptable gravel substitute trenches, the credited width of the trench bottom area may be calculated at 1.2 times the actual width of the gravel trench and in no case shall the credited width exceed 0.9 m (3 feet).

When this credit is applied it will result in a higher actual effluent loading rate. The actual loading rate cannot exceed the loading rate for secondary treated effluent on that same soil profile. The resulting actual effluent loading rate also cannot exceed limits set out in Article 8.1.2.2 based on the treatment capacity of the soil. In addition on sandy soils that have over 35% coarse fragments the actual effluent loading rate cannot exceed the limits set out in Article 8.1.2.4.

Provisions set out in Article 8.1.1.5 that may allow adjustment of loading rates based on maintaining the 7 day travel time to restrictive layers in the underlying soil may be applied if sufficient soil depth is available.

Credits applied to the trench bottom area required for a gravel trench using pressure effluent distribution receiving primary treated effluent must be applied consistent with credits applied and allowed in regard to chamber systems, which is also limited to a maximum credit of 0.9m (3 feet).

The reason for this limit on the application of this credit is consideration for the increased organic loading on the infiltration area in a trench which creates an oxygen demand that could exceed the capacity of the soil to allow the oxygen to the trench bottom at the width of 3 feet while also being loaded heavily. This is why the credits applied to chamber widths are limited to a maximum of 3 feet. This same principle must be applied when calculating the credits for pressure distribution in gravel trenches.

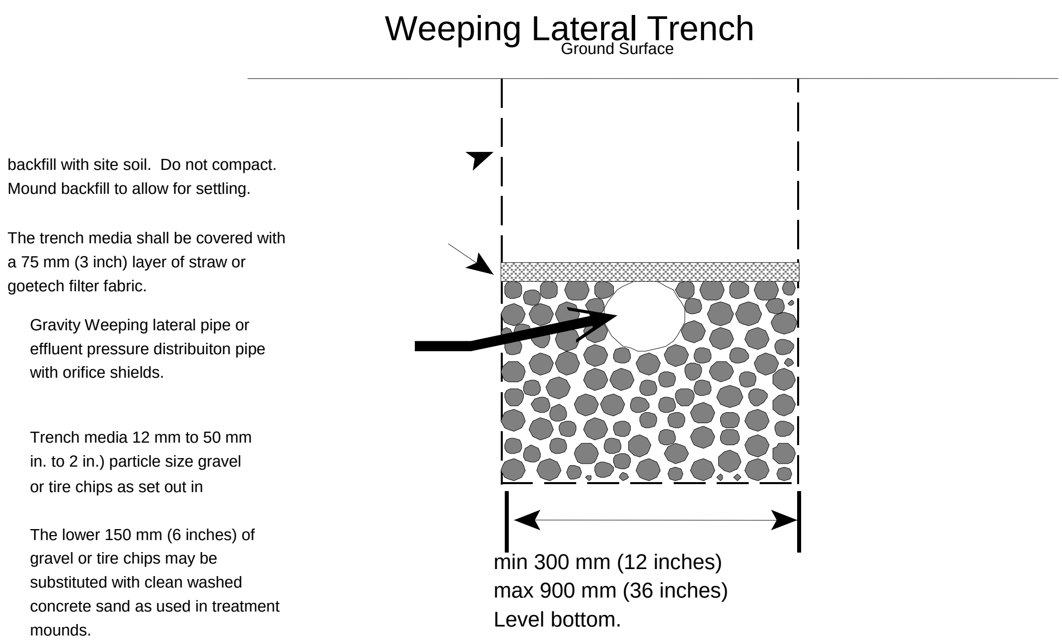
Design and Construction of Weeping Lateral Trench

Each weeping lateral pipe, and the trench bottom throughout their entire length, should be nominally level. The top of the trench (ground surface) can vary as long as the depth to the trench bottom does no exceed the 900 mm (36 in.) maximum depth.

The weeping lateral piping shall be bedded in gravel, or other acceptable media. When gravel or alternate acceptable media is used, the top of the media should be even with the top of the weeping lateral piping. This provides support for the piping and prevents it from becoming oval shaped or broken due to the weight of the soil above or, in the event that vehicles are driven over the trenches.

If gravel is used in the weeping lateral trench, a 12 inch depth of washed, coarse gravel of a particle size 12 mm to 50 mm (1/2 in. to 2 in.) is used in the bottom of the trench. The lower 150 mm (6 inches) of gravel may be substituted with clean sand. The sand must be washed sand and not contain any silt or clay. See, Article 8.2.2.3 for the media used in the weeping lateral trench.

Figure: Weeping Lateral Trench Cross Section Detail



Trench Media Volumes Required

Depth of Trench Media	Trench Width	Cubic Meters (Yards) of Media Meter (Foot) Weeping
150 mm (6 inches)	600 mm (24 inches)	0.9 ^{3} (0.038)
300 mm (12 inches)	600 mm (24 inches)	0.18m ^{3} (0.075)
150 mm (6 inches)	900 mm (36 inches)	0.14m ^{3}
300 mm (12 inches)	900 mm (36 inches)	0.27m ^{3} (0.11)

Gravel in the trench provides these functions:

- It allows effluent to escape freely from the weeping lateral to prevent freezing.
- It provides temporary storage of the dosed volume of effluent until it is able to infiltrate into the ground.
- If effluent distribution lateral pipe (gravity or pressurized) are laid directly in soil, the perforations soon plug and the effluent cannot escape. Gravel keeps the escape holes open; 0.3 m (12 in) of gravel is preferred.

Cover the clean gravel with any kind of straw (except Flax straw) or a geotech filter fabric to prevent the backfill soil from falling into the gravel and filling the air spaces in the gravel. See pg. **327** for typical specs on geotech fabric.

If tire shreds are used as a gravel replacement, the tire shreds must be compacted in the trench prior to the installation of the effluent lateral piping. A filter fabric is required over the tire shreds instead of the straw.

Backfill in the weeping lateral trenches must not be compacted. Do not pack the backfill or run vehicles over it. Allow 50 mm to 75 mm (2 or 3 in.) of excess backfill to make up for settling, and allow the backfill to settle naturally.

Chamber Type Treatment Fields

Chamber type treatment field trenches are an alternative to gravel filled trenches. Chambers are manufactured structures that replace the gravel used in a trench and provide the same function as gravel in that a void space for temporary storage of the dosed effluent is provided. The chambers are installed in the excavated trenches beginning with a starter section and each chamber interlocks with the next chamber. The manufacturer provides ends, splash pads and other accessories for their chambers.

There are several manufacturers of chambers and each manufacturer has different installation requirements. Some manufacturers require the chambers to be covered with a filter fabric, others do not. The method of connecting piping to the chambers may be different from manufacturer to manufacturer as well as the method of installation of small diameter piping for pressurized distribution laterals for the distribution of effluent throughout the entire length of the weeping lateral trench.

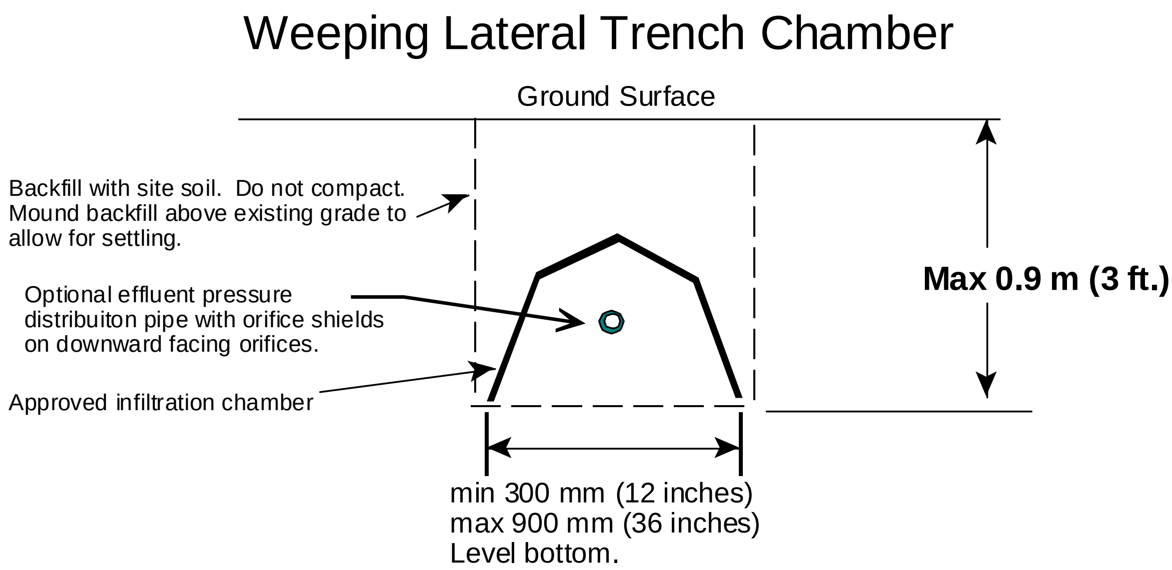
Chamber type treatment fields are subject to all normal installation requirements for treatment fields. However, there are some additional requirements for the installation of chambers. Chamber system installations must include splash pans supplied by the manufacturer, or the most upstream 3 m (10 ft.) of the infiltration surface of the weeping lateral trench or other area that directly receives the effluent dose, shall be covered with a minimum of 100 mm (4 in.) of gravel, or use some other suitable means to dissipate the hydraulic energy of the effluent entering the trench to prevent erosion or disturbance of the trench bottom. This is required only in gravity weeping lateral trenches. It is not required if pressure effluent distribution laterals are used.

Although the there may be some advantages to the use of chambers such as they are light weight, easy and quick to install, and less site cleanup (removal of excess or spilled gravel and straw) is required, chambers are subject to same problems in the soil as gravel filled trenches. The same site variables that effect the operation of gravel filled trenches, also effect the operation of chamber systems.

Chamber systems must provide the same equivalent square footage of trench bottom as required for a gravel filled trench system. A chamber is credited with an equivalent width 1.1 times its actual width when receiving primary treated effluent and effluent is distributed by gravity through the length of the trench. A credit of 1.3 times the actual width is allowed when the effluent is distributed using pressure distribution laterals. Chamber credits are set out in Article 8.3.1.5 for systems using primary treated (septic tank effluent) and in Article 8.3.1.5.(3) when secondary effluent is supplied to the trenches. Article 8.3.1.5 sentence (2) sets out a limit a maximum credited width of chamber of 3 ft. when primary treated effluent is applied; so a 3 foot wide chamber would not receive any credit for its width. This limit does not apply when secondary treated effluent is applied.

See pg. **312** (gravel trenches) and pg. **325** (chambers) for further discussion on this limited credit on the width as it also applies to gravel trenches using pressure distribution of effluent and the credits available in that situation.

Figure: Treatment Field Trench Chamber Cross Section Detail



Sizing of Treatment Field Trench Bottom Area

Treatment fields are sized using three basic criteria:

- The peak volume of sewage expected per day (with consideration to the strength of the sewage effluent)
- The quality or strength of the effluent
- The soil's capacity for receiving effluent

Based on this criteria effluent loading rates set out in Table 8.1.1.10 or A.1.E.1 are applied.

Although there may be other site specific consideration that must be made, by using this criteria the weeping lateral trench bottom area can be determined.

Treatment Field Worksheet

The following worksheet provides a process for calculating the required trench bottom area in a treatment field.

Primary Effluent Treatment Field

Trench Bottom Surface Area & Length Sizing

This design worksheet was developed by Alberta Municipal Affairs and Alberta Onsite Wastewater Management Association.

The complete system is to comply with Alberta Private Sewage Standard of Practice 2009
This worksheet does NOT consider all of the requirements of the mandatory Standard
Use only Imperial units of measurement throughout (feet, inches, Imperial gallons, etc…)

Step 1) Determine the expected volume of sewage per day:

Note: Use Table 2.2.2.2.A. (p.30) & 2.2.2.2.B. (p.31) as a guide to determine expected volume of sewage per day. Provide allowance for additional flow factors as detailed in Table 2.2.2.3. (p.32)

Expected Volume of Sewage per Day [ ] **F1**

Assure that the sewage strength does not exceed the requirements of 2.2.2.1.(2) (p 30)
Effluent quality must meet the requirement of Article 8.1.1.6(1)(a) page 97.

Step 2) Determine the (design) soil effluent loading rate:

Soil Effluent Loading Rate [From >30 - 150 mg/L column]

[ ] Texture **&** [ ] Structure **&** [ ] Grade **=** [ ] **Imp. gal/ sq.ft./day** **F2**

Note: Effluent loading rate MUST be determined from soil texture, structure, and grade classification according to Imperial Table A.1.E.1. (p.151).
Note: Ensure infiltration loading rate chosen does not exceed loading rates as set out in 8.1.2.2. (p. 101

Step 3) Calculate the required infiltration surface area for the soil BEFORE area reduction factors:

Expected Volume of Sewage per day		**Soil Effluent Loading Rate**		**Soil Infiltration Area Required**	
[ ]	÷	[ ]	=	[ ]	**F3**
Imp. gal/day		**Imp. gal/sq. ft/day**		**sq.ft.**	
From F1		From F2			

At no time shall primary treated effluent loading rates exceed the loading rates for secondary treated effluent.

Step 4) Type and width of trench bottom used:

Actual Pipe & Rock Trench Width in inches. [ ]	**inches**	÷	12	=	[ ] **feet**	**F4**
Actual Chamber Width in inches [ ]	**inches**	÷	12	=	[ ] **feet**	**F4A**

Step 5) Calculate optional credited loading rates for distribution systems:

Primary treated effluent is required to have a minimum 5 feet Vertical Separation below infiltration zone.

					Credited Width of Trench (feet)	
Pipe & Rock Trench	Actual Width in Feet From F4	X	1	=	3 ft. Maximum	F5
Pipe & Rock Trench with Pressure Distribution	Actual Width in Feet From F4	X	1.2	=	3 ft. Maximum	F5
Chambers - Gravity Feed	Width of Chamber in Feet From F4A	X	1.1	=	3 ft. Maximum	F5A
Chambers - Pressure Distribution	Width of Chamber in Feet From F4A	X	1.3	=	3 ft. Maximum	F5B

Step 6) Determine linear feet of trench required:

Infiltration Area Required			Credited Width of Trench			Total Trench Length in Field		
	sq. ft.	÷		ft.	=		feet	F6
From F3 or F3A			From F5, F5A or F5B					

Step 7) Select number of weeping lateral trenches and Determine length of each of trench:

Total Trench Length Required in Field			Number of Individual Weeping Lateral Trenches		Length of Each Weeping Lateral Trench		
	ft.	÷		=		feet	F8
From F6			F7 Designer Determination				

It is good practice is to make the overall field area long and narrow when possible on a particular site.

Step 8) Summary:

F1		Imp. gal/day - Daily Flow, including any additional fixtures.
F2		Imp. gal/sq.ft. - Effluent Loading Rate.
F3 or F3A		Sq. Ft. - Soil Infiltration Surface Area.
F4		Ft. - Actual width of Gravel Trench or Chamber.
F5A or B		Ft. - Credited Width of Gravel Trench or Chambers.
F6		Ft. - Total trench length required.
F7		Number of weeping lateral trenches.
F8		Ft. - Length of each weeping lateral trench.

Location of Treatment Fields

The first consideration in determining the location of the treatment field is the soil conditions available. The best location is where the best soil conditions exist on the property. The location of the treatment field also needs to consider the impact on and by other development on the property such as driveways, hard packed yards, garden areas, paths, surface drainage routes, etc. The locations available are most restricted by soil conditions on the property. As the soil cannot be changed, this is the prime criteria in selecting the location for a treatment field. If favorable soil conditions are limited on the property, it may require some change in the planned location of other development on the property.

Also affecting the location are the minimum distance separations set out in Article 8.2.2.1 to such features as water sources (wells) water sources, property lines and buildings. These separation distances also apply to these features that may be on an adjacent property. The site investigation must look beyond the property line as required to ensure these distances are met.

The treatment field should be constructed on elevated, well drained ground as opposed to low areas which may be subject to flooding or where a seasonally saturated soil conditions may be shallow in the soil.

The ideal location is a sloping, sheltered, well drained, sunny location where the grass is well kept in summer and a substantial depth of snow accumulates in the winter.

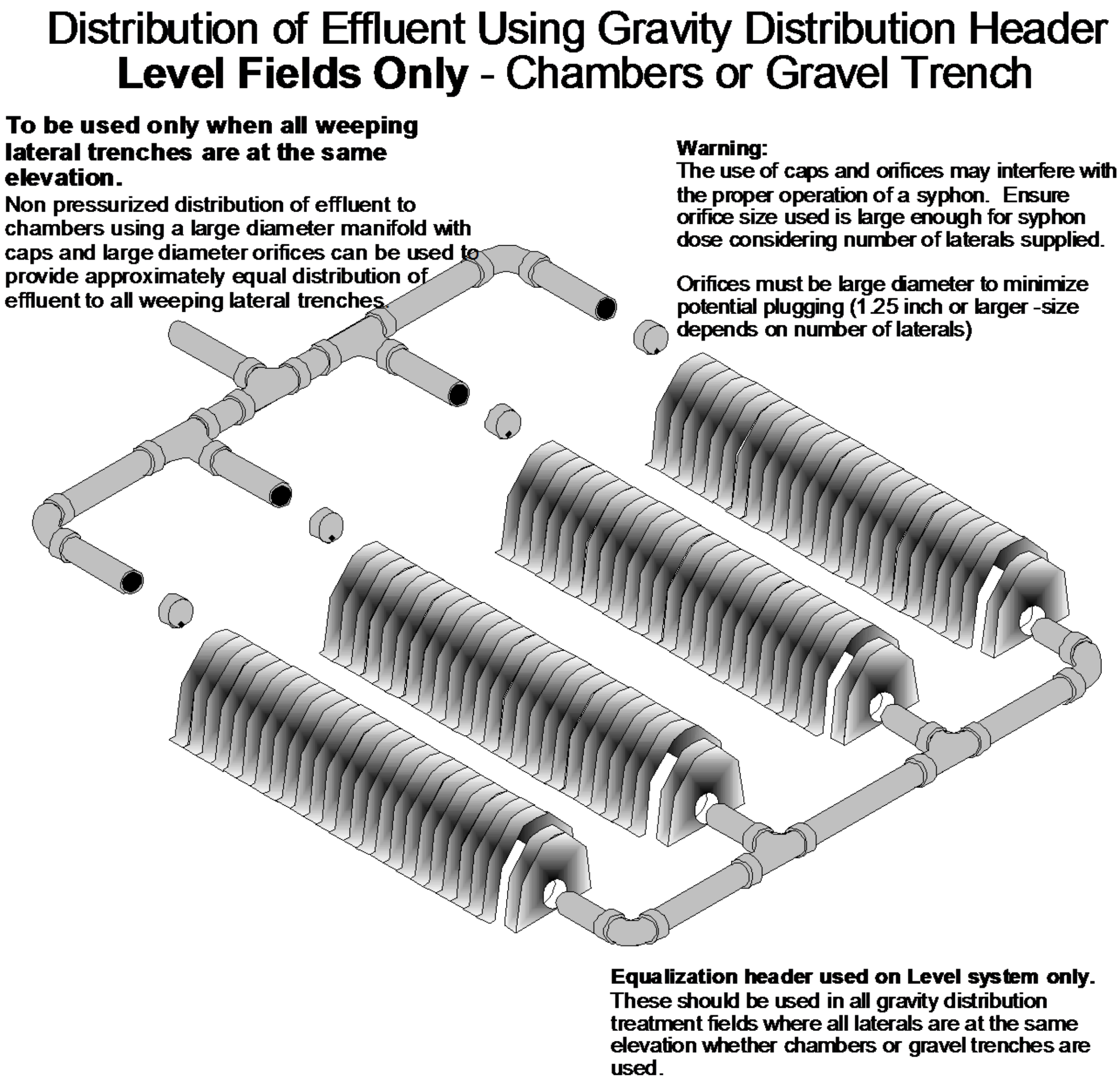
Level Ground Systems Gravity Trenches

Effluent can be supplied to each trench in a level ground treatment field using the following methods:

- (a) a pressure supply to each trench,
- (b) a distribution box, or
- (c) a gravity distribution header using fittings such as (Y's), (T's), (TY's), or "crosses" in the gravity distribution header that must be installed level and all perforated piping and trench bottoms must be at the same level; See, Article 8.2.2.5.
  (the use of a gravity header and such fittings is allowed but has limited effectiveness at achieving equal distribution);

The effluent dose to the distribution box or gravity header can be by siphon or pumped doses. Effluent cannot be delivered to the trenches by a trickle flow.

Figure: Gravity Distribution of Effluent in Field



Sloping Ground Treatment Fields

Where the treatment field is located on a sloping area, special precautions must be taken to equally supply effluent to all the individual weeping laterals. This can be accomplished by using distribution boxes, pressure supply to the start of the laterals or an entire pressure effluent distribution lateral system. This is set out in Article 8.2.2.6

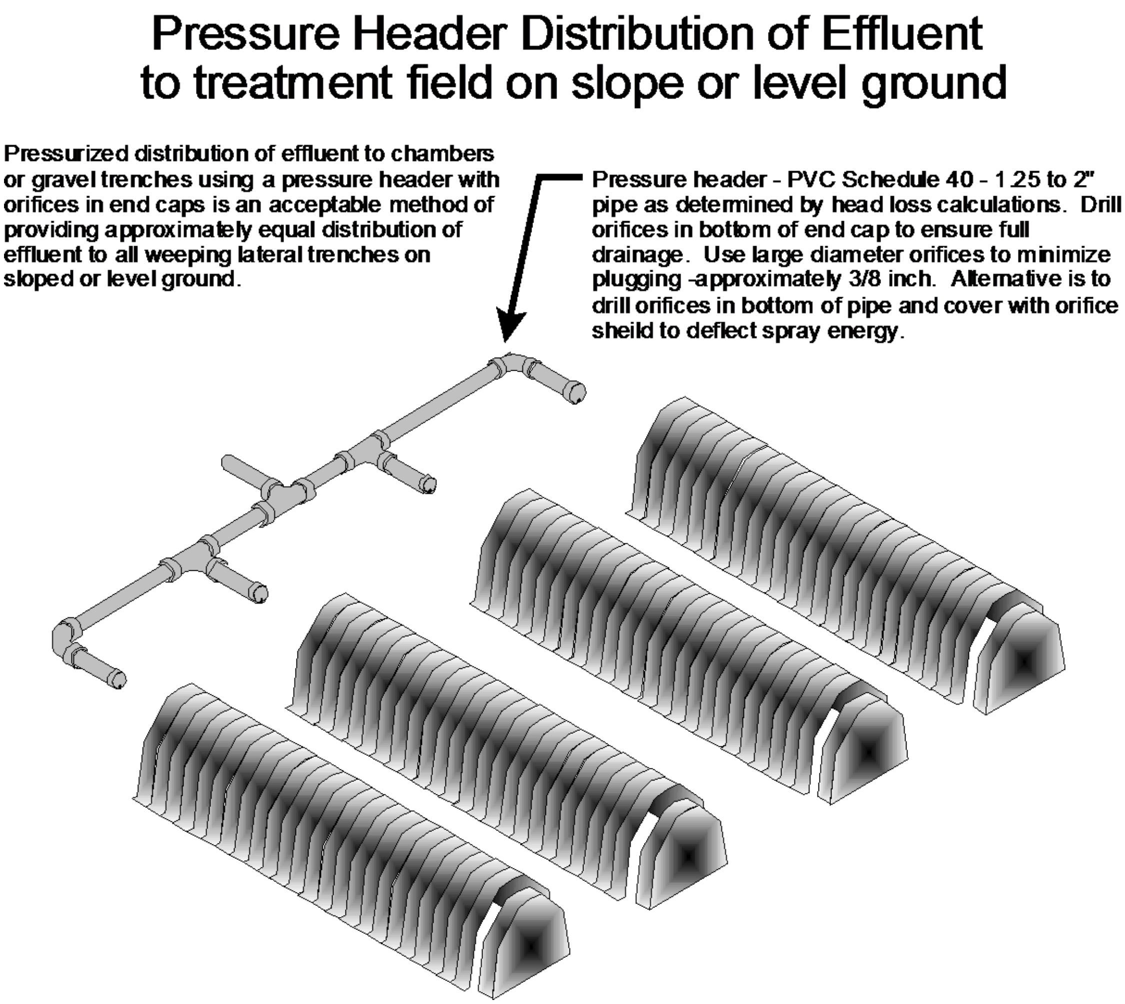
On sloping ground systems, each weeping lateral trench is level from end to end, but each individual weeping lateral trench is at a different elevation.
Selecting the layout of the trenches requires that the laterals are aligned so the length of the lateral is at 90 degrees (or a right angle) to the slope at the site.

The soil backfill around the distribution pipe that runs from trench to trench on a slope must be tightly compacted to prevent effluent from following the distribution pipe in the disturbed earth of the trench down the slope and overload the lower trenches.

Sloping Ground Treatment Fields: Using Pressure Supply to Gravity Laterals

A pressure header can be used to provide equal distribution of effluent to each weeping lateral. It is one of the methods required by Article 8.2.2.6 to ensure equal distribution to all weeping lateral trenches. This is the most effective method of ensuring even distribution of effluent to gravity weeping laterals. There is no credit for reducing trench bottom area using this method. To gain credit for reduced trench bottom are full pressurized effluent distribution laterals that run the length of each trench is required.

