Private Sewage System Design Example/Template

Field

PREFACE

(Version April 1, 2013)

This is an example design document for a septic tank and treatment field system. It reflects the information needed to demonstrate the design considerations for the particular site and system required by the Private Sewage Standard of Practice 2009 (Standard) have been made. Considerations needed for a particular site may go beyond those used as an example in this document.

This example document can be used as a template by editing or adding critical information to suit the particular site and system. This is an example only.

While it is preferable to use a consistent format to facilitate quick review, other formats of the design may be accepted by the Safety Codes Officer (SCO), if the design includes the required information that shows the necessary design considerations were made.

A design is required in support of a permit application. It includes drawings and supporting information as it applies to the specific design. This is the information a SCO will review to evaluate whether design considerations required by the Standard have been adequately made prior to issuing the permit.

Including the design in the operation and maintenance manual that must be provided to the owner, will simplify development of the operation and maintenance manual.

PRIVATE SEWAGE SYSTEM DESIGN CONSIDERATIONS AND DETAIL.

Joe Smith
Box 1,
Somewhere, Alberta

Legal Description of Property: SE Sec 9, Twp 71, Rge. 5, W of 6 Mer.
Lot 1; Blk 1; Plan 123450
Municipal Address: 19035 - Rge. Rd. 5

This private sewage system is for a 4-bedroom single family dwelling. The total peak wastewater flow per day used in this design is 450 imperial gallons. The average operating flow is expected to be 300 gallons per day.

The sewage system includes a septic tank and treatment field system. This system is suitable for the site and soil conditions of your property. The design reflected in the following applies, and meets, the requirements of the current Alberta Private Sewage Systems Standard of Practice (Standard). The system will achieve effective treatment of the wastewater from this residence.

1 Wastewater Characteristics

1.1. Wastewater Peak flow

The development served is a 4-bedroom single-family dwelling. Based on the characteristics of the home identified during the review the total plumbing fixture unit load in this residence is 21. Fixture unit load is as follows:

- Main bath = 6 fixture units
- Bathroom with shower off master bedroom = 6 fixture units
- Kitchen sink = 1.5 fixture units
- Laundry stand pipe = 1.5 fixture units
- Bathroom in basement = 6 fixture units

Total peak daily flow used in the design is: **(75 Imp. gal/bedroom x 4 bedrooms x 1.5 persons/bedroom)**	**450 Imp. gal/day**

1.2. Wastewater Strength

Characteristics of the development were considered to assess sewage strength. No garbage grinders or other characteristics were identified that would cause typical wastewater strength to be exceeded.

Projected wastewater strength for the design is:	**BOD 220 mg/L** **TSS 220 mg/L** **Oil and Grease 50 mg/L**

1.3. Wastewater Flow Variation Considerations

The characteristics of this development indicate wastewater flow volumes will not vary substantially during the day or from day to day. As a result, no flow variation management is needed.

2 Site Evaluation Findings

2.1 Site Evaluation

The lot is 3.88 acres (1.57 hectares). The dimensions of the property are shown in the drawing attached in Appendix A. The adjacent land use is country residential development, varying in size from approximately 1.5 to 3 hectares. There is a water well and a treatment mound on the neighbouring property to the north and south.

Blueberry Creek runs parallel to the southwest property line. The southwest portion of the property has a 5% slope toward the creek. Seasonally saturated soils were found in the lower slope areas near the southwest property line. Line locates confirmed there are no existing utilities in the area selected for the system components. **The area selected for the system must be kept clear of any utilities to be installed.** No utility right-of-ways or easements were noted on the subject site based on a review of the survey plan attached to this design and as indicated by the owner.

The site evaluation assessed the area within in 330 ft (100 m) of all system design components. The selected treatment site is nominally flat. No significant setback constraints were noted. Pertinent features identified during the site review and the required setback distances are identified on the site plan in Appendix A.

2.2 Soils Evaluation

Three soil test pits were investigated on this site. Test Pit 1 is located where the owner preferred the system be located. This area has severe soil constraints requiring a treatment mound at more expense; however, this area could act as a back up if needed. Test pits 2 and 3 identified better soil characteristics suitable for the installation of a treatment field receiving effluent from a septic tank.

There is little variability between test pits 2 and 3 so they are adequate for design purposes. The location of the test pits are shown on the site plan in Appendix A. Soil profile descriptions of each test pit are attached in Appendix B.