Figure : Pressure Header to Gravity Weeping Lateral Trenches



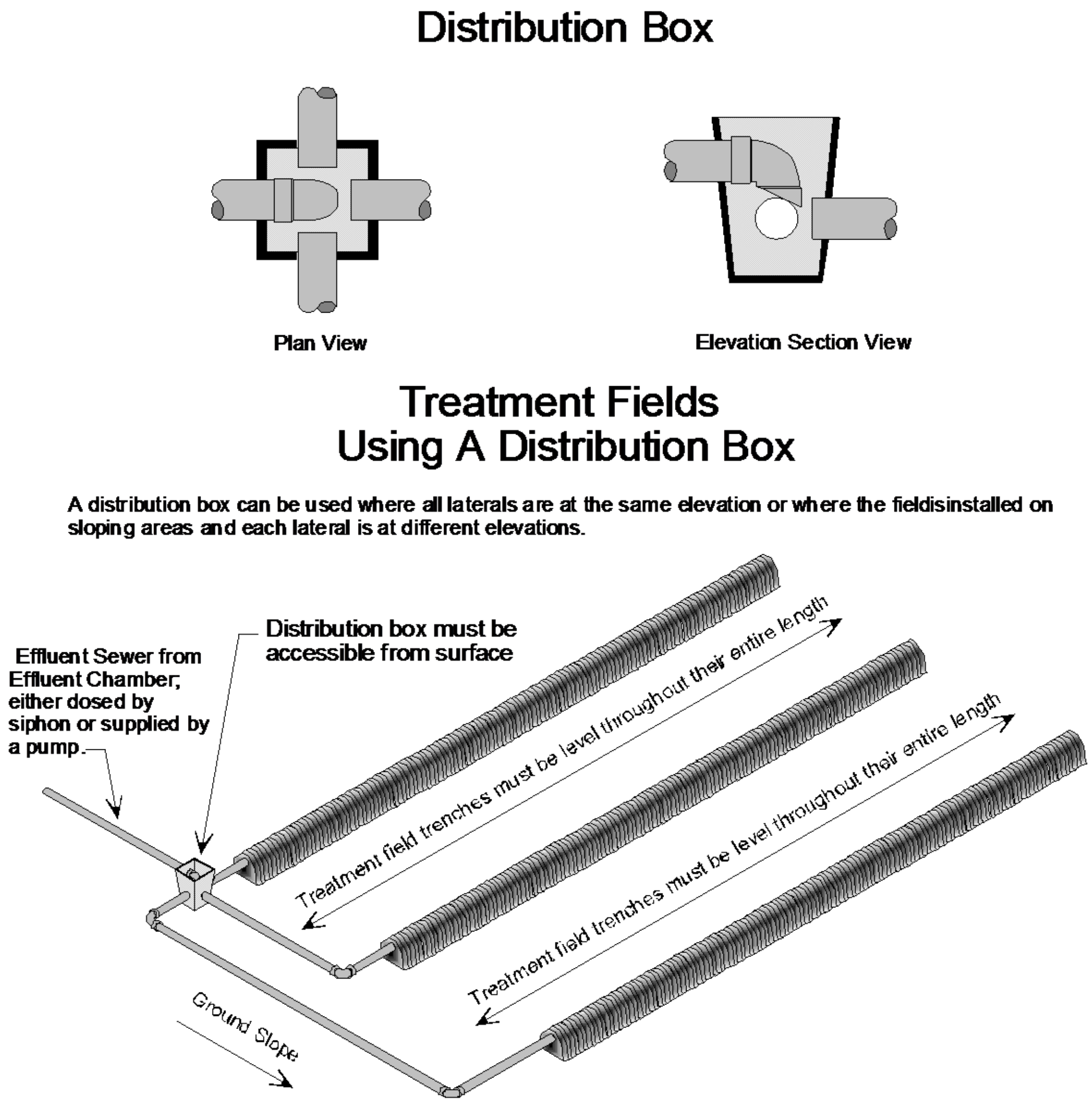
Sloping Ground Treatment Fields Using Distribution Boxes

The distribution box is used to distribute relatively even volumes of effluent to each weeping lateral with gravity flow. Settling of the distribution box or heaving due to frost can put the outlets out of level and so flow from each outlet may not be even. In jurisdictions that allow trickle flow, such as in other provinces and many parts of the U.S., distribution boxes are viewed as ineffective. Any movement of the distribution box is critical when trickle flow from a septic tank is used as the small amount of flow will definitely be diverted to the lowest outlet; however this Standard does not allow trickle flow from the tank to the field.

The effluent must be supplied to the distribution box in a dosed volume. This higher flow rate from a dose of effluent minimizes the difference in distribution that may occur due to the box being out of level as compared to when trickle flow is used.

Distribution effectiveness must be checked yearly. Distribution box designs may include such things as adjustable weirs, baffles, or orifices etc. that allow for adjustment after installation.

Figure: Distribution Box Effluent Distribution in a Treatment Field



A benefit from using the distribution box is that it allows access to adjust distribution so that flow to one lateral could be shut off or minimized. This may be done in the event ponding in one particular weeping lateral is noticed in the monitoring ports of the treatment field trench that are required by Article 8.2.2.10 and displayed graphically on pg. **364**.

Small dimension distribution boxes are most effective. Many distribution boxes available are large and rectangular in shape, having the inlet on one side and many outlets along the other side and in some cases, the ends. These large distribution boxes create significant horizontal distances between the outlets that are farthest apart. With the large surface area of this design and distance between outlets, any movement of the distribution box caused by frost heave or settling amplifies the difference in elevation of the distribution box outlets resulting in unequal distribution.

To minimize the potential for unequal flow from the distribution box, it is important to:

- keep the distribution box as small as possible, See Article 8.2.2.7. ,
- keep the number of outlets to a minimum,

- keep the outlets as close together as possible,
- provide a volume flush to the distribution box and field, and
- prevent the momentum of the incoming effluent from washing directly into an outlet.

Sloping Ground Treatment Fields; Using Drop Boxes – Article 8.2.2.8

Drop boxes are simply a container with holes for the effluent inlet and outlet piping to the weeping laterals. The ends of the outlet pipes must extend into the drop box far enough to be capped off. Periodic capping allows the weeping lateral(s) to be given a rest period by forcing the effluent to overflow to the next drop box and lateral(s). The lid of the drop box must be accessible from surface to provide access for capping the weeping lateral(s), and a method of monitoring the condition of the treatment field. Proper marking of the location and protection of the drop box lid and insulation to minimize freezing is required.

Drop boxes load each trench progressively down the slope. As one trench is filled with effluent and reaches capacity over time the excess effluent will then flow to the next trench. This results in each trench being filled and saturated as they are used. This causes anaerobic conditions in the trench and removes any advantage of increased digestion of the sewage by aerobic microorganisms. While drop boxes are an acceptable method of distribution it is not a preferred method. The drop box method can overload the treatment capacity of individual trenches.

Split Treatment Fields

Split Treatment for the Purpose of Providing Rest Periods

Split fields are advantageous in areas with soils that have a high saturation percentage (high percentages of clay or expansive clays), as these soils may be expected to have reduced infiltration rates after being in use for a period of time. These expansive clays will shrink as they dry causing considerable cracks in the soil which will accept effluent when the laterals are put back into use. The cracks will provide a greater surface area for the effluent to enter the soil.

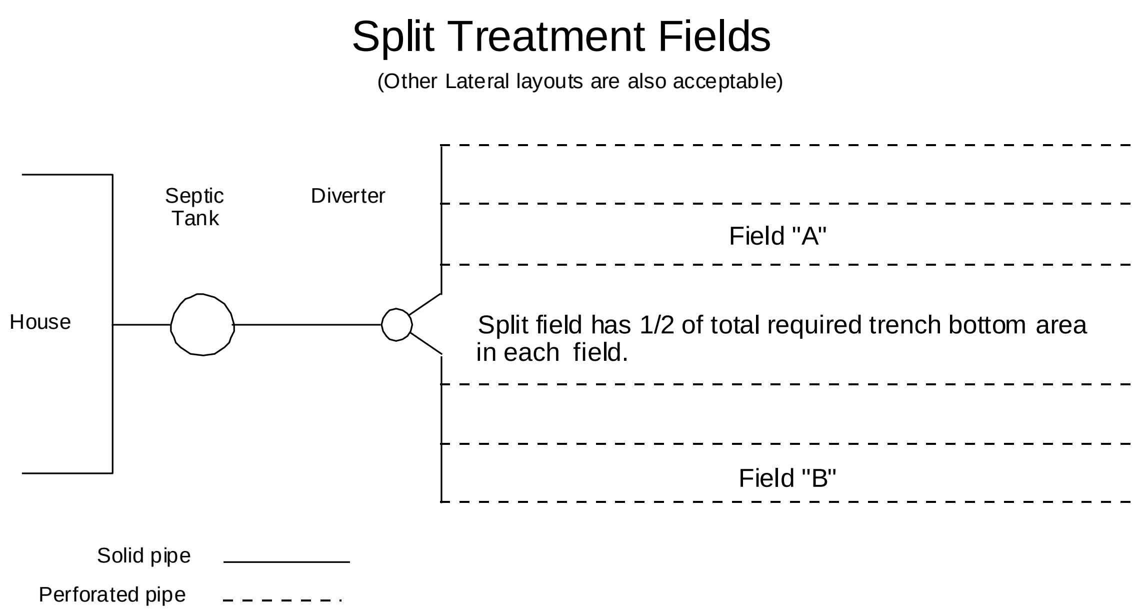
Another advantage of the split field system is that treatment field can be split so each part is located in smaller areas separated from each other. See pg. **324**, Fig. Split Fields. For example, one treatment field area in the front of the house and the other in the back yard. This can be a viable alternative in situations where there is not sufficient room in one area to install the total area of weeping lateral trench required, or a way to add on to an existing treatment field which has failed. In this case, the new treatment field may not have to be full size if there is certainty the old treatment field area will recover in a reasonable time. After the old field recovers the effluent is regularly switched from one field area to another.

Using split fields will result in higher actual effluent loading rates on the infiltration surface as only half the field is used at a time. The resulting loading rate cannot exceed the maximum allowed by Article 8.1.2.2 that is limited by the treatment capacity of the soil based on achieving a 7 day travel time of the effluent trough the soil.

Split Fields Used for Adjusting to Occupancy Variations and Concern with Freezing

Using the split field arrangement can help address variations in occupancy that often occur in a home. The design must address full peak flow anticipated for the building at full occupancy; however, the actual occupancy may be significantly less than used in the design. When this occurs a split field can be an advantage in the winter time as the full available wastewater flow goes to one part of the field and provides more heat from the water to reduce the potential for freezing. If occupancy increases the system can be set up to supply both parts of the split field. Split fields do not necessarily have to operate as a one or the other side; both sides can receive effluent if the system is designed appropriately.

Figure: Split Treatment Fields



This system takes the total required trench bottom area of weeping laterals required and splits it into two separate fields. The minimum size of each field when using the split field method must not result in an actual loading rate that exceds the amounts allowed in Article 8.1.2.2.

The use of a diverter (a small manhole in which the unused outlet is pluggedor a valve is provided on pressure distribution), allows the owner to switch the flow of effluent from one field to the other. This provides a rest period where a saturated or inefficient field may dry out and regenerate.

Raised Treatment Fields: Articles 8.2.2.11 to 8.2.2.14

Raised Treatment fields may be installed where a Restrictive Layer (low permeable soils or a seasonally saturated layer) does not provide sufficient vertical separation for the installation of a normal in ground treatment field. This system is installed by importing fill material to allow the trench bottom to be very shallow in or even above the in situ soil. The imported material must be coarse textured soils as required in Article 8.2.2.12 and any imported fill directly under the trenches must meet the requirements as set out in Article 8.2.2.11.(1) (b). When considering this method, it is a good practice to haul in the fill material and let it settle naturally over winter before proceeding with the installation of the system. This will help to avoid settling and landscaping problems after the installation is made. Grass cover should be established as soon as possible after the installation is completed.

In addition to the requirements set out in these Articles that apply to raised treatment fields all other requirements as apply to an in ground treatment must be met.

The requirements to configure the field to address linear loading may likely apply if there is a reduced depth to the restrictive layer that is causing the use of the raised treatment field. In most cases a treatment mound will be a more effective system choice when considering cost. The required fill materials in a raised field are essentially the same as used in a treatment mound.

Chambers Used in Treatment Fields

Manufactured chambers can be used in treatment fields in place of the gravel media used in traditional system.

All requirements as apply to treatment fields using trench media (washed gravel) as set out in Section 8.2 also apply to the use of chambers in treatment fields. Specific requirements that differ with regard to chamber systems is set out in this section.

As with trenches that use media the width of chambers may range from 1 foot wide to 3 feet wide.

Chambers are allowed a credit as compared to trenches that use media (such as gravel) as set out in Article 8.3.1.5 which addresses credit for both primary treated effluent and secondary treated effluent.

In the application of any credits allowed for chambers the resulting actual effluent loading rate cannot exceed the maximum loading allowed in Article 8.1.2.2 for specific soil textures that are required to ensure the 7 day travel time is achieved by the depth of the treatment boundary. This often comes into consideration in sandy soils.

Chamber Credit: Primary Treated Effluent

The credit when applying primary treated effluent is to consider the width of the chamber is 1.1 times the actual open area of the chamber. The outside width of the chamber base is not the width to apply the credit to as the chamber "feet" will take up approximately 50mm (2 inches) on each side of the chamber although this varies by manufacturer.

If pressure effluent distribution laterals are used, the credited width allowed for the chambers is 1.3 times the actual open width provided by the chamber. The provision that the required trench bottom area can be reduced when pressure effluent distribution laterals are used as provided in Article 8.2.1.8 cannot be applied on top of this 1.3 credit.

When applying primary treated effluent (septic tank effluent) the credited width of the chamber cannot exceed 0.9 m (3 feet) as set out in Article 8.3.1.5. (2). This requirement specifically applies to primary treated effluent and so does not apply when secondary treated effluent is being used.

Chamber Credit: Secondary Treated Effluent

When secondary treated effluent is being applied to the trench bottom, the credited width for the chamber is calculated at 1.1 times the actual width of the chamber as set out in Article 8.3.1.5.(3). Of course secondary treated effluent must be distributed using pressure distribution so there is no additional credit for pressure distribution. If timed dosing is used to control the dosing frequency and equalize flow, the credit width applied can be 1.2 times the actual width of the chamber.

The credited width using secondary treated effluent can exceed 0.9m (3 ft.) even though the credited width cannot exceed 0.9m (3 ft.) when applying primary treated effluent. The reason for this difference is the amount of organic loading on the trench bottom and resulting oxygen requirements at the trench bottom. Allowing the calculated trench width to exceed 3 ft. when applying primary treated effluent will likely exceed the soils capacity to allow sufficient oxygen to reach below the trench where it is required. With secondary treated effluent that has much lower organic loading this does not become a problem.

Chambers: Installation Requirements

Article 8.3.2.2 requires that the manufacturer's installation requirements are followed except where there is a conflict with this Standard. One area that manufactures instructions often conflict with is the credited width used in determining the amount of chamber system required. Credits they suggest do not apply if they exceed the credits allowed under Article 8.3.1.5. These credits do not apply on treatment mounds. See Article 8.4.1.9 for chambers used on mounds.

Gravity weeping lateral trenches that use chambers must include protection of the soil infiltration surface where the effluent enters the chambers. The chamber does not protect the infiltration surface from the incoming rush of a dosed volume of wastewater the same the gravel in typical gravel trench does. There are a few methods described in Article 8.3.2.3 that can be used. The intent is the infiltration surface is protected from erosion at the entry point. A 2 inch layer of gravel can be laid over the first 1.5m (5 ft.) of the trench bottom; a goetech fabric can be laid over the infiltration surface for the first 1.5m (5 ft.); or some other suitable means that protects the infiltration surface from the erosion of the entering effluent. Geotech fabric must not be placed over the entire infiltration surface.

Consideration of the method used to supply the effluent to the chamber needs to be considered when selecting the most appropriate method of protecting the infiltration surface from erosion. Some methods will result in higher flow rates than others. The purpose is to stop the incoming flow from picking up fine soil particles and washing them further down the infiltration surface that could plug the soil pores.

Some Chamber manufacturers do not recommend the chamber be covered with goetech fabric. This Standard does not require the chamber be covered with goetech fabric so the manufactures installation instruction can be followed. However the manufactures often put out additional bulletins that indicate a goetech fabric should be used in certain conditions.

In general the conditions described by the manufacturer include:

- Chambers installed in uncompacted, very fine, uniform sands.
- Installations left uncovered and subject to a major rain event.
- Systems not sodded (or stabilized) in a timely matter after final cover-up has occurred.
- A drainfield located in a poorly drained area such as:
    1. an area subject to inundation by frequent flooding events,
    2. surface drainage of rainwater is directed over the system, or
    3. a drainfield not protected by gutters, curtain drains, or installed in a high water table area. *(of course these are areas that need to be avoided with any treatment field)*

Recommended filter fabric specifications are as follows:
- Fabric shall be non-woven
- Weight: 0.35 oz./s.y. to 1 oz./s.y.
- Apparent Opening Size (AOS): 20-30 U.S. Sieve (ASTM D 4571)

Treatment Mounds – Section 8.4

Treatment mounds are most often used on sites that have limited depth of suitable soil to a restrictive layer such as a saturated soils or fine textured structureless soil that limits downward flow of the effluent. The treatment mound is constructed on top of the in situ (existing) soil so that all of the available soil depth is used for treatment and the dispersion of the effluent in the soil. Although some evapotranspiration (the uptake and evaporation of water by plants) occurs in mounds to remove some effluent in summer, the design must not rely on evapotranspiration being significant. Evapotranspiration is not significant in the summer and does not occur in the winter when the ground is frozen and covered with snow.

Figure : Treatment Mound General View

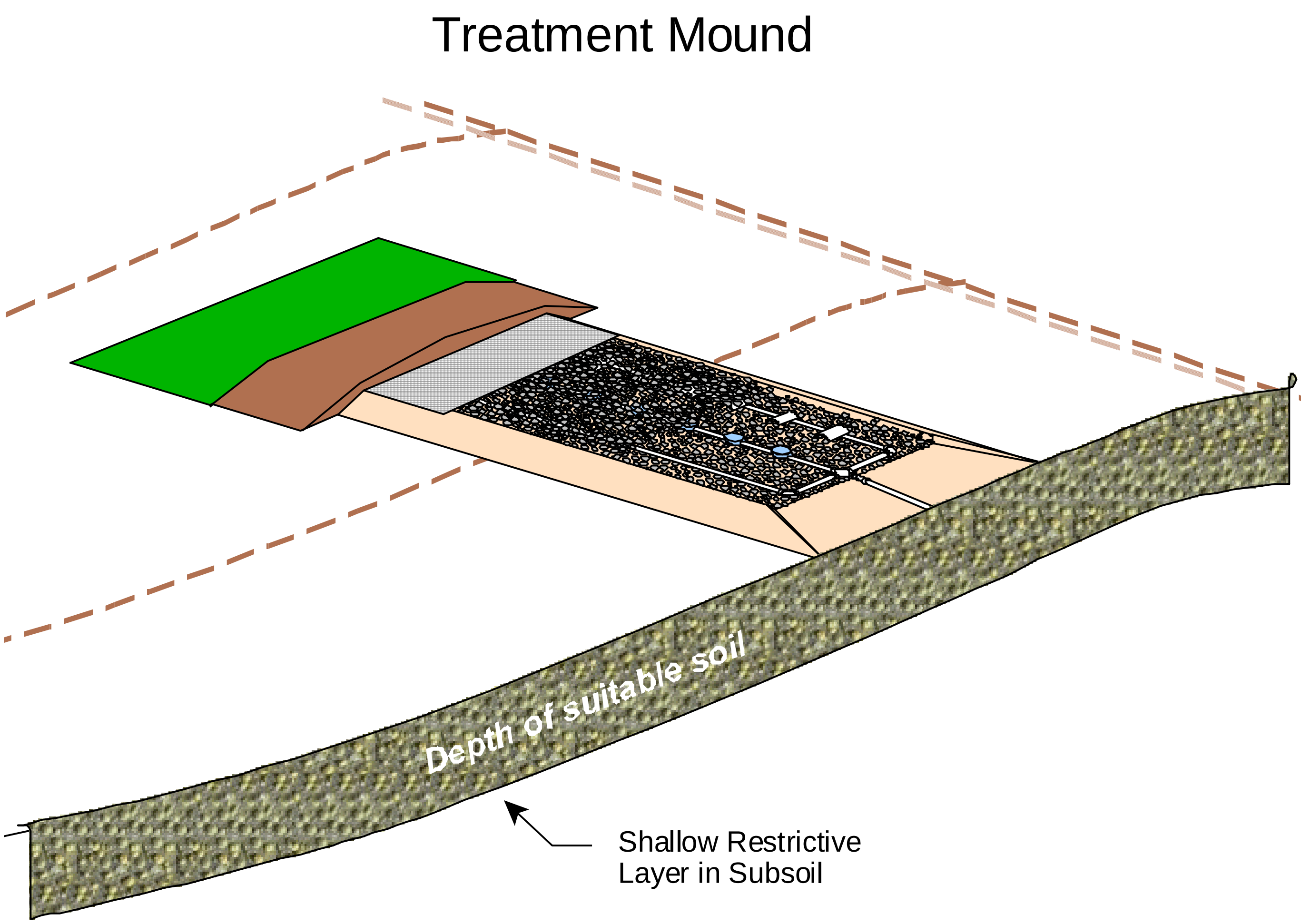
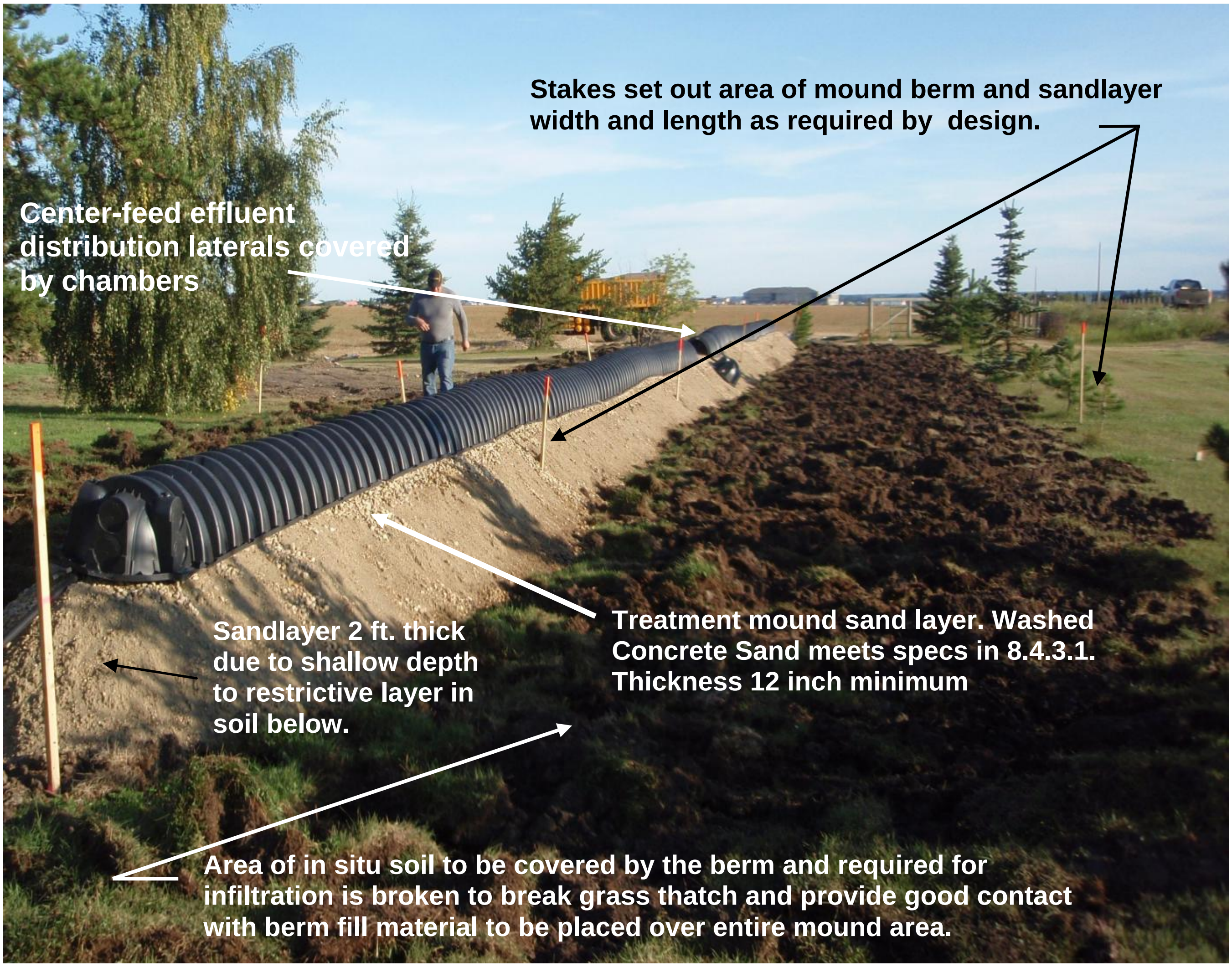


Figure: Treatment Mound Photo



Treatment Mounds – General Descriptions

Sand Layer

A treatment mound includes a layer of specifically graded, clean washed sand that effluent is spread over to provide an excellent aerobic environment needed by microorganisms to remove the organic loading in the sewage effluent at the high rate it is applied on the sand layer. It operates similar to a sand filter in removing the organic loading. The removal of organic loading from the effluent that occurs in the sand layer results in effluent equivalent to secondary treatment standard (Level BII) leaving the bottom of the sand layer. This higher quality effluent allows higher long term infiltration loading rates into the soil as compared to septic tank effluent.