3 Key Soil Characteristics and Effluent Loading Rates

3.1. Restrictive Layer Considerations

A restrictive layer exists at 7 feet below surface as indicated by:

- redoximorphic features – mottling at 7 ft; gleying below 7.5 ft,
- saturated, sandy clay textured soil having massive structure at 7.5 feet will severely limit downward flow.

3.2. Limiting Condition For Soil Loading Rate Selection

The key soil characteristic affecting effluent loading is**:**

- **Fine Sandy Loam (FSL) textured soil having a blocky, grade 3 structure at the depth of 24 to 60 inches.**

3.3. In Situ Soil Effluent Loading Rate Selection

- **effluent loading rate for primary treated (septic tank) effluent on this soil is 0.32 Imp. gal/day/ft^2.**

3.4. Effluent Linear Loading Rates and Design Considerations

The soil profile characteristics do not require the application of linear loading rates set out in the Standard. However, this design minimizes linear loading as the laterals have been oriented to make the field long and narrow and at 90 degrees (perpendicular) to the assumed direction of the underlying ground water flow toward the creek to the southwest.

The trench bottom depth of this treatment field will be at a maximum of 2 feet below surface. For this level site the trench bottom elevation for the 5 weeping lateral trenches are the same.

4 Initial Treatment Component Design Details

Details of the initial treatment components required for this design are attached in Appendix C.

4.1 Septic Tank and Dose Tank

Details of the initial treatment components required for this design are attached in Appendix C.

4.1 Septic and Dose Tank Requirements

4.1.1 Septic Tank

The working capacity of the septic tank specified for this design is 1218 Imperial gallons. Appendix C includes specifications for septic tank Model ST 1218.

The minimum working capacity based on Table 4.2.2.2 of the 2009 SOP for this development is 940 Imp. gal.

Burial depth of the septic tank at finished grading above the top of the tank will be 4ft 6 inches. This tank is rated for a maximum burial depth of 5 ft 10 inches. Insulation of the tank is not required as the burial depth exceeds 4 feet.

4.1.2 Dose Tank

The dose tank (second chamber) has a total capacity of 670 Imp. gal. In addition to the single dose volume the tank provides approximately 220 Imp. gal emergency storage above the high effluent alarm setting. Specifications provided by the manufacturer are shown in Appendix C.

4.1.3 Effluent Filter

An inline 2-inch diameter Sim/Tech© model STF-100 effluent filter having an effective opening of less than 1/8-inch (3.2 mm) is used. When clean the filter is rated at a head loss of 0.5 feet at a flow of 80 Imp. gal/min. A one year service interval is expected with typical flow volumes and wastewater characteristics.

5 Soil Treatment Component Design Details

5.1 Selection of Soil Infiltration System Design

The system selected for this design is a septic tank and treatment field using 22 inch wide chambers and pressure distribution of effluent. To maintain the required 5 foot vertical separation to the restrictive layer identified in the soil profile the maximum depth of the trench bottom is 2 feet below grade.

5.2 Treatment Field Size

Trench bottom area:

Expected peak daily flow:	450 Imp. gal/day
Soil loading rate:	0.32 Imp.gal/day/ft^2
Trench bottom soil infiltration surface area:	**1407 ft^2**

The 22 inch chambers receiving primary treated effluent Level 1 that is spread over the trench bottom surface area using pressure distribution receives a 1.3 width credit, resulting in a credited trench bottom soil infiltration width of 2.38 feet.

Total length of trench bottom required:		591 ft
Layout consists of:		
5 weeping lateral trenches	-	each 120 feet long.

The location of the treatment field on the property and layout of the laterals and are shown in Appendix A and D. The treatment field sizing worksheets are provided in Appendix E.

6 Effluent Distribution Design Detail

6.1 Effluent Pressure Distribution

Five 120 ft centre fed pressure effluent distribution laterals are used over the soil infiltration area. The calculations are provided in Appendix E on the pressure distribution worksheets. The pressure distribution lateral layout drawing is included in Appendix D.

6.1.1 Effluent Pressure Distribution Lateral Design

The distribution laterals are center fed resulting in ten 60 ft pressure distribution laterals.

- Each lateral is 1-inch schedule 40 PVC pipe.
- Each lateral has 12, 1/8-inch orifices drilled at 5 foot spacing.
- The laterals shall be installed to maximize the elevation above the soil infiltration surface and exceed the minimum 4 inches above the soil infiltration surface.
- Pressure distribution lateral piping will be supported at a maximum of 4 foot spacing.
- All orifices shall point up except every 4th orifice shall point down and be equipped with an orifice shield.

The design achieves a minimum 5 foot pressure head at each orifice, resulting in a design flow of 0.34 Imp. gal/min from each 1/8-inch orifice.