Built on Top of In Situ Soil

Building the treatment mound on top of the in situ soil also takes advantage of using the most upper layers of soil that are more permeable than the underlying soils and are more active biologically due to a greater oxygen supply at the surface so treatment is further enhanced.

Purpose of the Covering Berm

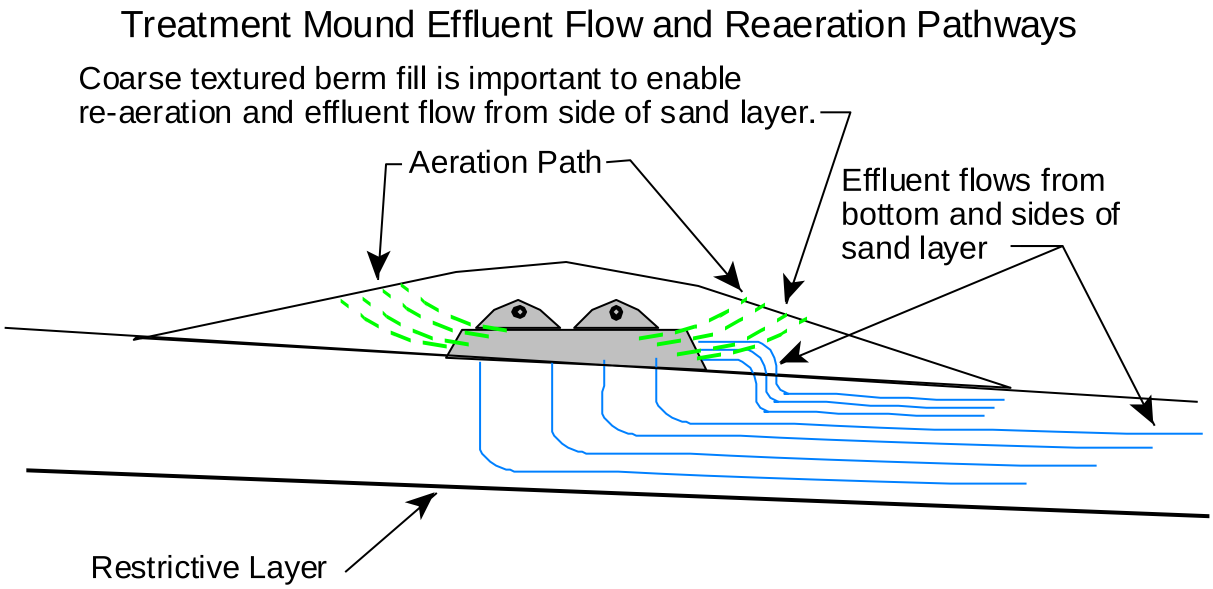
The allowed effluent loading rate on the sand layer is 0.83 gallons per sq. ft. which is often twice as much or more than the in situ soil below the sand layer can accept. As a result some of the effluent must exit the sand layer from the side and spread some distance before infiltrating into the in situ soil. For this reason the sand layer and effluent distribution system are covered by a berm of imported soil that extends out from the sides of the sand layer a sufficient distance to cover the area of in situ soil needed to infiltrate the excess effluent applied to the sand layer. In addition to covering the required in situ soil infiltration area, the berm is needed to protect the sand layer and effluent distribution system from freezing and prevent direct contact with the effluent by people and animals.

Berm Fill Material Permeability Characteristics

The fill material of the berm must be coarse textured soil that allows sufficient hydraulic conductivity to allow the effluent to effectively move out of the sand layer sides as needed and to allow a sufficient supply of oxygen to maintain aerobic conditions in the sand layer. The requirements for fill material are set out in Article 8.4.2.7. Very seldom is the soil found on site suitable for the berm fill material. Most often the need for the treatment mound is because of less than favorable soils at the site. Once excavated and moved the structure of the onsite soil is destroyed and the permeability, to both air and water movement, is reduced significantly.

To increase long term stability of the mound berm, to help shed precipitation, and to make the mound look nice in the landscaping, the coarse textured fill material is covered with approximately 75mm (3 in.) of finer textured topsoil that is suitable for establishing a grass cover over the berm. This cover over the coarse textured fill will have sufficient water holding capacity to support the growth of the grass much the same as is done on golf greens which are built over a coarse textured sand by design to grow grass better.

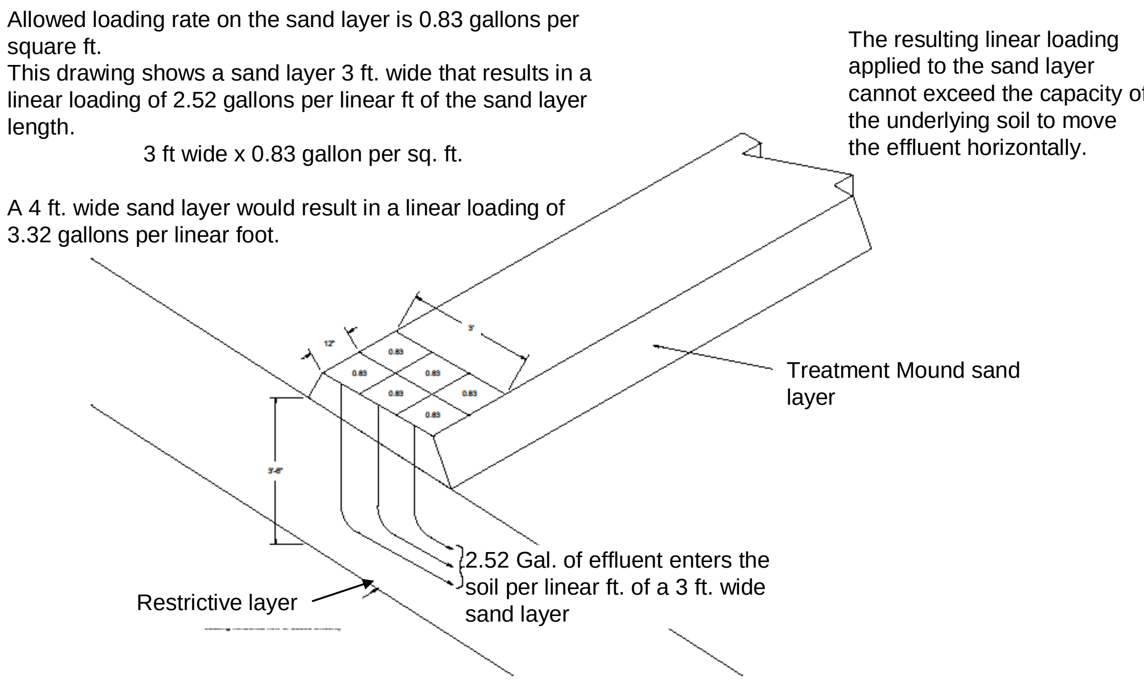
Figure: Treatment Mound Effluent Flow and Re-aeration



Linear Loading Considerations - Treatment Mound Shape

Treatment mounds are most often used to address sites where there is a shallow restrictive layer that limits the depth of suitable soils for treatment and the downward movement of effluent. Because the restrictive layer limits the downward movement of the effluent the added effluent must move horizontally in the soil away from the treatment mound. The design of the mound must ensure the effluent that is applied day after day can move away from the mound horizontally through the available soil above the restrictive layer. The effluent will need to move hundreds of feet away from the mound as over time more and more effluent is applied. To achieve this, the design must consider the capacity of the soil to move the effluent horizontally. The concept of linear loading on the soil was discussed on pg. **301** and supported by a graphic showing the concept. The graphic below focuses on the concept of linear loading rates resulting from the sand layer of the treatment mound.

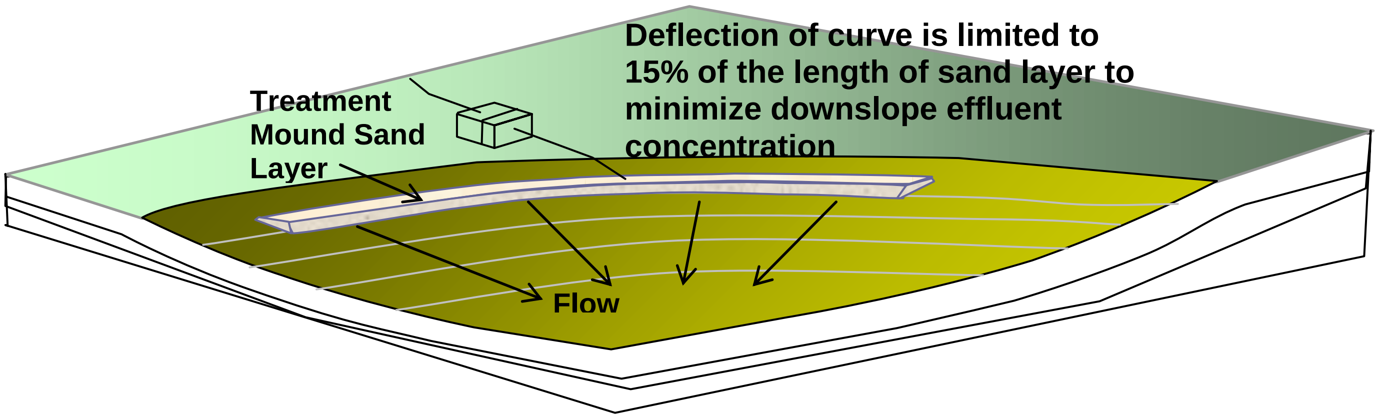
Figure: Sand Layer Linear Loading Concept



Linear Loading on a Convex Slope (Curved Slope)

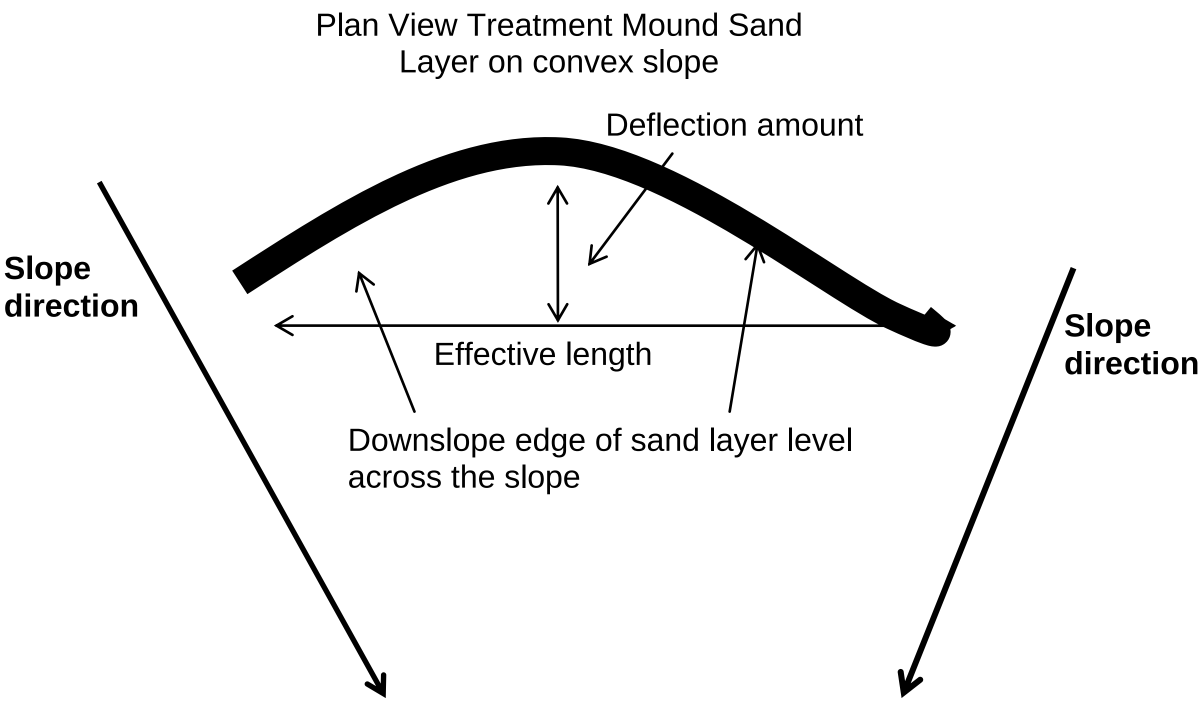
The slope of the land at site may not be simple and all in one direction. Often the slope is curved and the sand layer of the mound must be curved to remain level along its length on such a curved slope. When located on a curved slope that is convex the linear loading in the downslope direction may become concentrated and overload the capacity of the soil. The graphic below depicts that concept.

Figure: Mound on a Convex Slope



To avoid problems with surfacing effluent cause by a concentration of effluent downslope of the sand layer, Article 8.4.1.3. 1) (c) requires the amount of curvature deflection be limited to 15%. This measurement of a maximum 15% deflection is shown in the plan view of the above graphic which follows.

Figure: Treatment Mound Convex Slope Plan View; Deflection Measurement



This plan view of a mound shows it extending into a concave slope as well. On the concave slope shown on the right side of the drawing below shows the concentration of effluent downslope is not a concern because the effluent spreads as it flows downslope through the underlying soil compared to the portion of the mound on the convex slope shown on the left of the graphic below.

Figure: Treatment Mound Convex and Concave Slope Plan View; Deflection Measurement

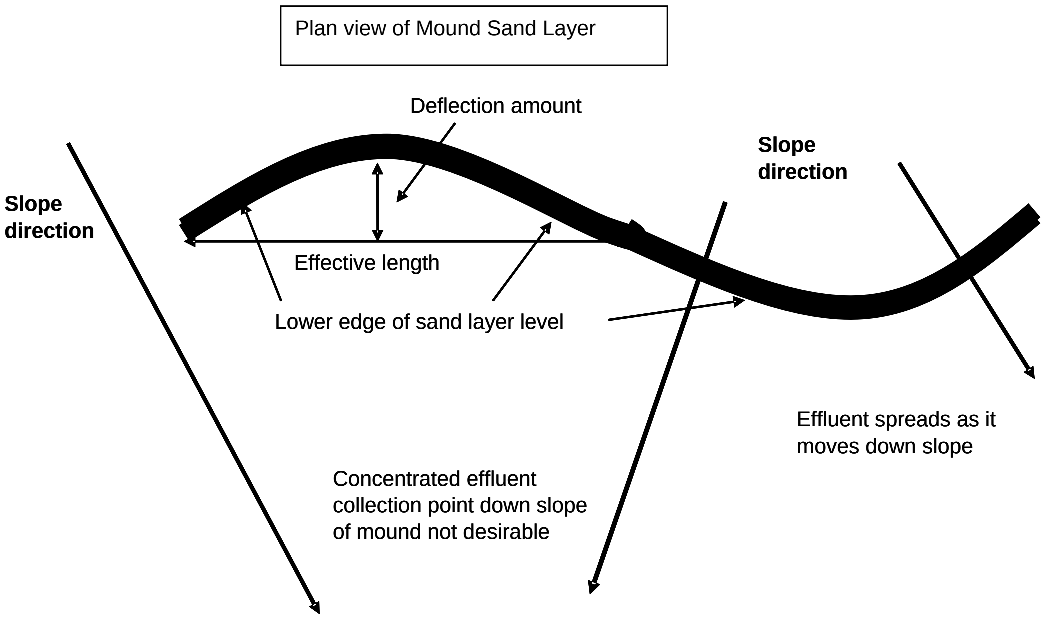
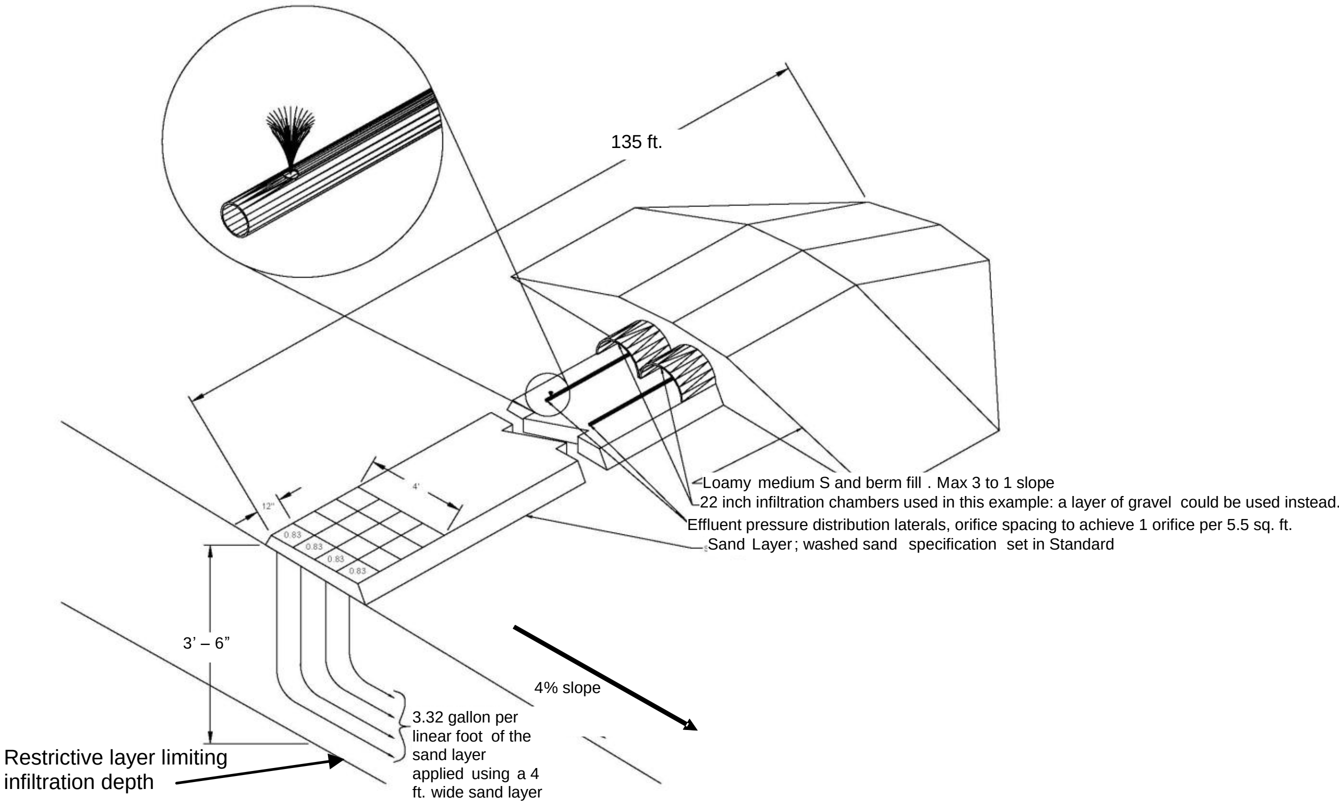


Figure: Typical Treatment Mound Design Drawing.



Treatment Mound Design

The design of a treatment mound as with any system starts with the determination of the soil characteristics which impact the design limitation of the mound. The second piece of design information is the peak daily flow from the development.

The starting point is to determine the area of the sand layer required which is a factor of the peak daily flow. The allowed loading rate on the sand layer is a maximum of 0.83 gallons per square foot.

Sand layer area = Daily peak flow divided by 0.83 gallons per sq. ft.

The second step is to determine the minimum length of the sand layer to meet the linear loading capacity of the in situ soil. The allowed linear loading is determined by Table 8.1.1.10 or Table A.1.E.1 for imperial measures. It is based on the slope at the site; the depth to a restrictive layer which is the available infiltration depth; the texture classification of the soil; the shape of the structure and the grade of the structure.

The length of the sand layer = daily peak flow divided by the allowed linear loading.

The required width of the sand layer (that receives effluent) is a result of the length required by linear loading. As the area of the sand layer has been determined and the minimum length has been determined, the width is simply a result of the math:

Width of the sand layer receiving effluent = area of sand layer divided by the length of the sand layer required. There is a maximum width of the sand layer of 3 m 10 ft. set out in Article 8.4.1.4.(1)(c)

The example design drawing shown in Fig. Typical treatment mound design, on pg. **335** is an example based on the site conditions as follows.

Soil: dominant texture applied as the limiting condition for the design is a clay loam soil texture and the dominant soil structure is blocky grade 3 (strong).

The restrictive layer is found at a depth of 3ft. 6 inch below surface and so this is the available infiltration depth.

The slope % at the site is 4%.

The mound is designed for a 4 bedroom house with no extra water flow characteristics so the the flow is 450 gallons a day.

The design shown is adequate for those conditions. The same conditions are used in the graphic illustration of the use of Table A.1.E.1 shown on pg. **304**. Following that illustration will help identify how the linear loading rate was selected for the conditions that are used to determine the minimum length of the sand layer to ensure the linear loading in not exceeded.

In Situ Soil Infiltration Area Covered by the Berm of the Mound

The minimum area the berm must cover is determined by the allowed effluent loading rate for secondary treated effluent on the in situ soil found in Table 8.1.1.10 or Table A.1.E.1. consideration must be given to the dominant direction of flow out of the side of the sand layer and direction of flow in the underlying soils. On a sloped site the effluent is anticipated to go downslope from the sand layer; on level site the effluent will move in both directions away from the sandlayer. The infiltration area of a mound on site that has a slope exceeding 1% is measured from the up slope side of the sand layer to the downslope edge of the covering berm. On site with less than 1% slope the in situ soil infiltration area can be considered to be on both sides of the sand layer so the infiltration area is measured from toe to toe of the covering berm.
The minimum infiltration area that must be covered by the berm = Peak daily flow divided by the in situ soil effluent loading rate for secondary treated effluent.

The extent of the berm slope must at least cover the required infiltration area but also must extend far enough to result in a berm slope that is not steeper than a 3 horizontal to 1 vertical slope.
Width of berm to achieve the minimum 3 to 1 slope = Height of berm on upslope side of the sand layer plus the increase in height of berm above the insitu soil across the width of the sandlayer multiplied by the percentage of slope the surface of the berm having a 3 to 1 slope forms with the slope of the existing soil at the site.

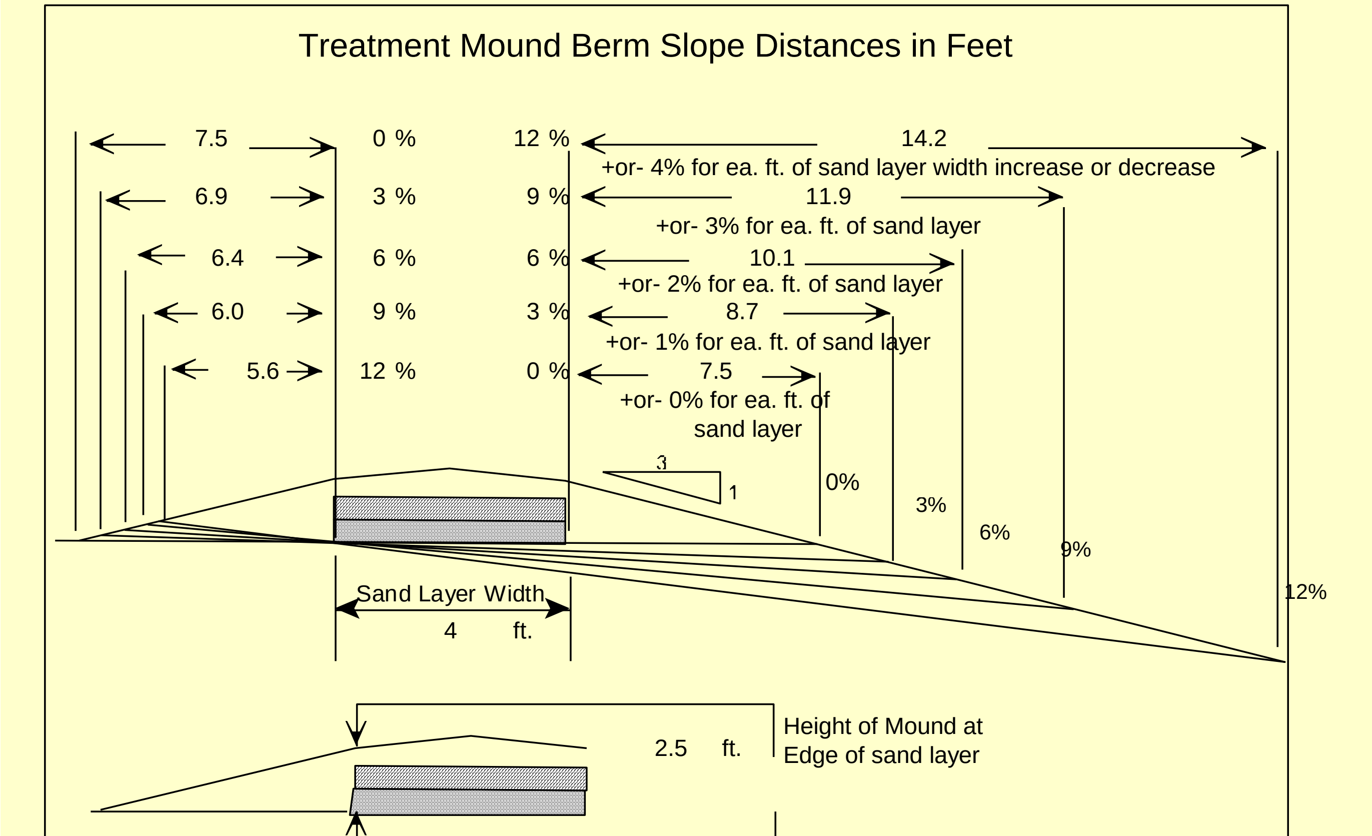
The width of the berm at a 3 to 1 slope will change from on site to another. It is impacted by the slope at the site and the width of the sand layer used in the design. The formula below can be used to calculate the distance the berm must extend to achieve a 3 to 1 slope on slope sites.

Downslope berm distance at 3:1 berm slope =
(Mound height at upslope edge of sand layer + [sand layer width X {slope%/100}]) / (0.33 – [slope% / 100])

Upslope berm distance at 3:1 berm slope =
Height of mound at upslope edge of sand layer / (0.33 + [slope% / 100])

Berm distance on level sites at 3:1 berm slope =
Height of mound at edge of sand layer / 0.33

Figure: Berm Slope Distances



Upslope Berm distance = Height of mound at edge of sand layer / (0.33 + [slope% / 100])
Downslope berm distance =
(Mound height at upslope edge of sand layer + [sand layer width X {slope%/100}]) / (0.33 - [slope% / 100])

To assist in the design steps and calculations required, a worksheet has been developed along with a drawing the represents the required distance of the berm to maintain a 3 to 1 minimum slope at the surface of the berm. The most up-to-date worksheet is available online at the Safety Codes Council website and Alberta Municipal Affairs web site. The worksheet available at the time this handbook was published is provided in the following pages.

SITE INFORMATION DETAILS

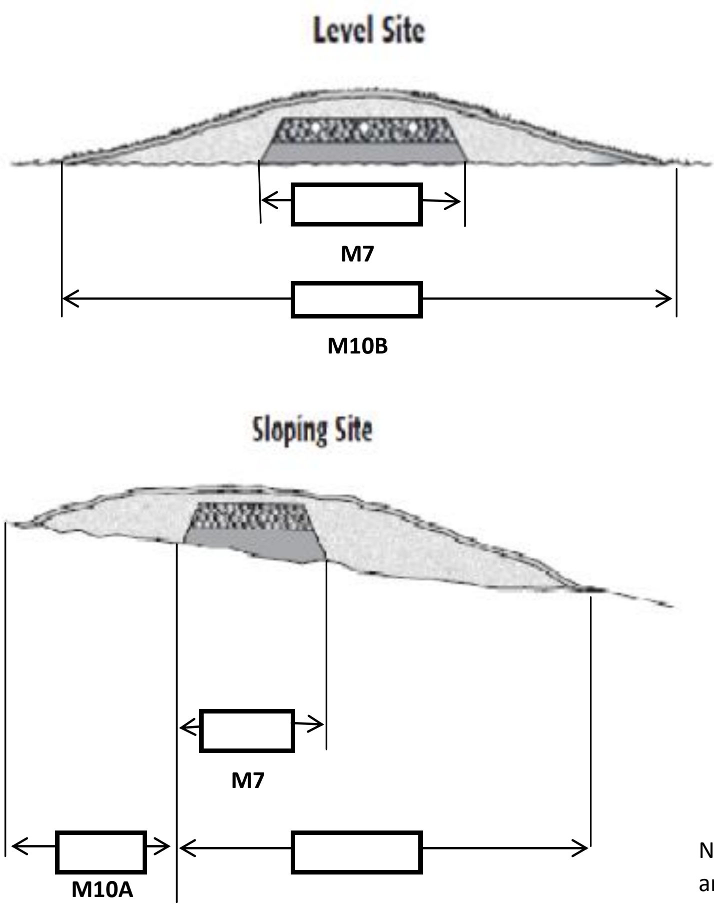
Landowner Name:
Location:
Job Number:
Installer Name:
Installing Company:

PSDS Design - Mound Worksheet

Treatment Mound: Sizing and Dimensions

Treatment Mound Dimensions Summary

This summary page is to be filled in with the noted dimensions once the worksheet has been completed.



Sand Layer Width (ft.)		**M7**
Sand Layer Length (ft.)		**M6**
Toe to Toe Width (ft.)		**M11A or M11C**
Upslope Mound Height (ft.)		**M9B or M9C**
Overall Length of Mound (ft.)		
Slope (%)		**M5A**

Note - All dimensions noted on summary drawings are in feet.

SITE INFORMATION DETAILS

Landowner Name: **Job Number:**
Location: **Installer Name:**
Installing Company:

Step 1) Determine the expected volume of sewage per day:

Facility Type **(i.e., residential, commercial, etc.)** | **Peak Wastewater Volumes (Imp. gal/day) Table 2.2.2.2.A and B. (p. 30 and 31)** | **per** ______ | **Number of Occupants**

Effluent volume generated per day from development based on facility type and occupancy, as detailed in Table 2.2.2.2.A and Table 2.2.2.2.B. — Imp. gal/day

Additional flow volumes in design - Provide allowance for additional loads factors as detailed in Table 2.2.2.2.A. (p. 30) and Table 2.2.2.3. (p. 32) — Imp. gal/day

Total Expected Volume of Sewage per Day — Imp. gal/day **M1**

Assure that the sewage strength does not exceed the requirements of 2.2.2.1 (1) - (p.27).

Step 2) Calculate the treatment area of the sand layer:

Expected Volume of Sewage per Day		**Sand Layer Loading Rate**		**Area Required for Sand Layer**	
Imp. gal/day	÷	Imp. gal. / sq. ft. / day	=	Square feet	**M2**
From **M1**		Max of 0.83 Imp. gal/ sq. ft. / day except for reduction for coarse textured soils [8.4.1.4 (1)(6) or 8.4.1.5 (1)(d)]			

Step 3) Determine the design soil effluent loading rate:

Soil Effluent Loading Rate
[From <30 mg/L column]

	&		&		=	Imp. gal/ sq.ft./day	**M3**
Texture		Structure		Grade			

Note: Effluent loading rate MUST be determined from soil texture, structure, and grade classification according to Imperial Table A.1.E.1. (p.151).
Note: Ensure infiltration loading rate chosen does not exceed loading rates as set out in 8.1.2.2. (p. 101

Step 4) Calculate the in situ soil infiltration area required:

Expected Volume of Sewage per Day		**Soil Effluent Loading Rate**		**Required Soil Infiltration Area**	
Imp. gal/day	÷	Imp. gal. / sq. ft. / day	=	Square feet	**M4**
From **M1**		From **M3**			

Step 5) Determine the site specific criteria of the installation site:

Slope of Installation Site

______ ft vertical elevation change in 100 horizontal ft

Ground Surface Slope = ______ **%** **M5A**

Depth to Restrictive Layer (if applicable in design)

______ **inches** **M5B**

SITE INFORMATION DETAILS

Landowner Name:
Location:
Job Number:
Installer Name:
Installing Company:

Step 10) Determine the in-situ soil infiltration width under mound and the toe to toe width of the mound:

Insert slope % at subject site, sand layer width and upslope mound height into drawing calculator to determine upslope and downslope mound lengths.

For a mound on a site with no slope (0% grade), the in-situ soil infiltration width is the same as the toe to toe width for the mound:

Width of Sand Layer		Upslope Berm Width		Downslope Berm Width		In-Situ Soil Infiltraton Width and Toe to Toe Width of Mound	
feet	+	feet	+	feet	=	feet	M11A
From M7		From M10A - off Berm Slope Worksheet		From M10B - off Berm Slope Worksheet			

For a mound on a site with slope (>1% grade), the in-situ soil infiltration width is:

Width of Sand Layer		Downslope Berm Width		In-Situ Soil Infiltraton Width	
feet	+	feet	=	feet	M11B
From M7		From M10B - off Berm Slope Worksheet			

Width of Sand Layer		Upslope Berm Width		Downslope Berm Width		Toe to Toe Width of Mound	
feet	+	feet	+	feet	=	feet	M11C
From M7		From M10A - off Berm Slope Worksheet		From M10B - off Berm Slope Worksheet			

Step 11) Confirm that mound width available for treatment provides the required soil infiltration area:

The width of the mound is based on the greater of:

- the width as determined by the 1:3 slope requirement, **or**
- the width required to provide adequate infiltration area

In-Situ Soil Infiltration Width Based on 1:3 Slope		Width of Soil Infiltration Required
	Greater Than	
From M11A or M11B		From M8

If the in-situ soil infiltration width (M11A or M11B) is not larger than the soil infiltration width required (M8) for the design, then the design width of the mound has to be adjusted to achieve the required soil infiltration width (M8). Adjusting the si

Step 12) Confirm the design complies with the Standard of Practice:

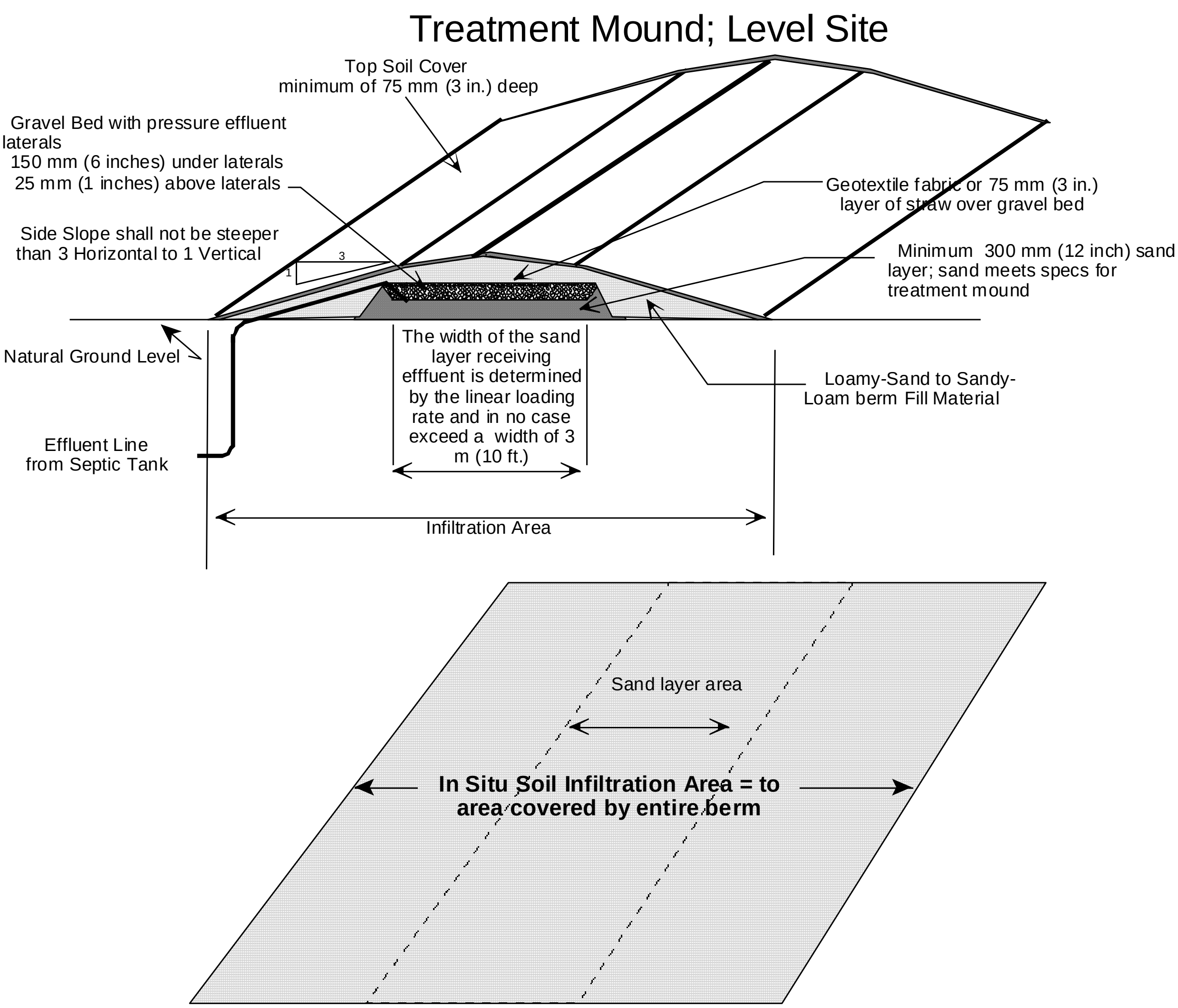
This worksheet does NOT consider all the requirements of the mandatory Standard. Please work safely and follow safe practices near trenches and open excavations.

To assist in understanding the differences in the area of the sand layer and in situ soil infiltration area along with the detail of the construction of the treatment mound the following graphics are provided.

In Situ Soil Area of a Mound Located on a Level Site (Slope 1% or Less).

The following graphic of a treatment mound on a level site shows the effluent infiltration area into the in situ soil is considered to be on both sides of the sand layer of the mound. The area covered by the berm must be at least equal to the area required to infiltrate the applied effluent based on secondary treated effluent.

Figure: Treatment Mound: In Situ Soil Infiltration Area on Level Ground

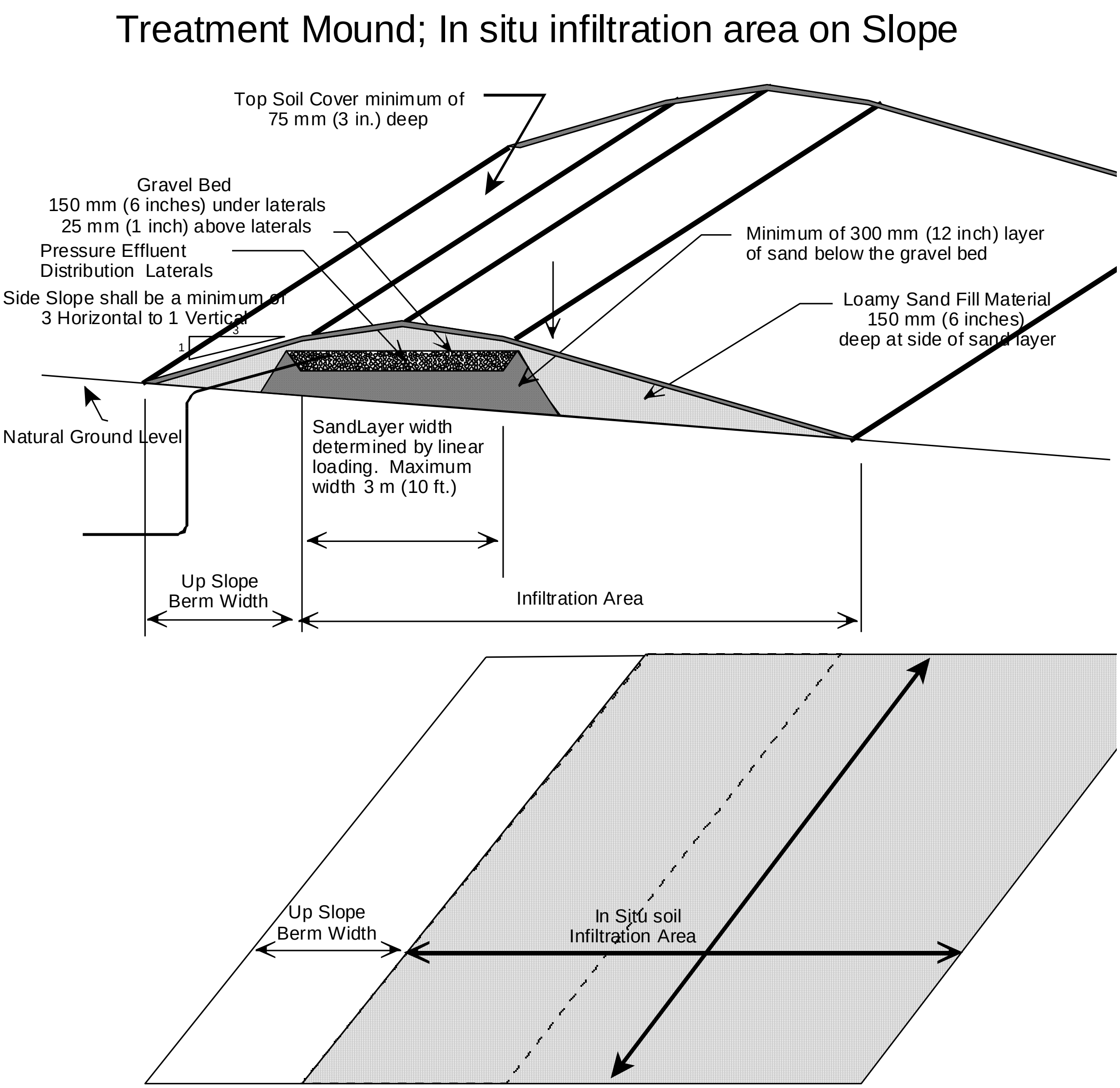


A comparison of the level site graphic above and the following graphic of a sloped site shows the difference in where the in situ soil effluent infiltration area covered by the berm is considered. On a sloped site of more than a 1% slope the area covered by the berm upslope of the sand layer is not considered as in situ soil infiltration area.

In Situ Soil Area of a Mound on a Sloped Site (Slope Exceeds 1%)

The graphic below shows the area considered as effective in situ soil effluent infiltration area applied in the design of a treatment mound. The area measured from the upslope side of the sand layer to the downslope side of the berm is considered the area available for infiltration of the effluent. This area must be equal to or greater than the distance needed for effluent infiltration based on the loading rate allowed for secondary treated effluent. Often the distance the berm must extend on the slope to maintain a 1 vertical to 3 horizontal slope will exceed the required infiltration area based on effluent loading rates. However that must always be checked in the design.

Figure: Treatment Mound; In Situ Soil Infiltration Area on Sloped Ground



Treatment Mound Construction

Compaction of the soil in the area of the mound must be minimized by using appropriate construction techniques. The placing of materials during the construction of the mound is best done with the use of a track hoe from the edge of the mound. This keeps all construction equipment off the mound area during construction and helps avoid uneven compaction of the in situ soil and construction materials.

Once the location of the outer edges of the *berm* has been established, the installation of the *effluent line* from the *septic tank* to the mound may be installed. The trench for the *effluent line* should enter the mound at the end of the mound on level sites or at the upslope side of the mound on sloped sites. Trenching will impact the capacity of the soil to laterally move the effluent away from the mound as the trench excavation and backfill process destroys soil structure. Without the soil structure the linear loading capacity may be reduced to zero in fine textured soils.

In difficult soil conditions where a 3 ft. vertical separation to the restrictive layer cannot be achieved the thickness of the sand layer can be increased to provide a 900mm (3 ft.) vertical separation as measured from the bottom or the 1 foot thick sand layer required in all systems to the restrictive layer in the in situ soil. Article 8.4.1.6 sets out the minimum vertical separation and the accompanying note identifies the ability to increase the thickness of the sand layer.

Sand Layer Used in the Treatment Mound

The specification for the sand used in the treatment mound sand layer is set out in Article 8.4.3.1. This is specifically graded sand that is washed free of fines as set out. This quality of sand is critical to the long term operation of the treatment mound.

A quick test to see if the *sand* contains too many *fines* is to place in a glass quart jar, 50 mm (2 inches) of *sand* and fill the jar with water. Shake the jar to mix the *sand* and water, then set the jar down and let the contents settle for several hours. If there is a layer of *fines* that settle on the top of the *sand* that is thicker than 3.2 mm (1/8 inch), the *sand* contains too many *fines* and is not suitable for use in a *treatment mound*. While this is a quick and dirty test in the field it is not always accurate and gives no indication of the particle sizes in the sand in comparison to the specification. The result of a particle size test of the sand carried out by the sand supplier is required to confirm quality of the sand.

The clean *sand* is placed over the scarified in situ soil. The first 75mm (3 in.) should be worked into the scarified soil to ensure effective contact with the in situ soil. The remaining depth of sand is then placed and the finished top of the *sand layer* that will receive effluent must be level in all directions.

Note: the width of the placed sand layer generally exceed the required width needed based on effluent loading rates. This is because the extra width is needed to support the gravel layer or chambers.

Distribution of Effluent Onto the Sand Layer

A pressure effluent distribution system meeting the requirements of Section 2.6 must be used to apply the effluent over the sand layer. The spacing of orifices must also meet the requirements of Article 8.4.2.6 that sets out that at least one orifice per 0.5 sq. m (5.5 sq. ft.) is provided. Where there is more than one pressure distribution lateral the orifices should be offset from one lateral to the next along the length of the laterals. Effective distribution of effluent is very important to long term treatment success of the system. The pressure distribution laterals are placed in a gravel layer or chambers over the sand layer receiving and treating the effluent.

The gravel bed, or a 2 inch layer of gravel and chambers, is placed over the *sand layer*. If chambers are used, the chambers must be installed on a minimum layer of 50 mm (2 inches) of gravel and the inside area of the chambers must provide exposure to a minimum of 80% of the *sand* surface (contact area). See Article 8.4.1.8 and 8.4.1.9 setting out these requirements.

When gravel is used, the effluent pressure distribution laterals must be installed in the gravel and covered with the gravel and all orifices equipped with orifice shields. See Article 8.4.2.5. If chambers are used, the distribution laterals must be installed inside the chambers and the orifices must point upward except for the number required to achieve drainage of the lateral to prevent freezing. Orifices pointing down must be equipped with orifice shields. The laterals must be elevated at least 4 inches above the sand layer as required by Article 2.6.2.6.

Treatment Mound Berm

The sand layer and effluent distribution layer above it are covered with a coarse textured berm fill material as required by Article 8.4.2.7, and as discussed on pg. **330,** that will allow effective re-aeration and movement of the applied effluent. The berm provides protection from freezing and covers the area needed to ensure infiltration into the in situ soil. The depth of the fill must be at least 6 inches at the side of the sand layer. The fill over the sand layer needs to be slightly sloped to ensure drainage of precipitation. The side slopes of the mound berm must not be steeper than 1:3 (one vertical to four horizontal).

A final covering of top soil of a suitable soil texture classification the will retain enough moisture to support grass growth must then be placed over the entire mound surface. See Article 8.4.2.7.(2)

A covering of grass must be established over the surface of the completed mound to protect from erosion and excessive infiltration of precipitation as set out in Article 8.4.2.8. Consider the installation of sod to provide an immediate cover rather than to seed grass.

Sand Filters and Re-circulating Gravel Filters – Section 5.3 and 5.4.

See pg. 371 for full size graphic.

Sand filters and recirculation gravel filters can provide effective treatment of waste water to high qualities. Sand filters and re-circulating gravel filters are very similar in design. The main difference between the two is the particle size of the media which is set out in the standard.

Sand filters and gravel filters receive effluent from a septic tank in most cases. The intermittent sand filter is expected to treat the effluent to a secondary treatment standard level BIII-DI (see Subsection 5.1.1 for specified quality) when designed effectively. Re-circulating gravel filters are expected to produce secondary treated level BII effluent. The effluent from the sand filter or recirculation gravel filter is discharged to a final soil based treatment system as accepted by this standard. Open bottom filters are not acceptable.

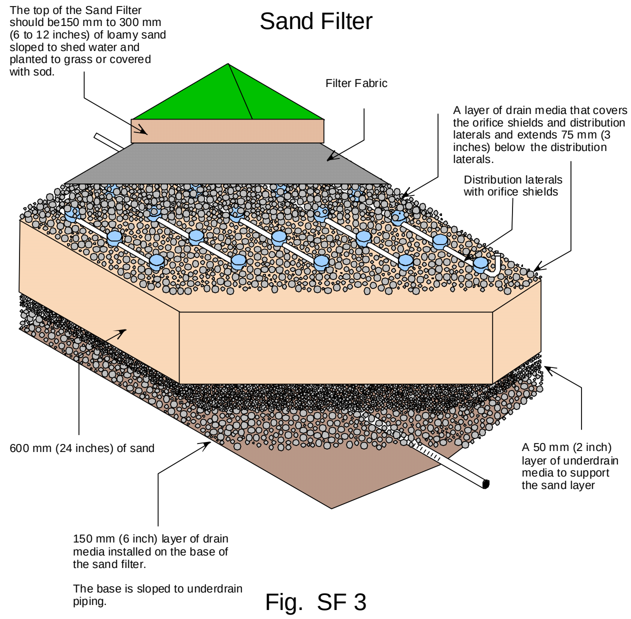


Fig. SF 3

Within the upper elevation of the *sand filter*, there is a pressurized distribution lateral piping system containing orifices, which is designed to discharge *effluent* evenly over the surface of the *sand*. To ensure the highest level of treatment, the *effluent* should be discharged to the *sand filter* in many small doses over a 24 hour day. This is best accomplished with the use of a timer which can be programmed to accommodate both the number of pump cycles per day as well as the length of each cycle. The use of a timer and the small doses of *effluent* encourage the movement of *effluent* through the *sand filter* to travel from *sand* particle to *sand* particle in thin films exposing these thin films to both oxygen and microorganisms that treat the *effluent*.

As the *effluent* passes through the *sand filter media*, solids and other contaminants are mechanically, biologically and chemically reduced. Naturally occurring microorganisms reside on the surfaces of the *sand* particles and thrive on the regular doses of food and nutrients contained in the *effluent*.

At the lower elevation of the *sand filter*, *effluent* which has passed through the *sand filter media* is collected by an underdrain pipe which carries the *effluent* to a pump chamber where it can be dosed to a final soil based treatment system using pressure distribution that is required for secondary treated effluent. In most cases pump vaults are installed in the interior of the *sand filter* and used to dose a *treatment field*.

In re-circulating gravel filters the collected effluent is returned to the recirculation tank and later dosed over the gravel filter again. The system is set up to achieve 4 re-circulations of the effluent over the gravel filter before being discharge to downstream soil based final treatment component. Any gravity piping returning the effluent to the re-circulation chamber must kept very short and be well protected from frost. Small regular doses of *effluent* discharged to a filter will result in essentially a trickle type discharge from the filter which is very subject to freezing during the colder months of the year.