There are 120 orifices throughout the effluent pressure distribution system resulting in a **total flow** of **40.8 Imp gal/min**. An additional 3.3 Imp. gal/min is added for the ¼ inch drain back orifice drilled at the lowest elevation of the effluent piping in the dose tank to achieve drain back of the laterals and supply piping.

Total flow from all orifices for this effluent pressure distribution system is 44.1 Imp. gal/min (53 U.S. gal/min).

6.1.2 Pressure Head Requirements

The total length of supply piping from the pump to the start of the pressure distribution laterals is 205 feet. The supply piping is 2 inch Schedule 40 PVC pipe. The allowance for equivalent length of pipe due to fittings is 69 feet of pipe. Total equivalent length of pipe is 274 feet. This is detailed in appendix E.

Pressure head loss due to friction
The friction loss through the piping at the flow of 40.8 Imp. gal/min is 10.1 feet of head pressure.

Other friction loss considerations required include:

- Allowance for head loss through the effluent filter under partial plugging is 5.5 feet.
- Allowance for pressure head loss along the pressure distribution laterals of 1 foot.

Total pressure head required to overcome friction loss is 16.6 feet pressure head.

Pressure head to meet vertical lift requirements include:

- A pressure head at each orifice of 5 feet.
- Lift distance of effluent from the low effluent level in the tank to the pressure distribution laterals is 7 feet.

Vertical lift and friction loss results in a **total pressure head** requirement of **28.6 ft**.

Pump specifications:
Demands for this pressure distribution lateral system are **44.1 Imp. gal/min (53 U.S. gal/min)** at **28.6 feet** of pressure head.

The pump capacity must exceed these demands to allow for variations in the design and decreased pump performance over time. A Myers model ME 50 effluent pump (1/2 hp) is specified for this system. The pump specifications with the effluent distribution system demands plotted on the pump curve are included in Appendix C.

6.1.3 Effluent Dosing Volume and Control settings.
The volume of effluent in the 600 ft of 1 inch PVC lateral piping is 22.4 Imp. gal. The volume of an individual dose must be at least 5 times the volume of the pressure distribution laterals, which is 112.2 Imp. gal.

The volume in the 205 ft of 2 inch PVC effluent supply line is 30.1 Imp. gal.
Total individual dose volume determining float settings is **142.3 Imp gal [30 Imp. gal to fill the effluent supply line and deliver the 112.2 Imp. gal per dose]**.

7 Controls
All effluent level control floats will be attached to an independent PVC pipe float mast.

7.1 Effluent Dosing Float Setting
The dose tank dimensions result in 11.27 Imp. gallons per inch of depth. The float control elevations shall be set at:

- 12.5 inches between float off and on elevations (deliver 142.3 Imp. gal/dose).
- Off: 19 inches off floor of dose tank
- On: 31.5 inches off floor of dose tank

7.2 High Liquid Level Alarm
The high level alarm specified for this system is a JB Series 1000T (manufactured by Alarm Tech Inc.).

- Alarm control float is set at 1.5 inches above pump on elevation or at 33 inches above the floor of the dose tank/chamber.

8 Operation Monitoring Components

The following components are included in the system design. See detailed drawings in Appendix D for locations.

8.1 Monitoring Ports

Monitoring ports are provided at both ends of the sand layer to enable inspection of the effluent ponding depth that may result.

8.2 Pressure Distribution Lateral Clean Outs

Clean outs are provided at the end of each pressure distribution lateral with access to grade through an access box suitable for its purpose and anticipated traffic.

8.3 Sampling Effluent Quality

Samples of the effluent can be taken from the effluent dose chamber.

9 System Setup and Commissioning

- Clean the septic tank and effluent chamber of any construction debris.
- Flush effluent distribution laterals.
- Conduct a squirt test to assess that residual head pressure required by the design is achieved and that the volume from each orifice is within allowed tolerances.
- Confirm the correct float levels and ensure this delivers the dose volume required by this design.

10 Operation and Maintenance Manual

The Owner's Manual detailing the design, operation, and maintenance of the installed system will be provided to the owner in accordance with Article 2.1.2.8 of the Standard.

Signature and closing by the designer/Installer.