Sand filters and gravel filters require maintenance. The pressurized distribution system should be checked annually for plugged orifices and the laterals flushed and cleaned by running a brush through them. Provisions for access to the ends of the laterals for cleaning purposes must be provided at the time of installation. Periodic cleaning of the *septic tank* as well as making sure the screen required on the *effluent* pump is in place and functioning properly is good preventative maintenance.

In the event that an excessive amount of solids has been discharged to the *sand filter* over a period of time, a layer of solids may form over the top of the *sand filter media* and become a restrictive barrier on the top of the *sand filter media*. It may be necessary to disturb the surface of the *sand filter media*, or in extreme cases, even remove and replace the top layer of *sand filter media*. The use of a larger *working capacity septic tank* will provide better primary treatment and result in an *effluent* with less suspended solids being discharged to the *sand filter* reducing possible clogging of the *sand filter*.

Sand Filter Design and Construction

Sand Filter Area

The *size* of the *sand filter* is determined by the expected volume of *sewage* per day and the loading rate for the specific type of sand used in the *sand filter*. Loading rates for the *sand filter* is 2.0 gals per sq. ft. per day for course *sand sand filter*s and 0.83 gal per sq. ft. per day for medium-*sand sand filter*s (see Article 5.3.1.4 and 5.3.1.5).

Sand Filter Effluent Loading Rates

Effluent is distributed over the surface of the *sand layer* with the use of a pressure distribution lateral system that provides a minimum coverage of 1 orifice per every 2 sq. ft. in a course *sand sand filter* and 1 orifice for every 6 sq. ft. in a medium-*sand sand filter*. Complete and even distribution of the *effluent* over the *sand layer* in intermittent doses is critical to the proper long term operation of the *sand filter*. Each *effluent* dose delivered to the *sand filter* is very small such that 12 to 24 doses result per day. The number of doses should be maximized by the design.

The type and quality of *sand* used in the *sand layer* is also critical to the long term success of the *sand filter*. The *sand* used in the design of the system must be very clean and of a particular *grade*. The use of *sand* other than that specified will result in poor performance and premature failure of the *sand filter*.

To achieve effective treatment, attention must be paid to the details of design and construction of the sand filter or gravel filter. Some companies provide design assistance, component parts for the *effluent* distribution and control components for these filters. Designers and installers not familiar with *sand filter*s or gravel filters should make use of these companies.

Drip Dispersal Systems – Section 8.5

Drip dispersal systems have been used in agricultural irrigation for many years. They also provide an effective means of dispersing wastewater effluent into the final soil based treatment system. The drip dispersal can be used with the purpose focused on the dispersal of the effluent into the soil and treatment or it can also be design to provide irrigation of green spaces.

Drip dispersal systems are not well established in cold climates such as in Alberta. Because of this a drip dispersal system must be backed up with another type of system set out in the standard that is know to typically survive the winter season without freezing. This may be a holding tank if the system owner is in agreement and the municipality has no restrictions on the use of a holding tank. Although not extensively proven in Alberta's cold climate there are installation that have shown to survive the winter if the piping is not buried extremely shallow for irrigation purposes.

When used for irrigation purposes consideration should be given to the water demands for irrigation and providing effective coverage of the area to ensure even water of the vegetation so strips do not show up in the grassed area in particular. The quality of water chemistry must also be considered. If the effluent has excess amount of sodium in it the sodium will build up in soil as the plants take up water and eventually increase to level that will damage the vegetation. Article 8.5.1.3 set out qualities of effluent in regard to both the SAR of the effluent and the requirement for disinfection when the effluent is used for irrigation and the drip dispersal piping is installed less than 300mm (12 inch) below surface. The effluent quality must be equal to or better than 15 mg/L TSS and $CBOD_5$ and to 200 CFU/100mg fecal coliform.

Effluent must be delivered to the drip dispersal system using timed dosing and the volume of each dose needs to be small to prevent instantaneous overloading of the soil during an individual dose.

Setting up the design and control systems to make effective use of the system and minimize the potential for freezing is complex. The companies supplying the drip dispersal systems have design tools and the system components needed to make a successful system. Any design of a drip dispersal system must make use of the manufacturer's installation guides as set out in Article 8.5.2.5. If there is a conflict between the manufacturer's instructions and this Standard the requirements of this Standard must be applied.

Open Discharge – Section 8.6

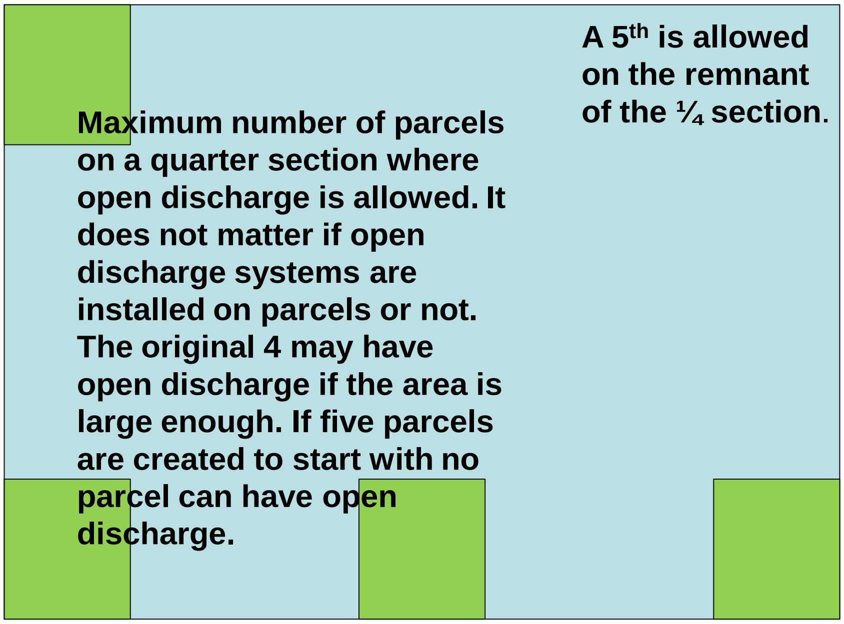
Open Discharge - General

Due care and consideration must be used when proposing this type of system. Open discharge systems are simply a means whereby *effluent* from the *septic tank* is discharged directly onto the ground surface.

Although an *open discharge system* may be one of the most economical methods of managing disposal of *effluent*, it is also the least desirable as the treatment capability is limited. Open discharge systems are not intended for use in residential subdivisions and should only be considered for use in rural areas where close proximity to neighbors, water supplies and property lines is not of any concern. Health, environmental and nuisance concerns are common when these systems are used in areas where development density is increasing. It is strongly recommended that the area wetted by the *open discharge system* be fenced to keep animals and children away.

To minimize problems with these systems, where the density of development exceeds the level typical of farming operations limits are set out in Article 8.6.2.2 of the Standard regarding where an open discharge system can be used. This article prohibits the use of open discharges once there are more than 4 subdivided parcels on a quarter section. This restriction applies whether the subdivided parcels have an open discharge on it or not.

Figure: Number of Parcels Limiting Use of Open Discharge Systems



Article 8.6.2.2 sentence (2) also restricts the use of an open discharge when high strength sewage is anticipated or where the expected peak volume will exceed 3 m^3 (660 gal) per day. These systems are intended only for residential application where density is minimal.

There are a number of methods of design of the open discharge, as shown in pg. **374**, Typical Open Discharge, Deep Buried Effluent Line, and pg. 373 Typical Open Discharge, Gravity. The method suitable for a particular site depends on the site conditions.

The open discharge drawing on pg. **374** indicates a shallow bury *septic tank* with a small *effluent* chamber. Care must be taken to ensure the *effluent line* is installed below frost level as the *effluent line* always contains *effluent*. The riser should be far enough above ground level to have sufficient head to cause the *effluent* to drain from the riser, to below frost level when the pump shuts off. The mound around the riser provides support for the riser, as well as some frost protection. The mound should be covered with large gravel or field stone to prevent erosion from falling *effluent*.

With a deep buried tank the piping can be set up to ensure all the *effluent* will drain from the *effluent line* back to the *septic tank* to prevent the *effluent line* from freezing. It is necessary to install this *effluent line* without dips or sags which may trap pockets of *effluent* which may freeze and obstruct the line in cold weather. The outlet end of the *effluent line* should be extended at least .3 m (1 foot) above ground level to prevent the outlet from being covered with ice in freezing weather and the outlet area should be protected with large gravel or field stone to prevent erosion and possible pooling of *effluent* in the area.

The open discharge graphic on pg. **373** indicates the use of a siphon type *septic tank* when sloping ground conditions are favorable. Here again, the outlet should be extended above ground level and the area where the *effluent* falls must be protected from erosion. A siphon type *septic tank* is capable of discharging in excess of 90 L (20 gallons) per minute and severe erosion may occur at the outlet if not prevented by the design of the outlet area.

All open discharge outlets must use material sufficient to prevent erosion of the soil at the outlet. This may include gravel, large rocks and substantial tree branches. The design of the outlet needs to be landscaped such that the flow of effluent away from the open discharge outlet will not result in a concentrated flow or stream away from the site. Article 8.6.1.1.(5) requires the design to spread the effluent so that the effluent is infiltrated into the ground within 100 ft of the outlet.

Open discharge should only be considered when all other forms of treatment and disposal are not feasible.

Sewage or Effluent Evaporative Lagoons – Part 9

Although *septic tank*s followed by some form of initial *effluent* treatment and final treatment and dispersal in the soil are the most commonly used method for private sewage systems, the use of a lagoon may be appropriate in some conditions.   *Sewage* piped to a *lagoon* may pass through a *septic tank* or may flow directly to a *lagoon* with no pre-treatment.

*Lagoon*s can provide a suitable method of managing sewage particularly in areas where heavy clay sub soils exist that enable the effective containment of the sewage as required in Article 9.1.1.1 and that limit the choice of other soil based treatment and dispersal systems.

A private *sewage lagoon* is not allowed to discharge as is often the case with a lagoon design under Alberta Environment's standards. Because they are not allowed to discharge effluent the lagoon must have sufficient water surface area to effectively evaporate the expected yearly average volume of *sewage* from the development as well as the annual precipitation that may fall into the *lagoon*. See Article 9.1.1.2 for specifics on sizing the lagoon surface area.

The detention of the *sewage* for the extended time causes disease transmitting bacteria to die off. The combined actions of oxygen from the atmosphere, sunlight, bacteria, and algae accomplish the treatment in *sewage* in *lagoon*s. In addition a correctly sized lagoon will evaporate the sewage received and to require discharge which is the intent of this type of lagoon.

The design of a *sewage lagoon* is such that it has a level, flat bottom and a maximum liquid depth of 1.5 m (5 feet) with 600 mm (2 feet) of freeboard above the maximum liquid depth to the top of the *berm*. In many cases it is best to design for an operating depth of only 2 feet as the surface area is maximized as related to the depth of the lagoon. This type of design will require much less movement of earth. The resulting lagoon may operate much like a wetland.

At the bottom of the *lagoon*, a smaller pit should be installed into which the sewage is discharged; See Article 9.1.1.4. The sides of this smaller pit should be lined with rock or a permanent type of cribbing or have a significant slope to prevent the sides from sloughing into the pit. The inlet piping should enter the *lagoon* approximately 600 mm (2 feet) below the top of the smaller pit. The purpose of the small pit is to allow space for accumulating sludge and provide frost protection for the inlet pipe. It takes much less *sewage* to fill the small pit and provide 600 mm (2 feet) of liquid over the inlet pipe. To prevent freezing of the inlet piping, a liquid level of 600 mm (2 feet) above the inlet is normally adequate. This inlet pit should be marked in a permanent manner that allows it to be located at a later time when accumulated solids may need to be removed from the pit. This area can also be marked with thin ice signs as the heat from the incoming effluent will cause the ice to thin.

Fencing of the Lagoon

A lagoon with an operating depth of more than 2 feet, or where it serves a development other than a single family residence must be fenced. The side slope of the lagoon interior is to be not steeper than 1 vertical to 3 horizontal to ensure both stability of the berm and allow person or animals that may enter the lagoon a chance of exit on a slope which is not to steep. However, even with this minimal slope required, a deep lagoon may cause exiting from the lagoon to be very difficult given the slippery muddy side slopes. Fencing is required as set out and is advisable for all lagoons.

Lagoon Construction

*Lagoon berm*s and bottoms must be constructed of compacted clay or lined so that seepage is minimized. See Article 9.1.1.1. for specifics on the criteria of soil hydraulic limiting measures.

*Berm*s are to have a 1.8 m (6 foot) top width and slopes of three horizontal to one vertical. Pg. **377** shows details of *lagoon* construction.

The gradual slope of the inside of the *lagoon* is very important for operational and safety reasons:

- When ice forms in the winter months, the ice expands and floats on the surface of the liquid, rising with the increasing liquid depth. In lagoons which have steep side slopes, the ice has been known to dig into the sides, effectively "capping" the lagoon, preventing any further entry of liquids. This causes the sewage to back up into the house similar to a plugged sewer, and may also result in a frozen building sewer. A hole cut in the ice will allow the liquid to overflow on to the top of the ice and drain the building sewer.

- In the event that a person or animal should for any reason fall into a lagoon, the gradual side slopes will allow that person or animal to crawl out to safety.

The operation of a *lagoon* requires regular inspection, and control of grass and weed growth on the *berm*s. Surface run off is to be diverted around the *lagoon*.

Privies – Section 10

Privies can be a suitable means of managing human excreta without using a water supply to flush away the waste.

Small private use privies can use a shallow earthen pit effectively. The depth of the pit is a maximum of 1.2m (4 feet) below grade. This provides aerobic conditions in the pit to enhance breakdown and provides a factor of safety in the event someone were to accidentally fall in the pit. The earthen pit privy cannot receive water waste that would provide transport of the waste through the soil and potentially fill the pit to overflowing as set out in Article 10.1.2.2.

The soil used in an earthen pit privy cannot include coarse textured sandy soils as set out in Article 10.1.2.5.

The location and construction of the privy should result in protecting the pit from any surface water runoff entry by mounding the privy up higher than the surrounding ground surface. The contact between the ground and privy structure should be made to minimize the entry of rodents that can then transmit disease.

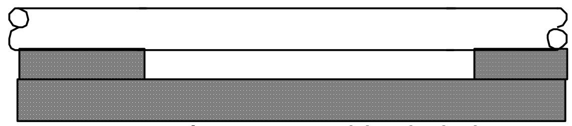
The privy structure has minimal requirements for accessories in Article 10.1.2.9. In some case, such as for larger public use privies that require water tight CSA certified tanks, the privy building structure will be subject to a building permit. Check with the local authority.

There are locations in some municipalities that restrict the use of privies just as they can do with sewage holding tanks. Confirm any rules the municipality may have regarding privies before proceeding.

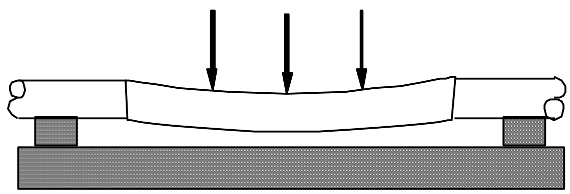
REFERENCED FIGURES

Buried Pipe Support and Bedding

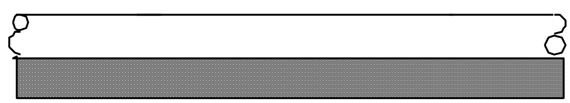
Support Of Underground Piping



Improperly supported buried pipe



An improperly supported underground pipe will sag and settle until it reaches a firm base. Plastic piping may bend and cause traps which trap water and may be subject to freezing or clogging. All piping if not properly supported is subject to breakage.



Properly supported underground piping should be laid with the barrel of the pipe evenly and continuously supported on a bed of undisturbed earth or tightly compacted earth. Ensure adequate tamping of earth under piping. The greater the depth of disturbed earth under the pipe the more tanmping is needed.

Article 2.5.2.1 Sewer line support
Article 2.5.2.6 Backfill
Article 2.5.2.7 Piping connections to tank

Septic Tank Styles and Types

Septic Tanks

All septic tanks must be certified to the CAN/CSA B66 Standard and Labeled by the Certifying Body.

Basic shapes of septic tanks;
(a) Cylindrical, may be horizintal or vertical;
(b) Spherical,
(c) Retangular.

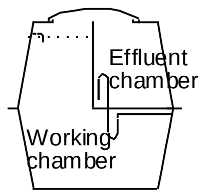
Basic Types of Septic Tanks:
(a) Single septic chamber "Trickle Tanks",
(b) Double septic chamber "Trickle Tanks"
(c) Single septic chamber "Siphon Tanks",
(d) Double septic chamber "Siphon Tanks",
(e) Single septic chamber "Pump Tanks",
(f) Double septic chamber "Pump Tanks",.

Basic septic tank materials;
(a) Concrete
(b) Fiberglass
(c) Polyethylene
(d) Steel (rarely used)

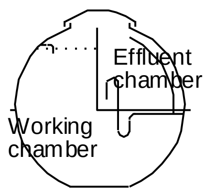
Note: The manufacturer's model number designation of their septic tanks do not necessarily indicate the *"Working Capacity"* of their products therefore, caution must be exercised when selecting a septic tank. The working capacity of the tank must be included on the certificaiton label required on the tank.

The required size of the septic tank set out in the Standard of Practice refer to the *"Working Capacity"*.

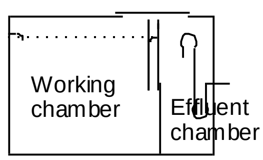
Single or double septic chamber "Trickle Tanks" muse be followed by an effluent dosing tank.



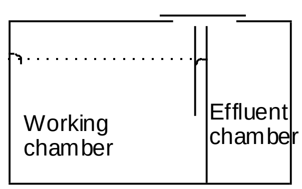
Single septic chamber "Syphon" type septic tank



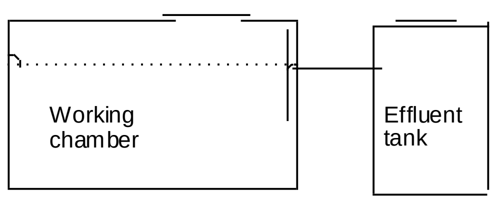
Single septic chamber "Syphon" type septic tank



Single septic chamber "Pump" type septic tank



Single septic chamber "Pump" type septic tank

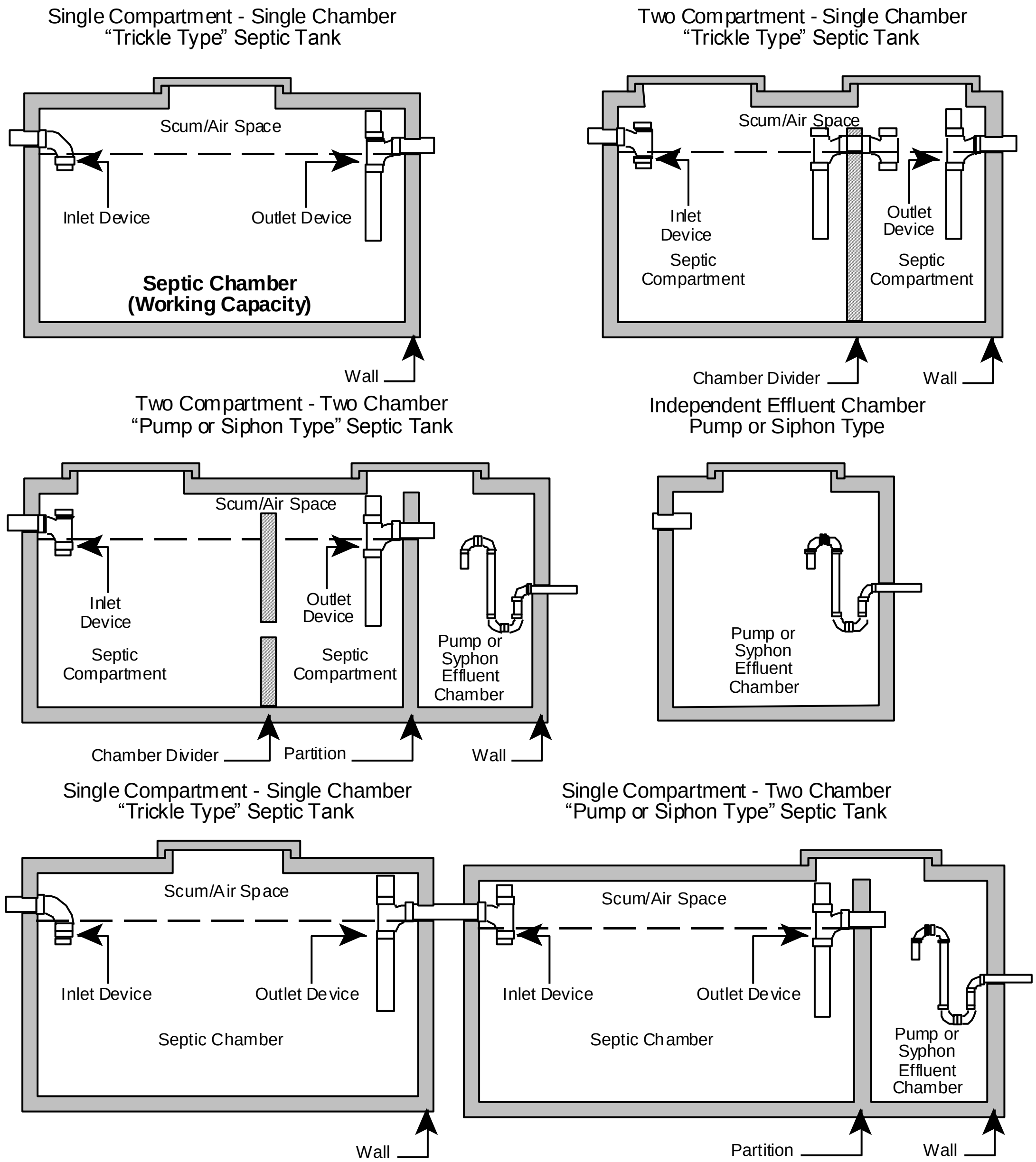


Single chamber "Trickle" type septic tank

Article 2.1.1.5 Dosing of effluent required (effluent chamber or tank needed)
Article 2.2.2.5 Flow equalization
Article 4.2.1.1 and 4.2.2.2 Working capacity
Article 4.2.3.1 Septic tanks requirement for materials

Septic Tank Component Drawings and Definitions

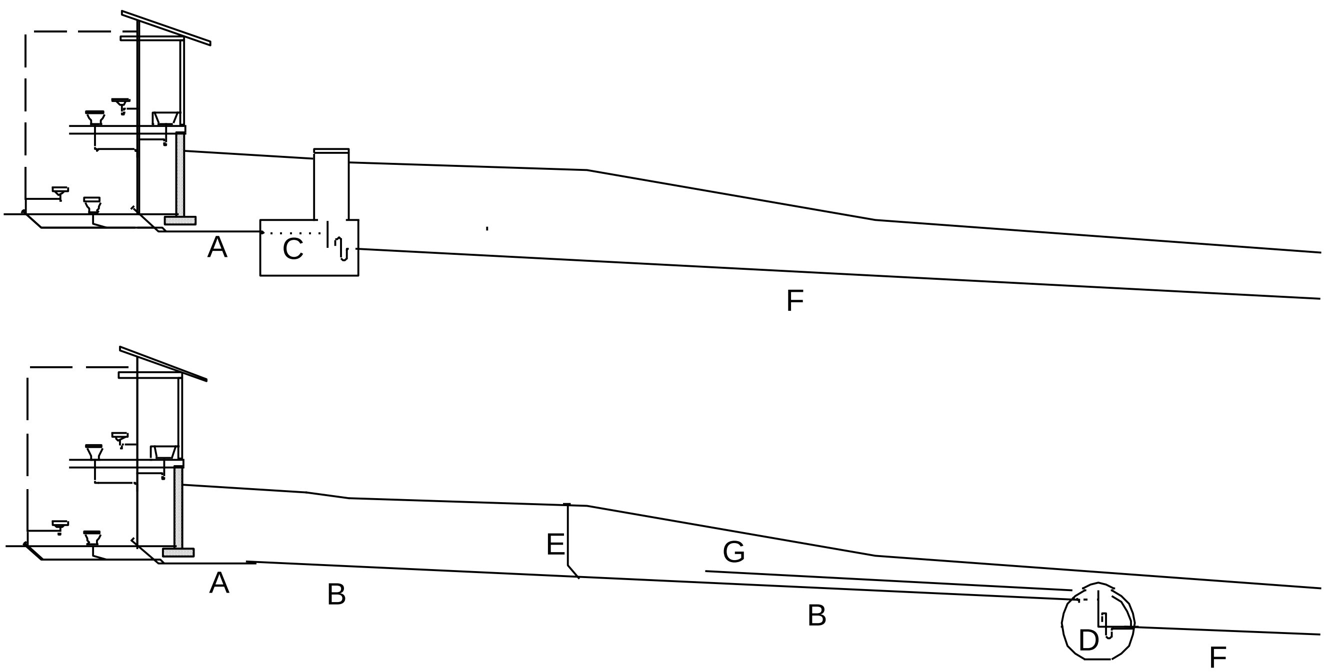
Septic Tank Configurations and Components



Article 2.1.1.5 Dosing of effluent required
Article 2.2.2.5 Flow equalization
Article 4.2.1.1 and 4.2.2.2 Working capacity

Tank Location Deep or Remote

Deep Or Remote Septic Tanks



(A) Building drain leaving the house, connects to either the septic tank or the building sewer.