Attachments:

Appendix A – Site Information [Site Plan, Property Subdivision Plan]

Appendix B – Soil Information [Soil Profile Logs, Laboratory Analysis Results]

Appendix C – Manufacturer's and Design Specifications for System Components

Appendix D – Detailed System Schematics and Drawings

Appendix E – System Design Worksheets

This design has been developed by (name of certified person and company name). This design meets the requirements of the Alberta Private Sewage Systems Standard of Practice 2009 unless specifically noted otherwise and in such case special approval is to be obtained prior to proceeding with installation of this design. *(Carry on with any other qualifications or limitations that in your opinion as the designer/installer are needed.)*

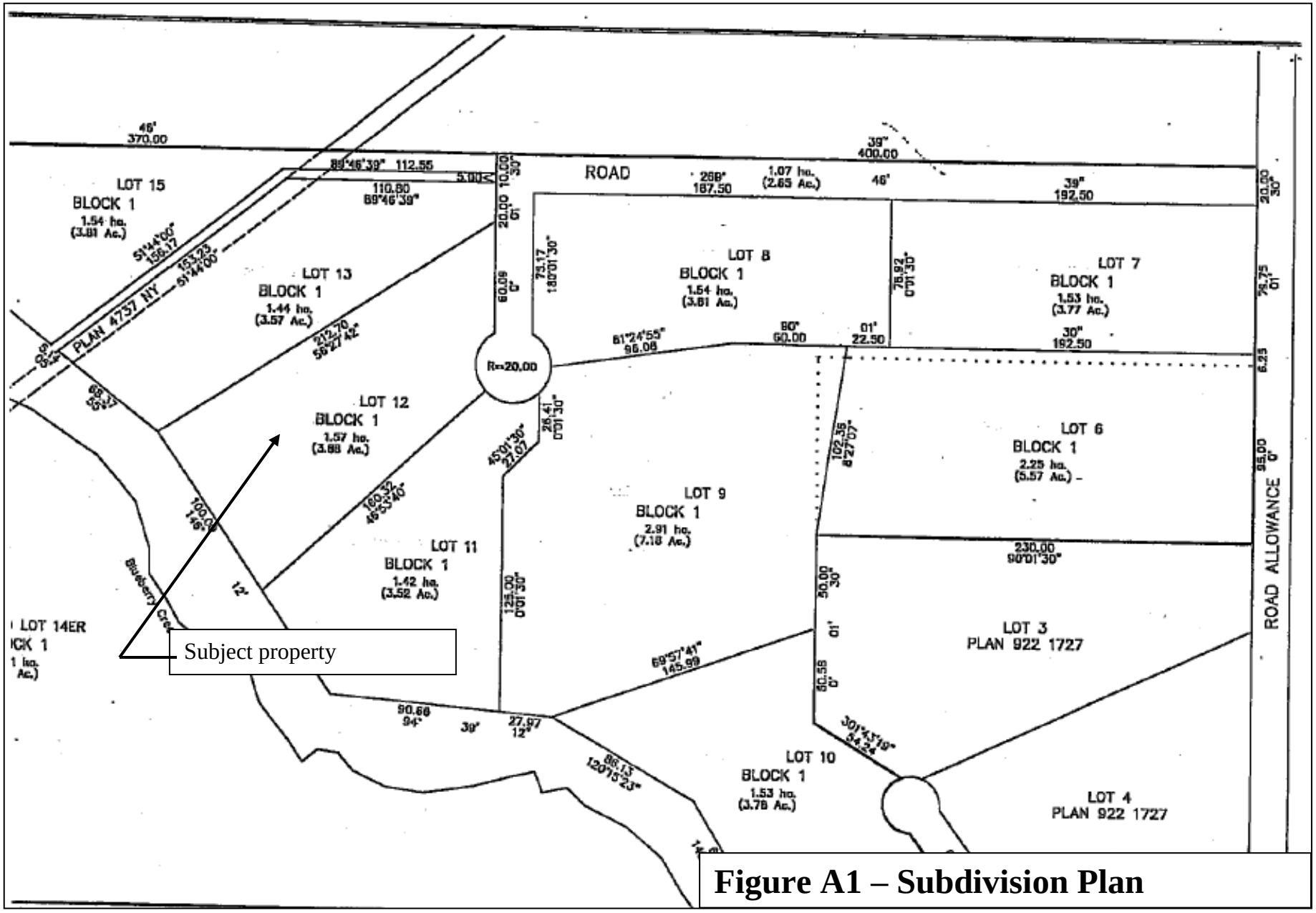