(B) Building sewer connecting the building drain to the septic tank.

(C) Deep septic tank, complete with access opening extension.

(D) Remote septic tank installed where the building sewer intercepts the hillside.

(E) Extended "y" cleanout.

(F) Effluent sewer from septic tank to effluent disposal system.

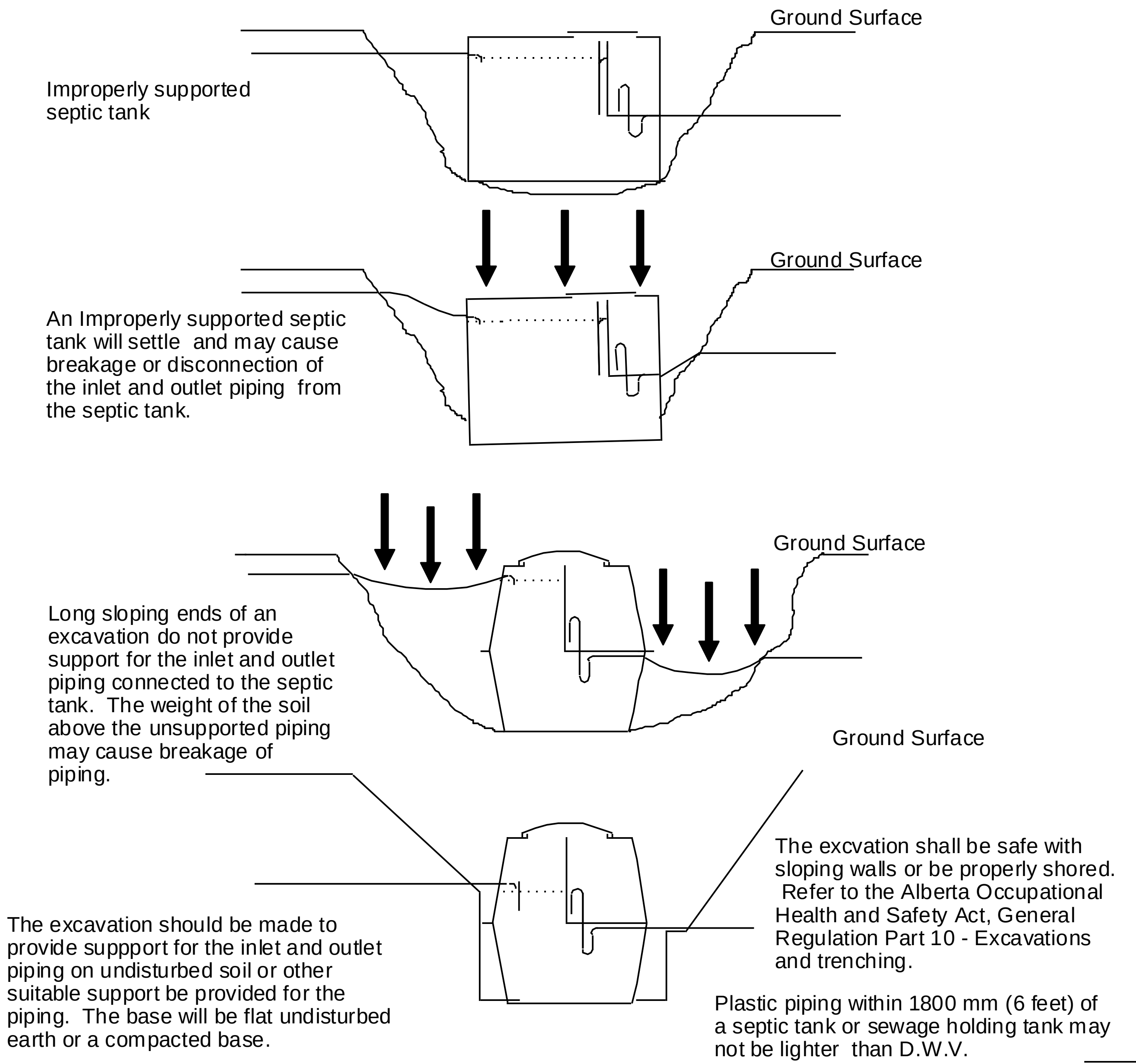
(G) Frost protection for the portion of the building sewer that does not have 1 200 mm (4 feet) of earth cover.

Location of tank for access and consideration of required burial depth is important. A tank does not have to be right net to the building.

See pg. **273** Septic Tank Location Considerations.

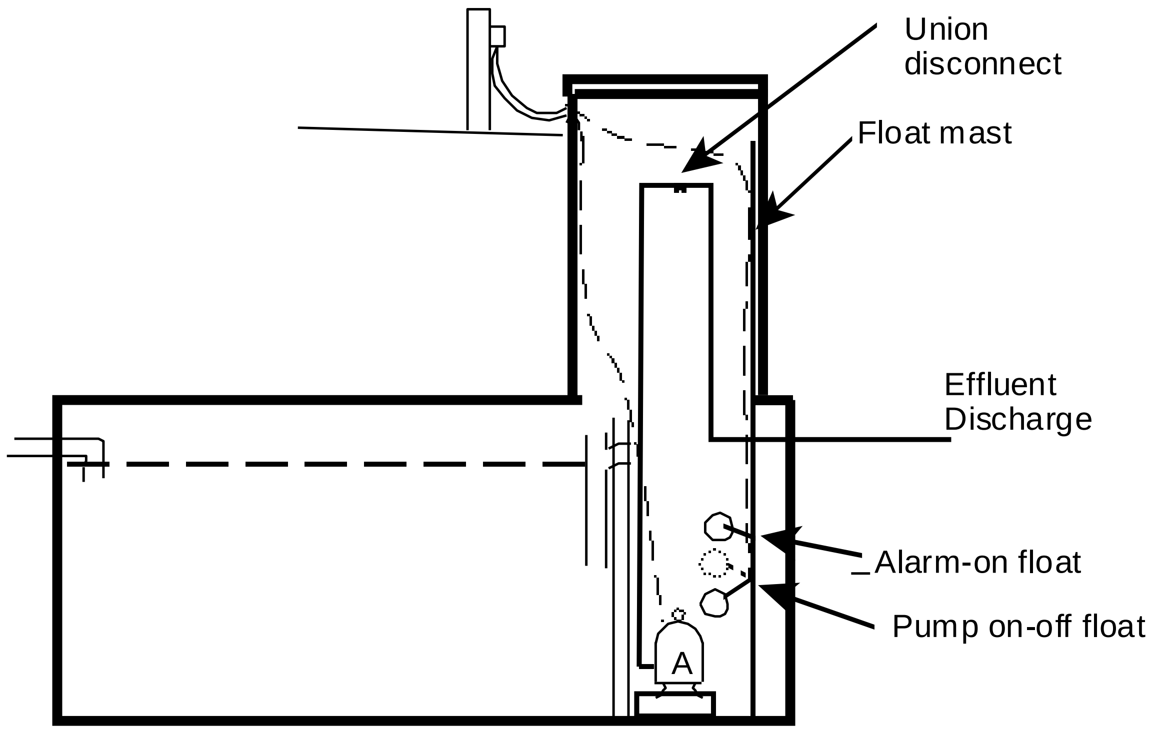
Tank Excavation and Support

Excavations For Septic Tanks And Sewage Holding Tanks



Article 4.2.2.7 Base for septic tank
Article 2.5.1.4 Piping support
Article 2.5.2.8 Pipe strength connection to tank (DWV schd 40)
Pg. **275**, Occupational Health and Safety Act , General Regulation - Part 10 excerpt.
Article 2.5.2.7 piping connections to tanks
Pg. **275** Excavation for Tanks and Trenches

Effluent Pump Piping and Float Mast

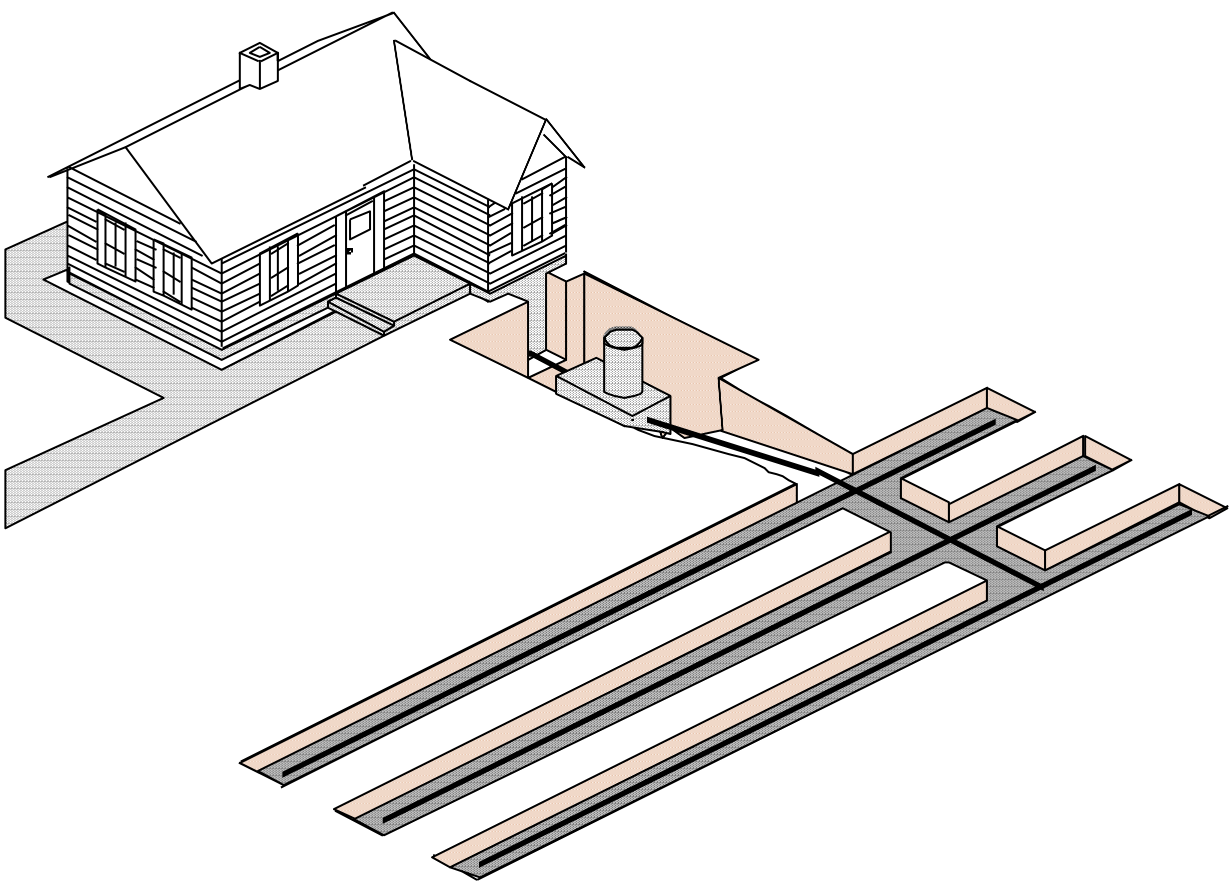


Article 2.3.1.4 mounting of water level controls
Article 2.4.1.7 mounting of water level controls
Article 2.3.1.2 alarms required
Handbook discussion on pg. **250**

Typical Treatment Field

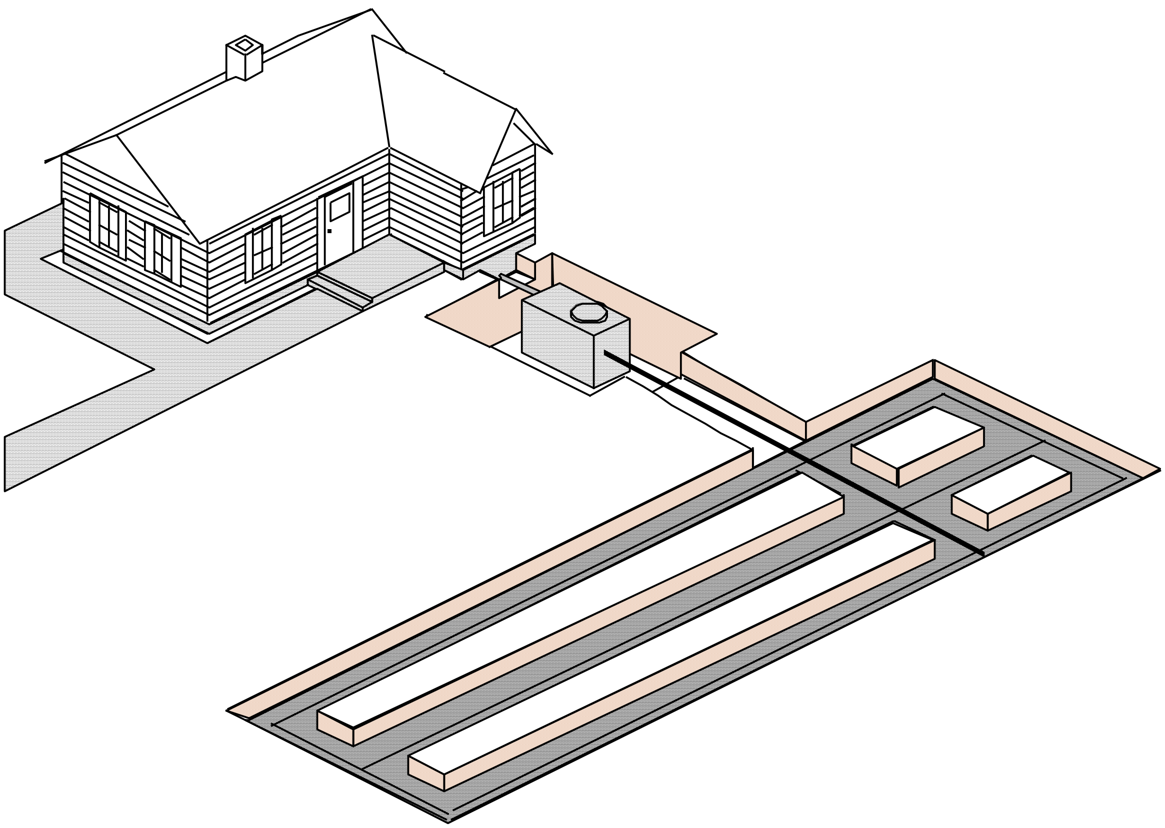
Treatment Field Installation
Deep Bury Pump Type Septic Tank

(Sample layout of field)

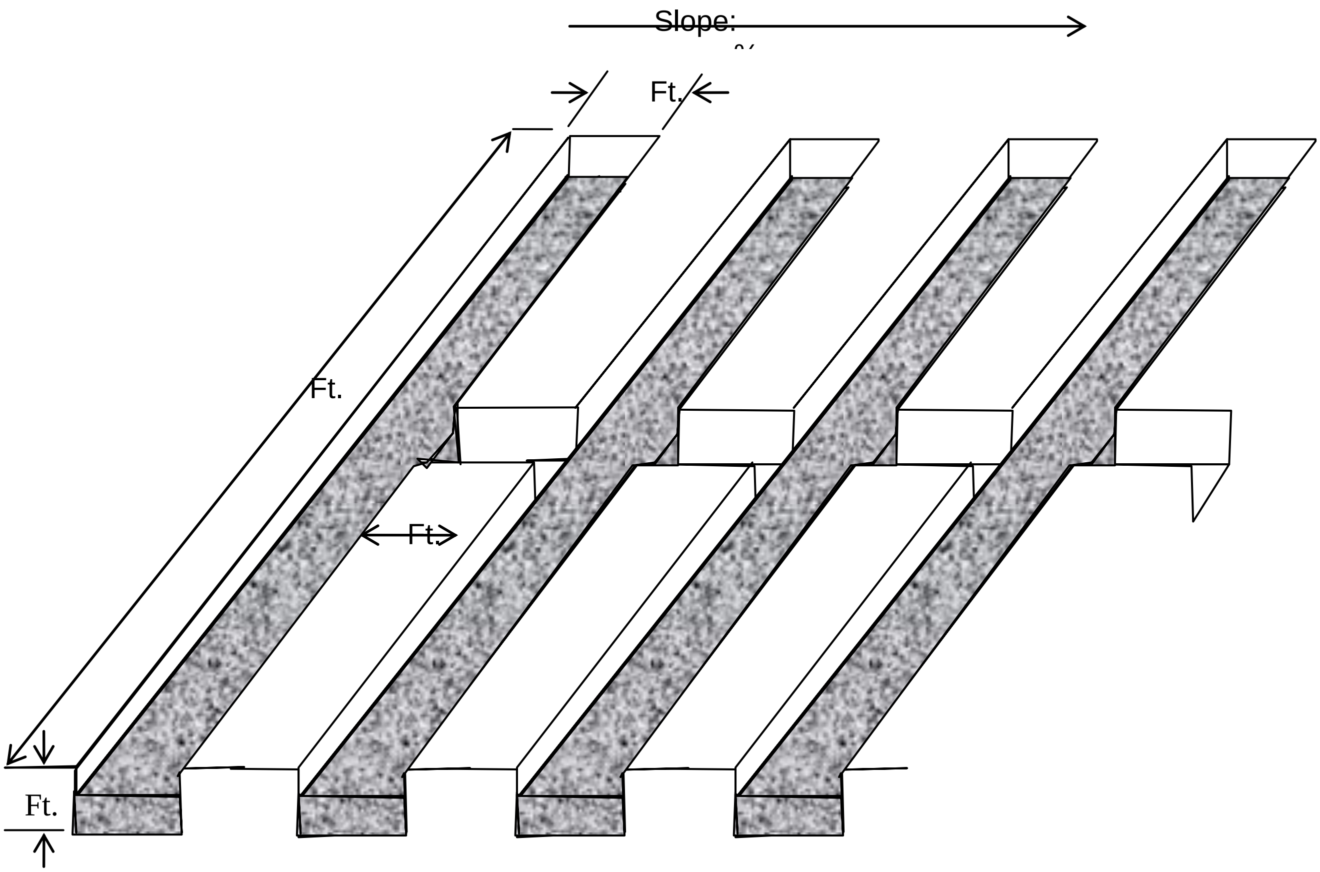


Typical Treatment Field Siphon Tank

Treatment Field
Shallow Bury Siphon Type Septic Tank

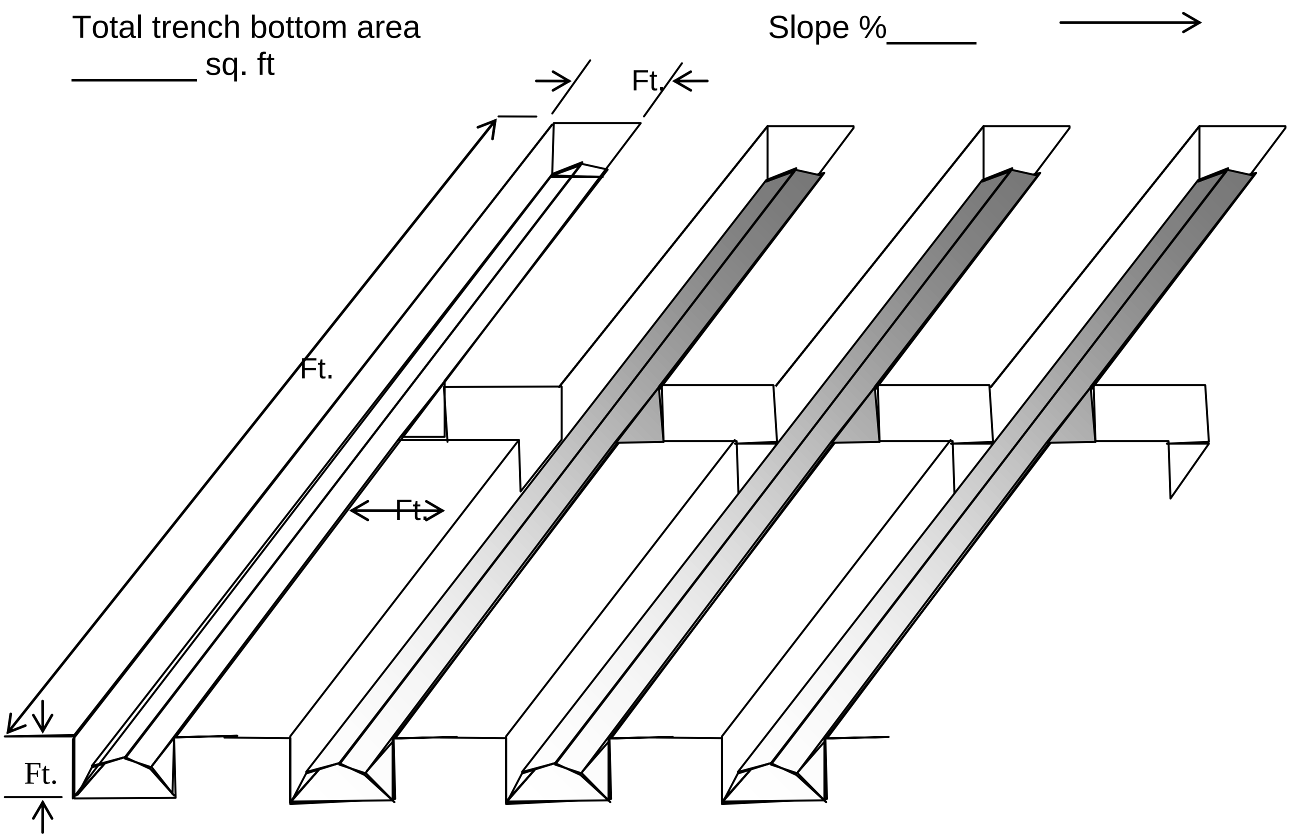


Treatment Field Gravel Trench Typical Design Drawing



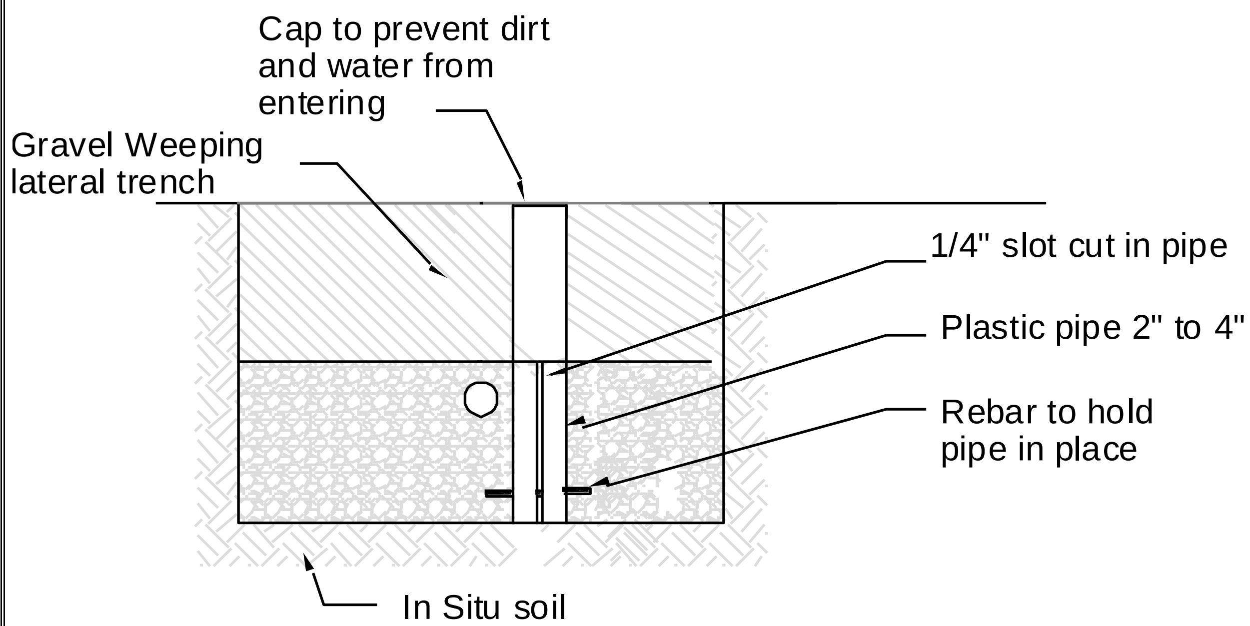
This drawing can be downloaded in Microsoft Word format that allows manipulation of the drawing; more or fewer trenches can be shown and dimensions can be added to suit a particular design as applicable. This drawing is not intended to be suitable for all field systems. Find this drawing in Word format at the Municipal Affairs website or the Safety Codes Council website. Further information on how to manipulate the drawing is provided online with the drawing.

Treatment Field Chamber Trench Typical Design Drawing

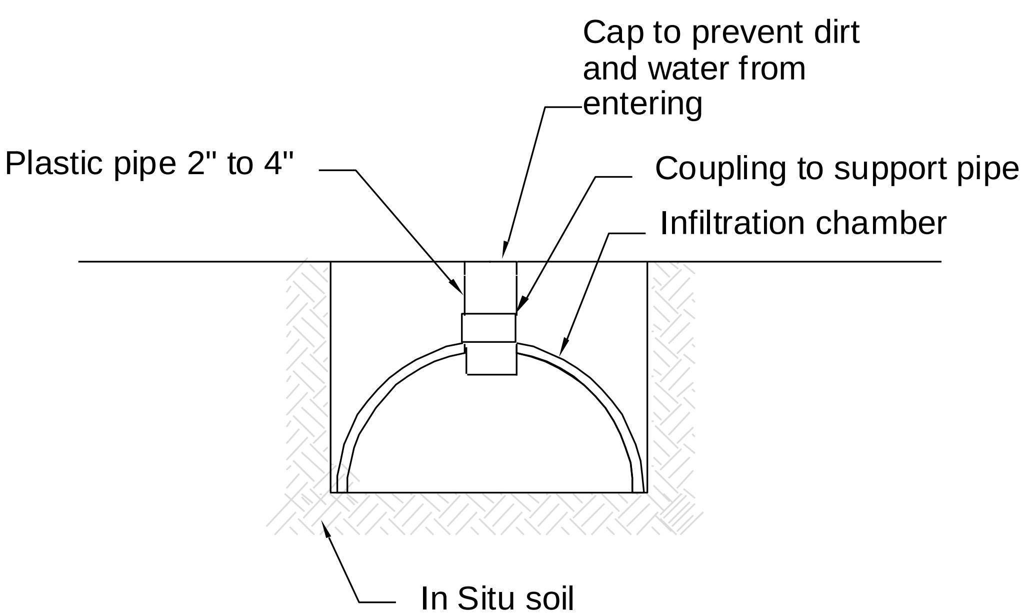


This drawing can be downloaded in Microsoft Word format that allows manipulation of the drawing; more or fewer trenches can be shown and dimensions can be added to suit a particular design as applicable. This drawing is not intended to be suitable for all field systems. Find this drawing in Word format at the Municipal Affairs website or the Safety Codes Council website. Further information on how to manipulate the drawing is provided online with the drawing.

Monitoring Pipe for Effluent Ponding Gravel Media

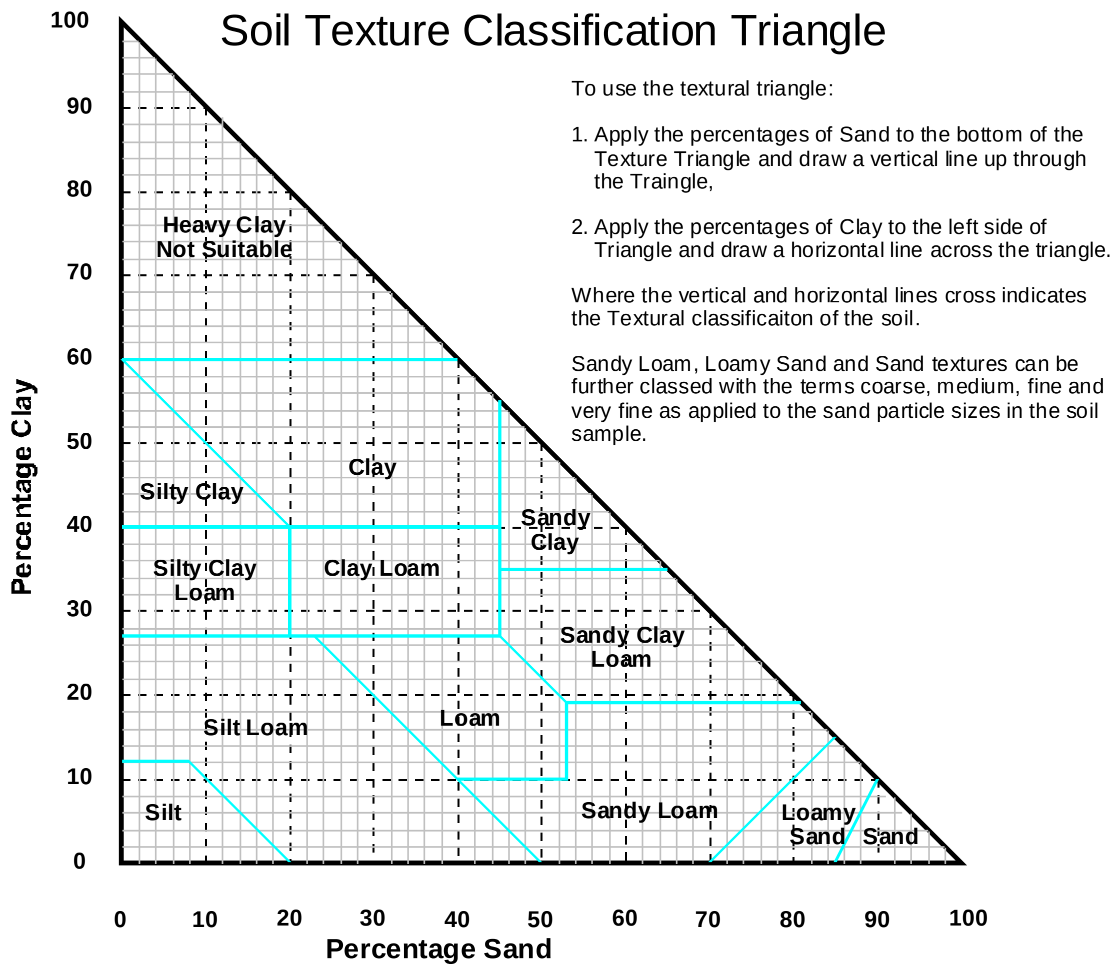


Monitoring Pipe for Effluent Ponding in Chambers



Article 8.2.2.10 Monitoring pipes
Article 8.3.1.1 (2) Sets out other requirements in standard apply such as in Article 8.2.2.10 so monitoring pipes are also required in chamber systems.
Article 8.4.1.2 Effluent Ponding Monitoring Pipes

Soil Texture Classification Triangle



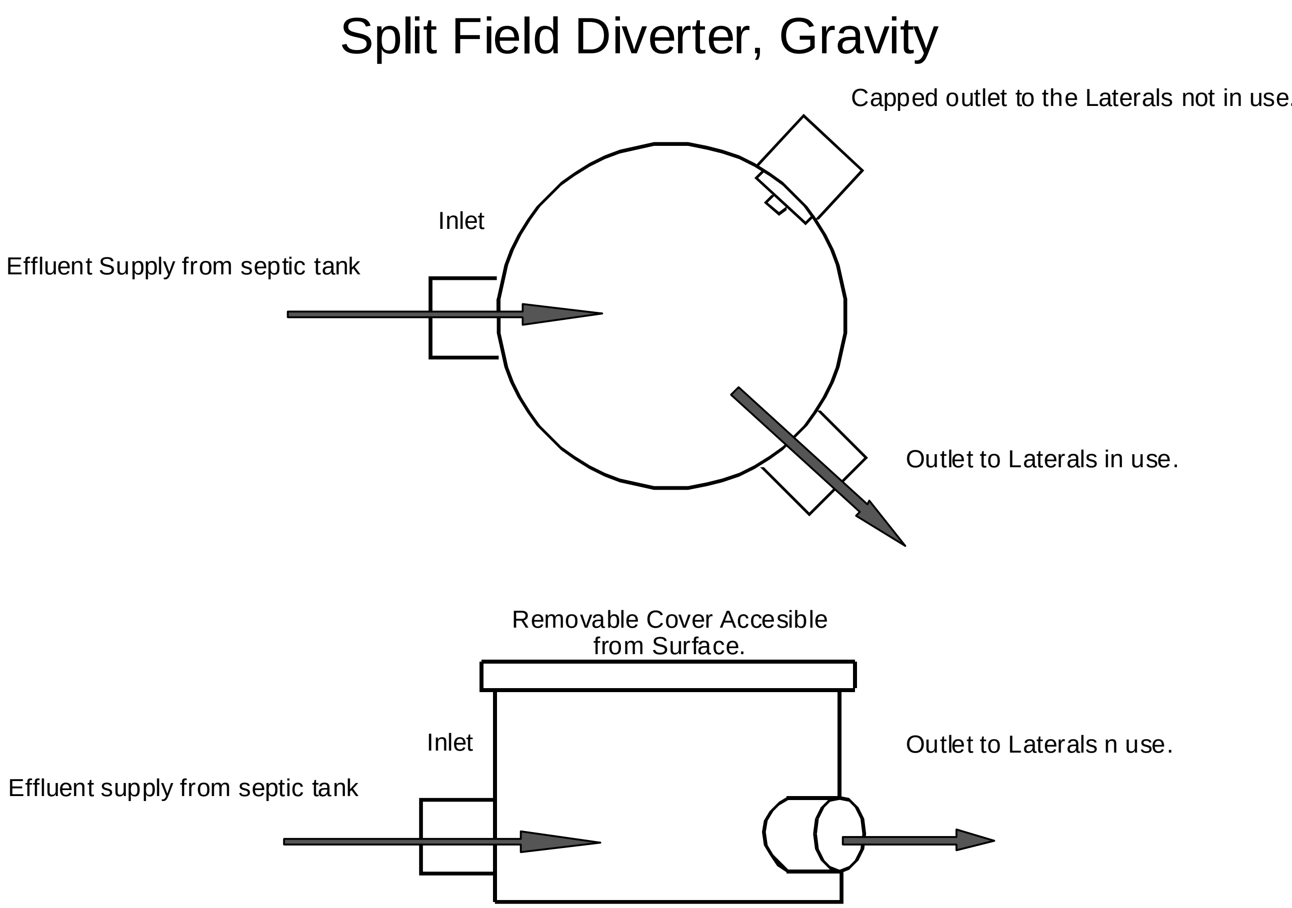
Note: Plotting the percentage of sand and clay provides the remaining percentage of silt.

The results of a Grain or Particle Size analysis will provide the percentages of Sand, Silt and Clay in the Soil sample.

Article 8.1.1.10 Effluent Loading rates on Soil.
Table A.1.E.1 Effluent Loading rates on Soil - Imperial Values

Pg. **11**, Definition grain size analysis
Pg. 18, Definition soil texture classification

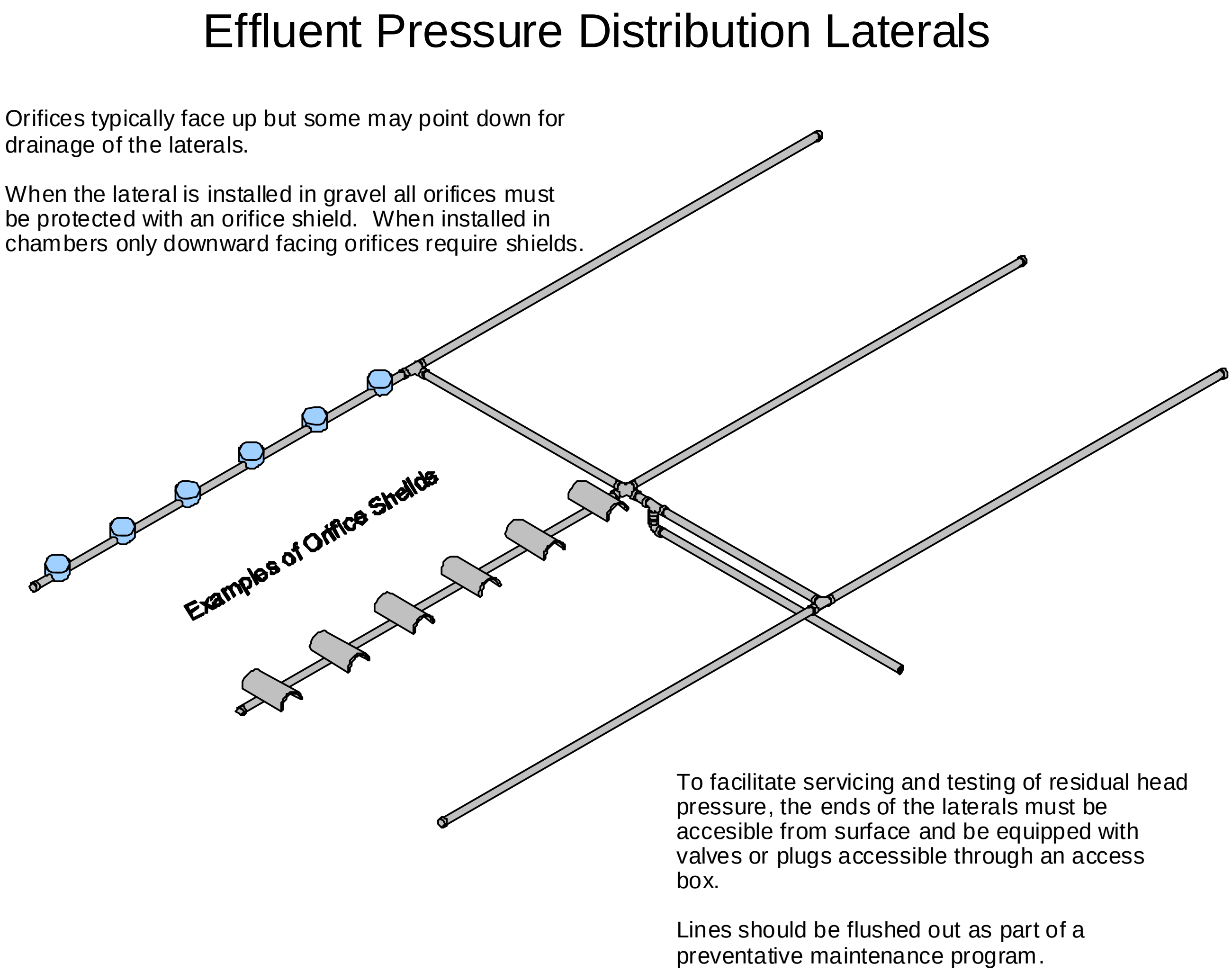
Split Field Diverter, Gravity



A Diverter is intended to provide a positive diversion of all effluent to one outlet.

Pg. **323**, Split Treatment *Field*s – handbook discussion

Pressure Distribution Laterals and Orifice Shields



The Rate of discharge per perforation *size* and Head pressure shall be calculated as in Table A.1.B page, **199**

Pg. **255**, Pressure Distribution Lateral Design

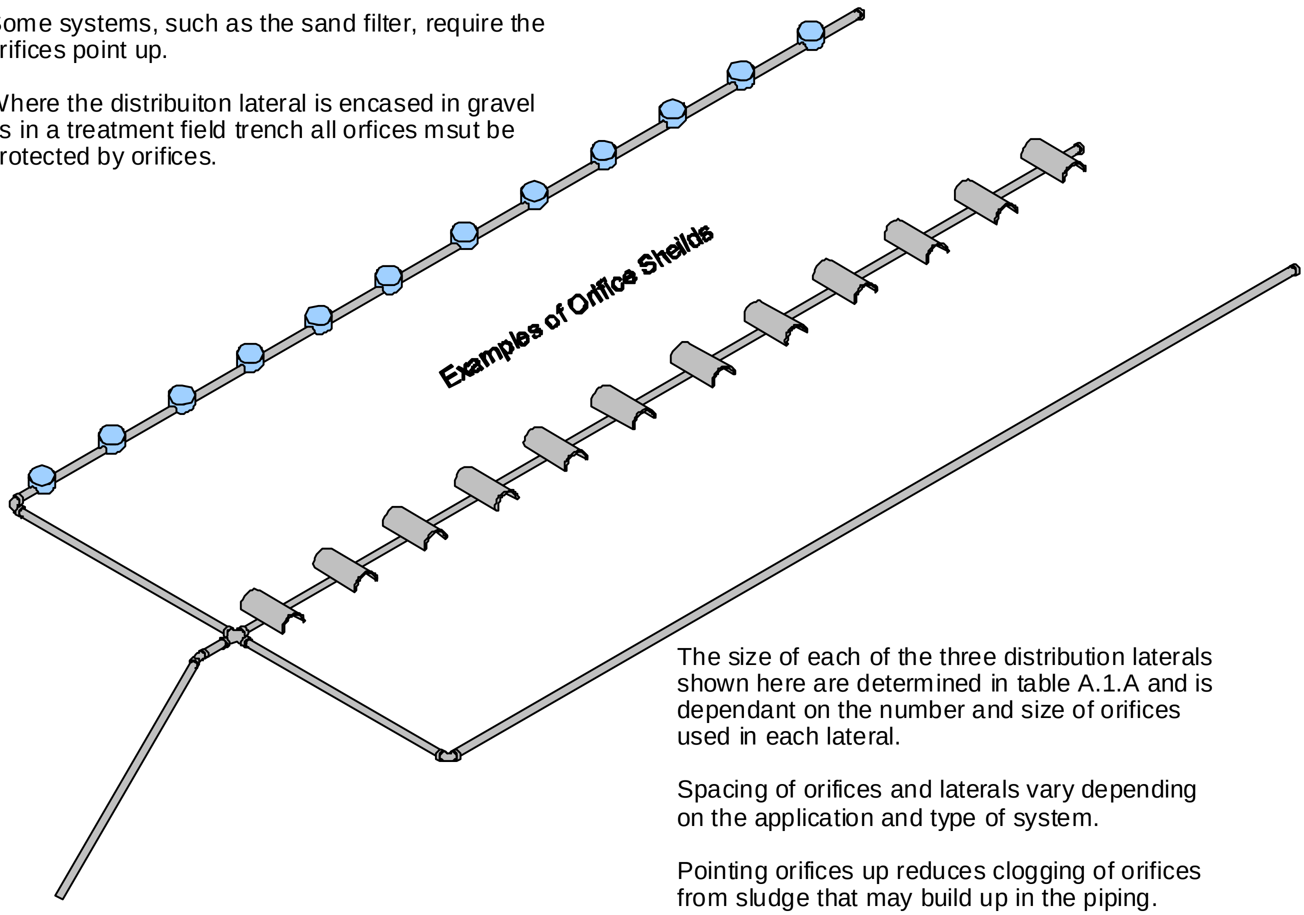
Pressure Distribution Laterals (End Feed)

Distribution Laterals

When the design requires orifices drilled in the top of the pipe some orifices may be drilled in the bottom of the distribution laterals to allow the lateral to drain to prevent freezing.

Some systems, such as the sand filter, require the orifices point up.

Where the distribuiton lateral is encased in gravel as in a treatment field trench all orfices msut be protected by orifices.



The size of each of the three distribution laterals shown here are determined in table A.1.A and is dependant on the number and size of orifices used in each lateral.

Spacing of orifices and laterals vary depending on the application and type of system.

Pointing orifices up reduces clogging of orifices from sludge that may build up in the piping.

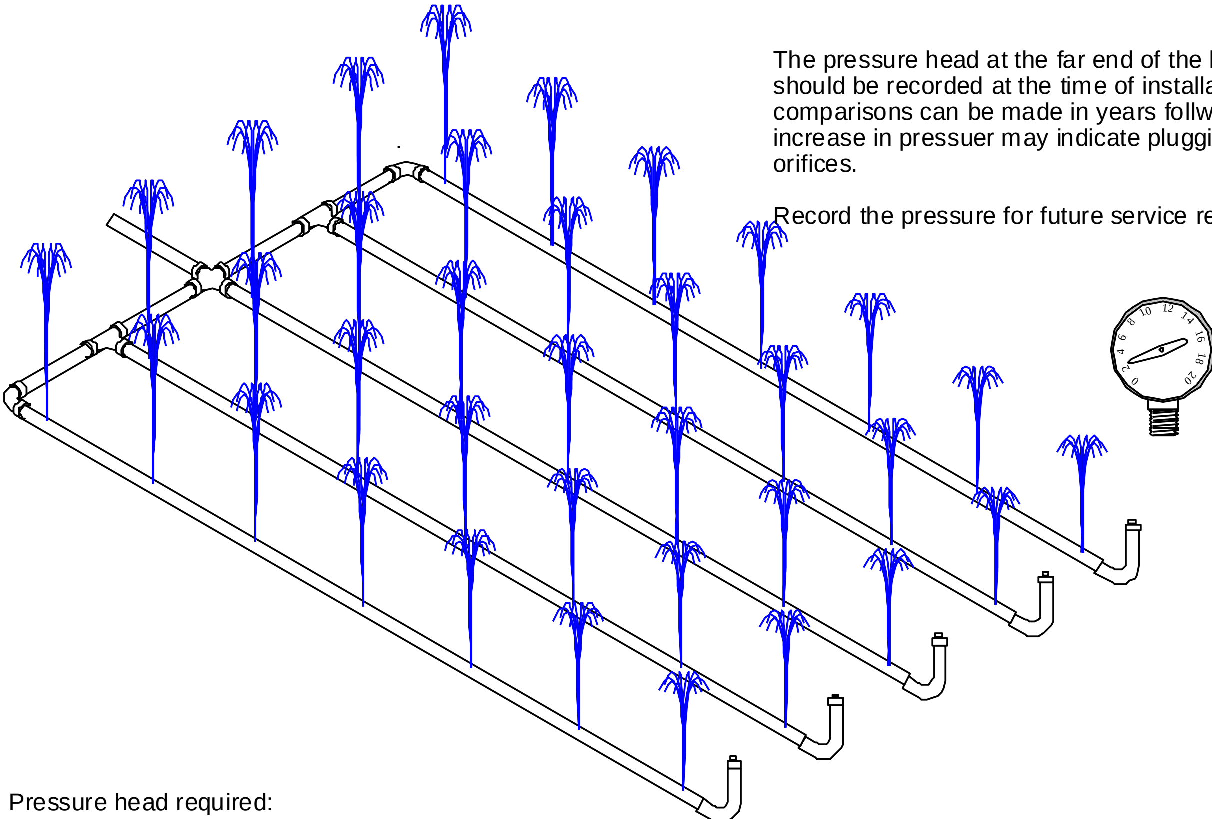
The rate of discharge per orifice, based on orifice size and pressure head, shall be calculated as in Table A.1.B.

Article 2.6.2.2 Orifice shields required
Pg. **255**, Pressure Distribution Lateral Design

Squirt Test on Pressure Distribution Laterals

Squirt Test

The squirt test is useful in testing and proving the design of pressure distribution systems for treatment mounds, sand filters, fields andother pressure distribution applications



The pressure head at the far end of the laterals should be recorded at the time of installation so comparisons can be made in years follwing. An increase in pressuer may indicate plugging orifices.

Record the pressure for future service reference

Pressure head required:

Squirt height is a minimum 1.5 m (5 feet) iwhen orifices ae 4.8 mm (3/16 in) or less and a minimum pressure of 600 mm (2 ft) when orifices are larger than 4.8 mm (3/16 in).

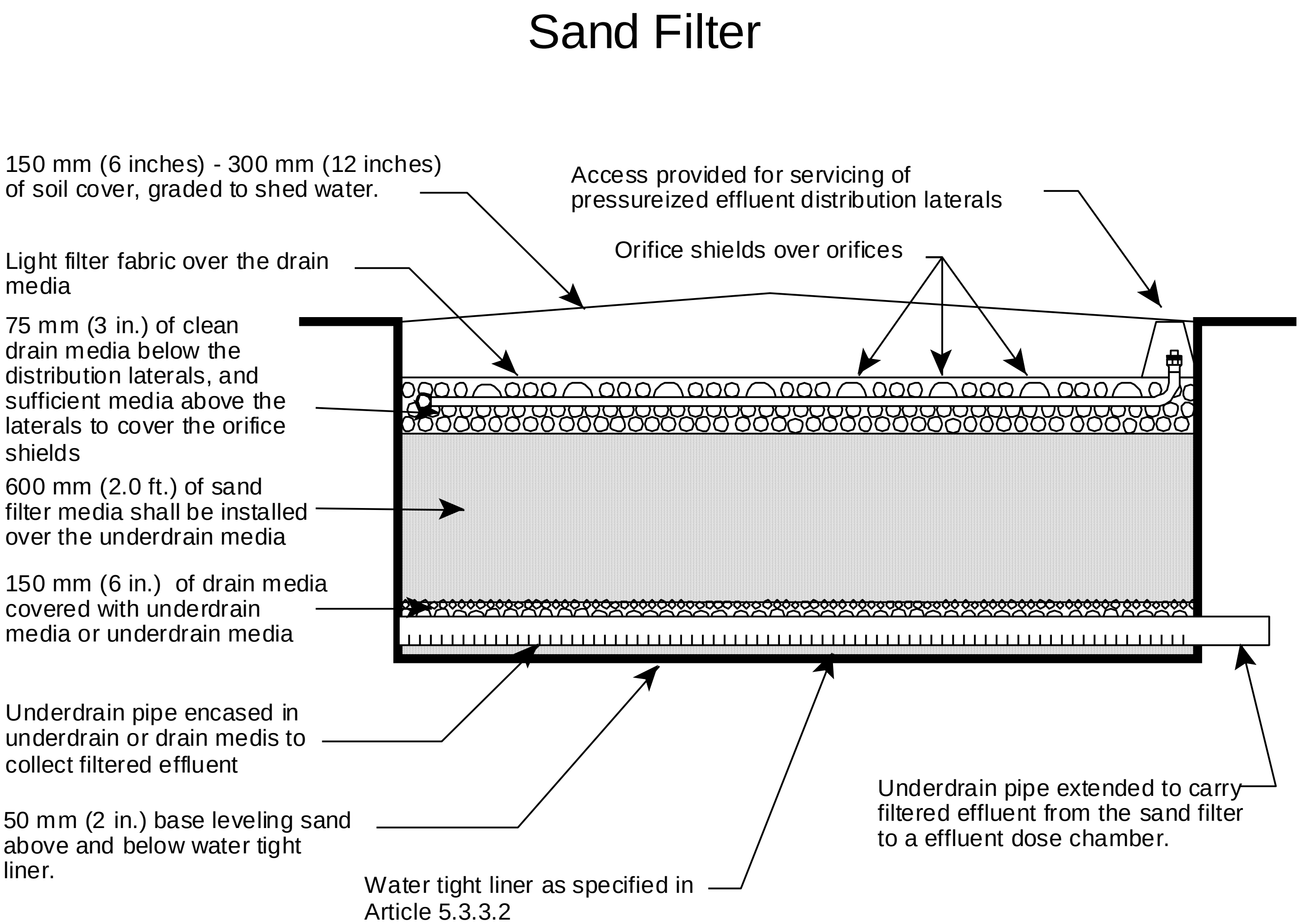
Squirt height should not exceed a 20% loss in squirt height from the start to end of lateral which coorosoponds to a 10% difference in the flow rate.

Volume discharged in a single dose event:
The difference in the volume discharged from orifices along a lateral cannot exceed 10% during an individual dose of effluent. The difference in volume dischared in a single dose event from any 2 orifices in the entire system cannot exceed 15%.

To check, collect volume discharged from the orifice closest to the supply and the orifice furthest from the supply in buckets and compare amount discharged in the dose event.

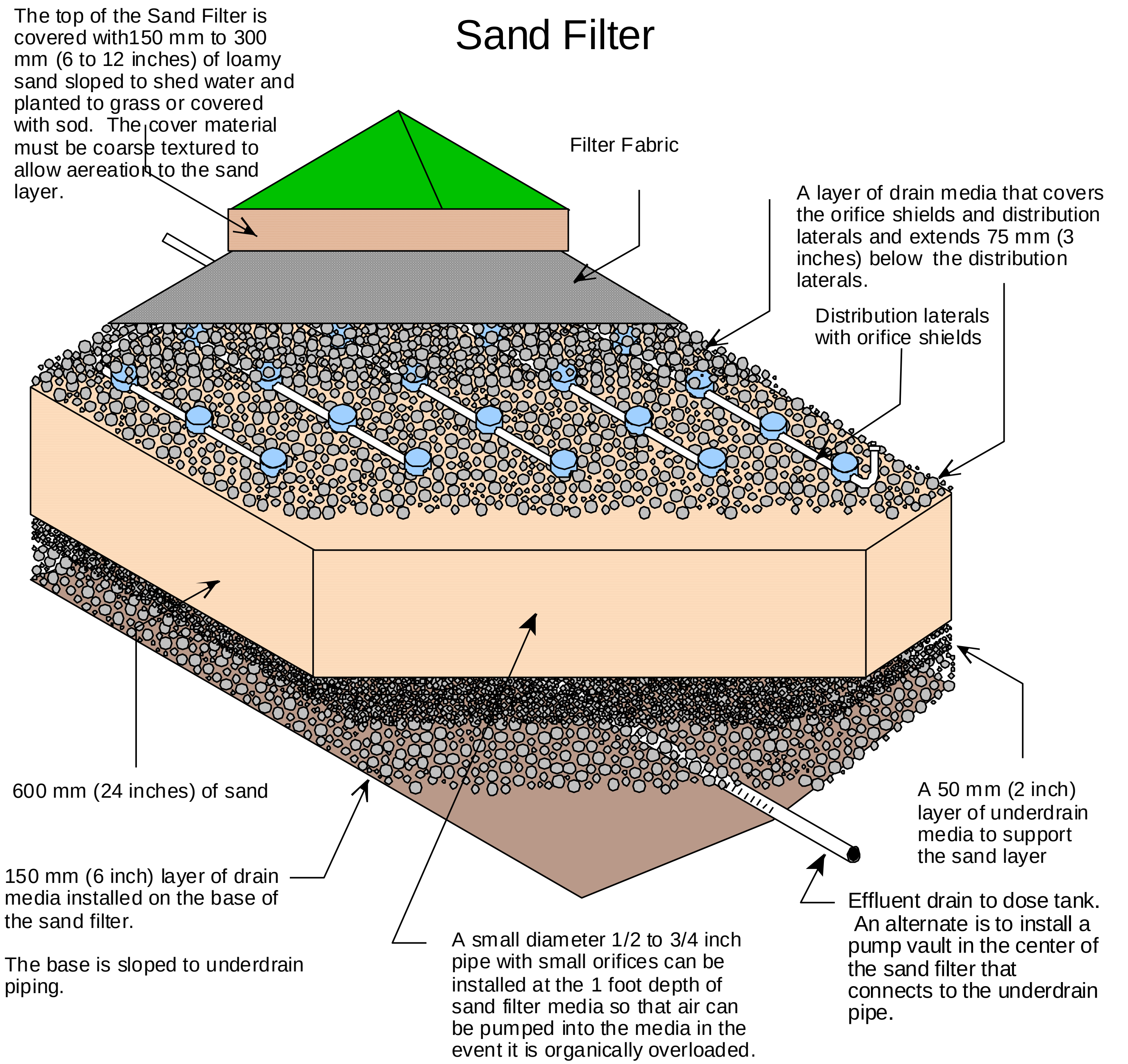
Article 2.6.1.2 volume discharge difference between orifices allowed
Article 2.6.5.1 (1)(d) minimum pressure head at orifices
Article 2.6.2.4 Maximum lateral length
Article 2.6.1.5(1)(i) lateral flushing access at end of laterals
Pg. **256**, Squirt Test
Article 2.6.1.5 Pressure Distribution Lateral Design

Sand Filter Vertical Cross Section



Subsection 5.3.2 Sand Filters
Pg. **346** Sand filter, handbook discussion section

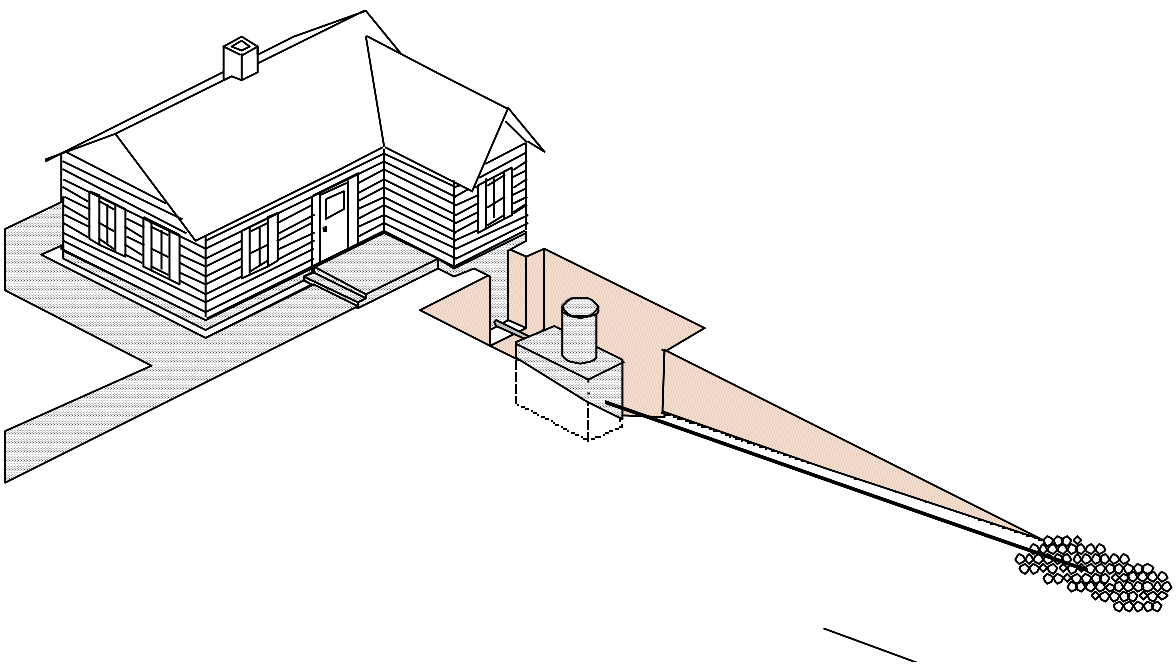
Sand Filter Cut Away Cross Section View



Subsection 5.3.2 Sand Filters
Pg. **346** Sand filter, handbook discussion section

Typical Open Discharge

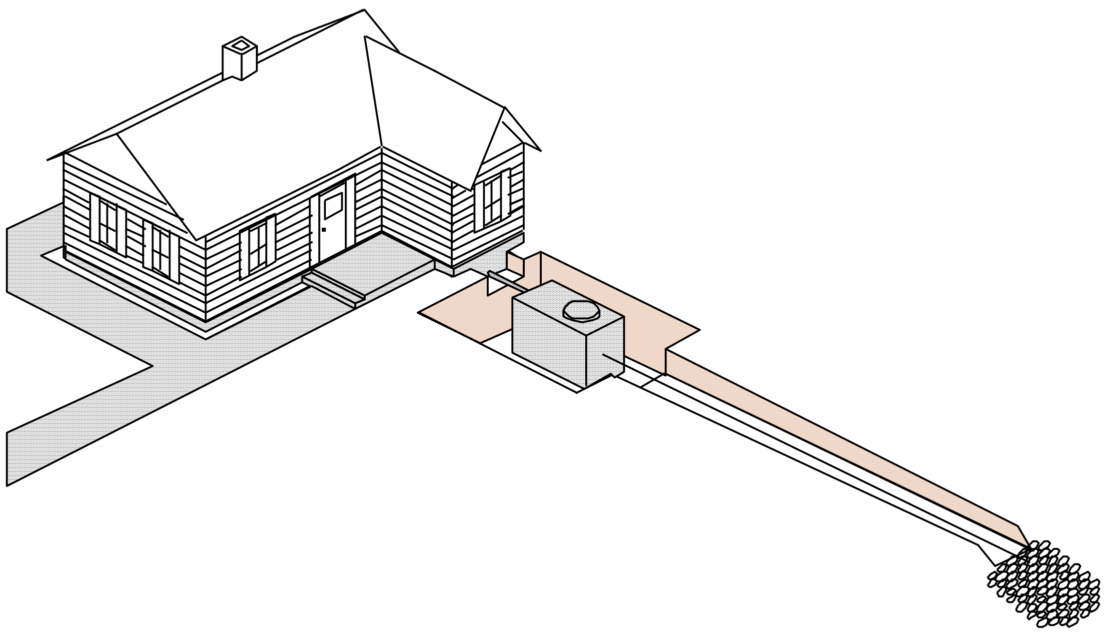
Open Discharge Installation
Using A Deep Bury Pump Type Septic Tank



Pg. **13** Open Discharge System definition
Section 8.6, Open Discharge System
Article 8.6.1.1 soil types allowed, effluent to remain on property, minimize ponding, landscape to encourage infiltration.
Article 8.6.1.2 Preventing Erosion
Pg. **348**, Open Discharge – large land area need for this system; minimum 90 meters (300 ft) to property lines.

Typical Open Discharge, Gravity

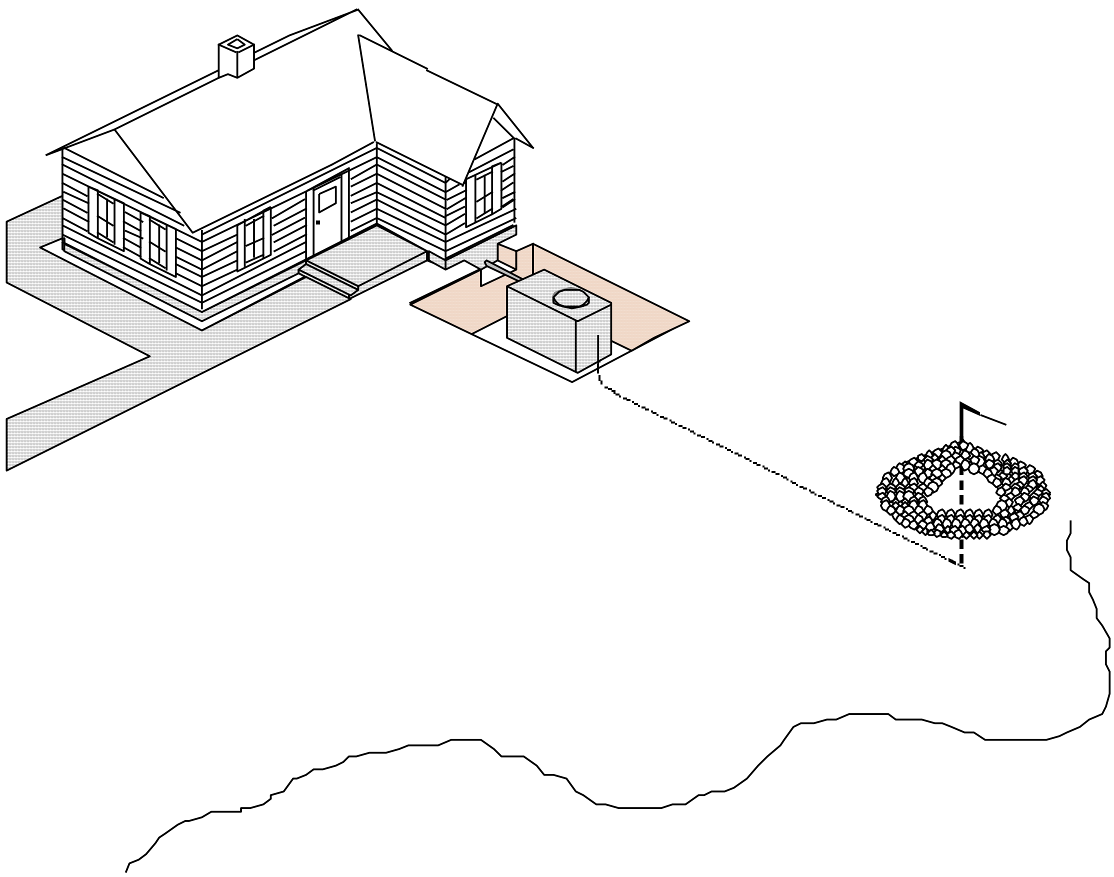
Open Discharge Installation Using A Shallow Bury Siphon Type Septic Tank



Pg. **13** Open Discharge System definition
Section 8.6, Open Discharge System
Article 8.6.1.1 soil types allowed, effluent to remain on property, minimize ponding, landscape to encourage infiltration.
Article 8.6.1.2 Preventing Erosion
Pg. **348**, Open Discharge

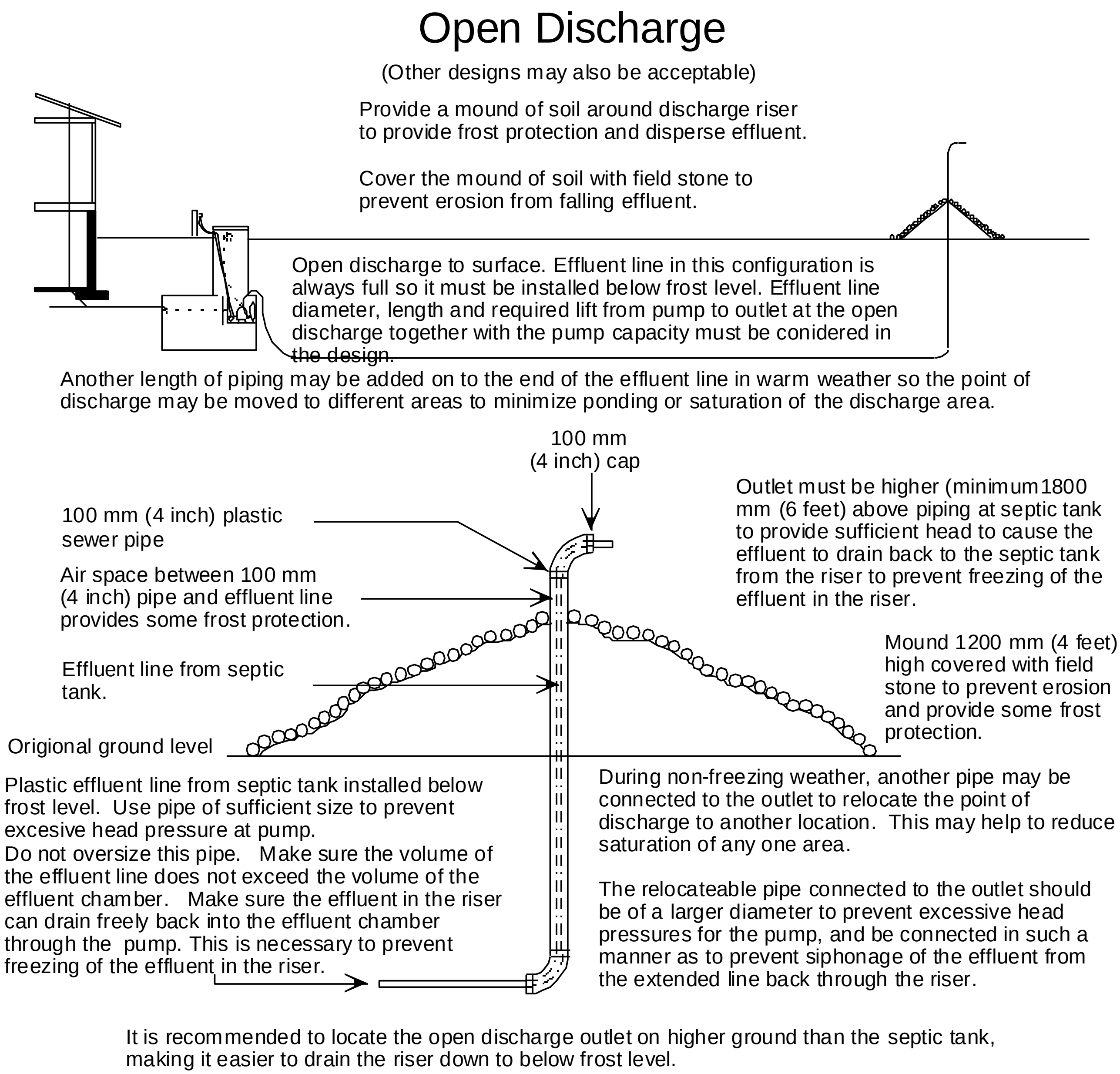
Typical Open Discharge, Deep Bury Effluent Line

Open Discharge Installation Using
A Shallow Bury Pump Type Septic Tank



Pg. **13** Open Discharge System definition
Section 8.6, Open Discharge System
Article 8.6.1.1 soil types allowed, effluent to remain on property, minimize ponding, landscape to encourage infiltration.
Article 8.6.1.2 Preventing Erosion
Pg. **348**, Open Discharge

Open Discharge Deep Bury Effluent Line Detail

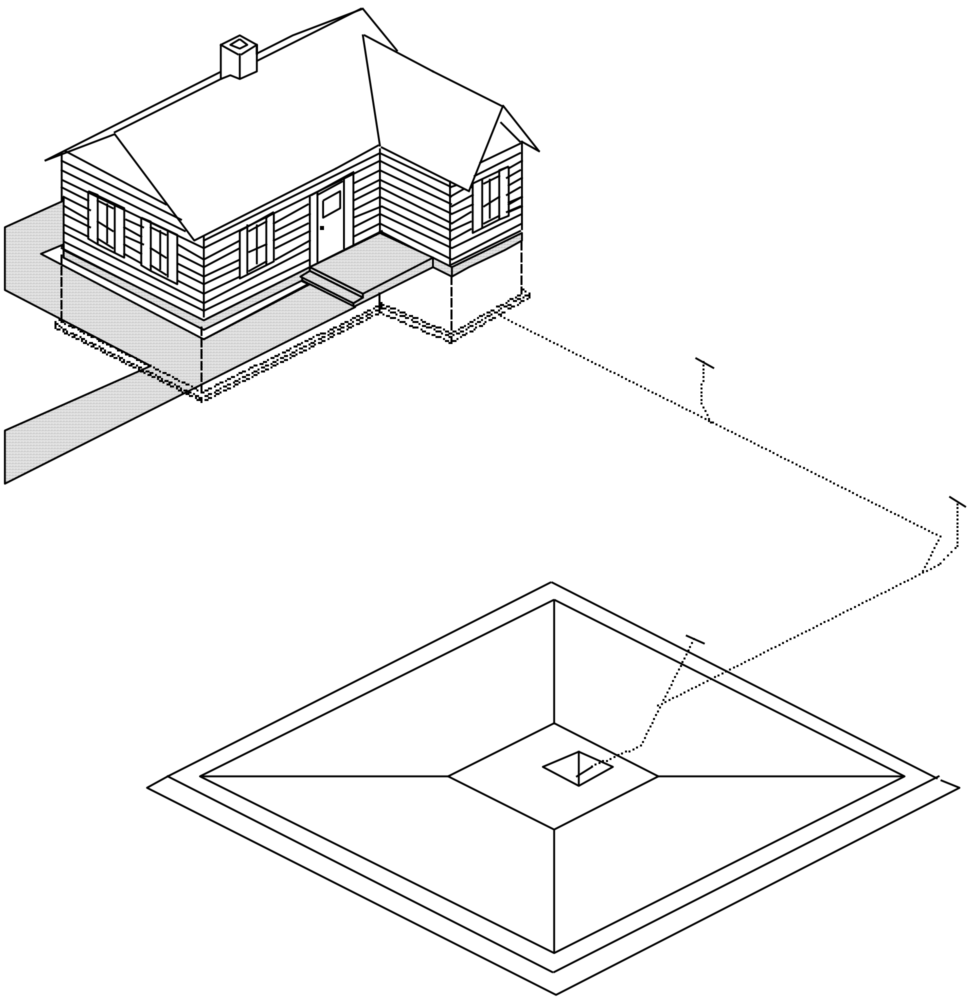


Pg. **13** Open Discharge System definition
Section 8.6, Open Discharge System
Article 8.6.1.1 soil types allowed, effluent to remain on property, minimize ponding, landscape to encourage infiltration.
Article 8.6.1.2 Preventing Erosion
Pg. **348**, Open Discharge

Lagoon, Typical

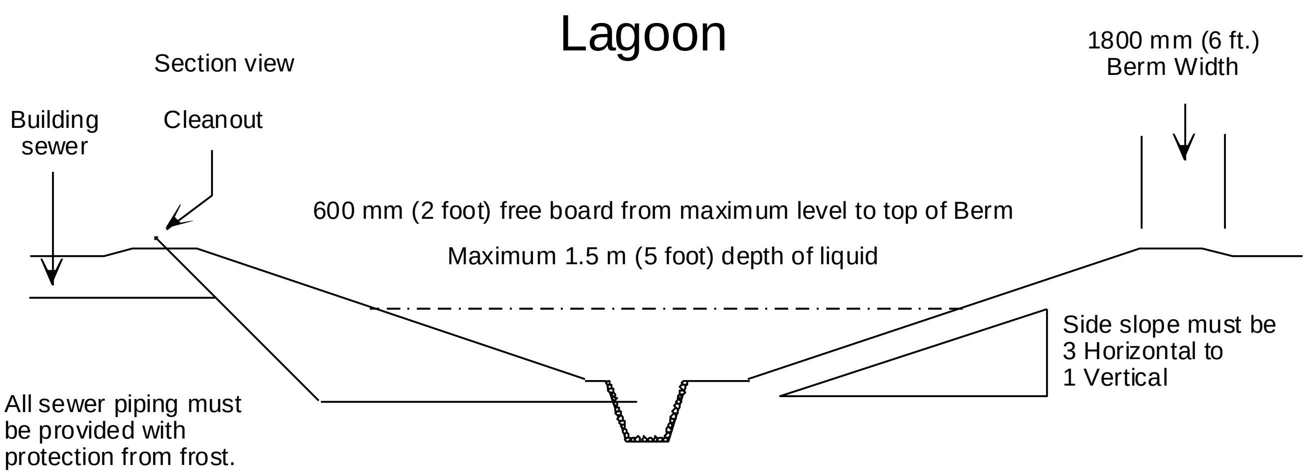
Sewage Lagoon Installation

(Other designs may also be acceptable)



Part 9, *Sewage* or *Effluent Lagoon*s
Article 9.1.1.2 Surface area large enough to evaporate sewage

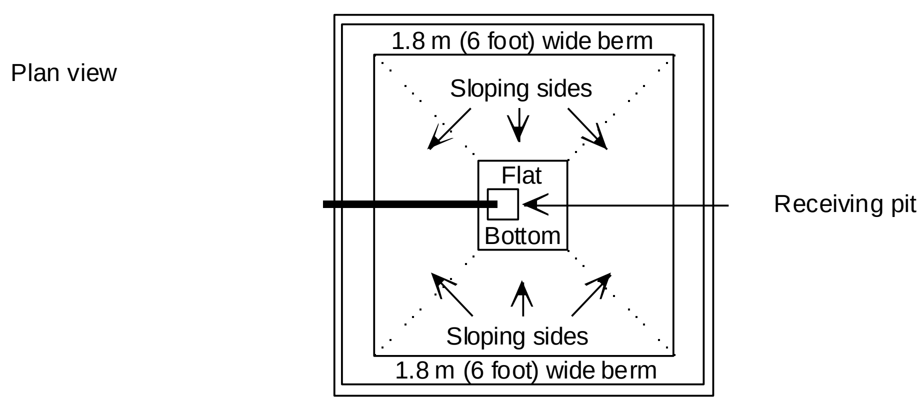
Lagoon Vertical Cross Section



Receiving Pit 1800 mm x 1800 mm (6 ft. x 6 ft.) Should be rock or block lined.

The building sewer should enter the receiving pit 600 mm (2 feet) below the bottom of the lagoon to provide sufficient liquid cover to prevent freezing.

If the receiving pit is not used, the large lagoon must retain 600 mm (2 feet) of liquid over the inlet piping to prevent the inlet piping from freezing.



Fence the lagoon for safety

Article 9.1.1.3 max sewage operating depth and side slopes.
Article 9.1.1.4 receiving pit required to prevent freezing and store sludge.
Article 9.1.1.5 fencing of the lagoon required if deeper than 600 mm (2 ft.)

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