Figure A1 – Subdivision Plan

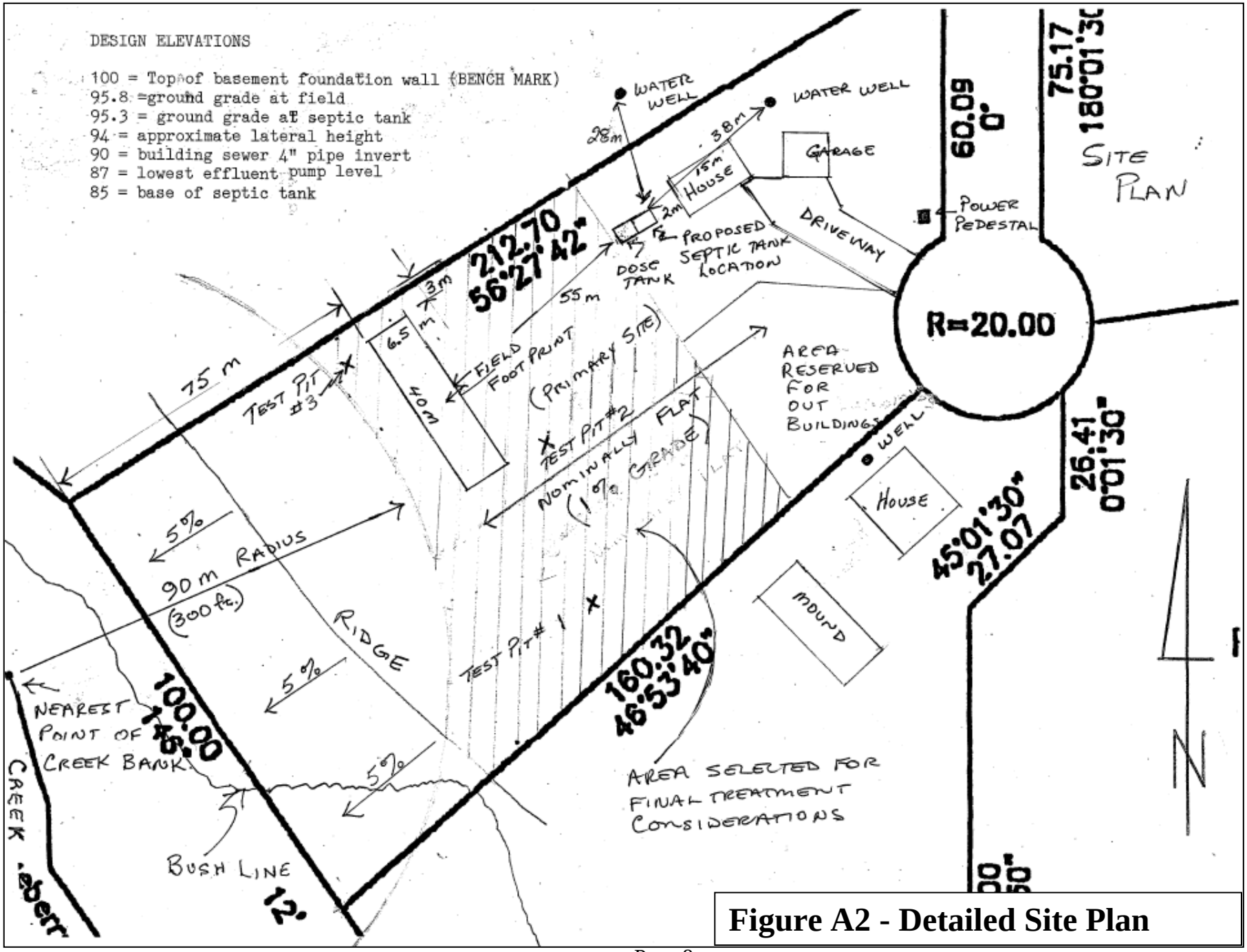


Figure A2 - Detailed Site Plan

Appendix B - Alberta Private Sewage Treatment System Soil Profile Log Form

Smith Residence Soil Assessment

Legal Land Location								Test Pit GPS Coordinates	
LSD-1/4	Sec	Twp	Rg	Mer	Lot	Block	Plan	Easting	Northing
SE	9	71	5	W6M	12	1	123450	65032	34507

Investigation Date: October 5th, 2009.	Vegetation notes: Prairie grasses.	Overall site slope %	Variable across site.
		Slope position of test pit:	2%

Test hole No.	Soil Subgroup	Parent Material	Drainage	Depth of Lab sample #1	Depth of Lab sample #2
Test Pit #1					

Hori -zon	Depth (cm) (in)	Texture	Lab or HT	Colour	Gleying	Mottling	Structure	Grade	Consistence	Moisture	% Coarse Fragments
A	Surface to 8 in.	Loamy Medium Sand (LMS)	HT	Dark brown.	None.	None.	Single Grain	0		Moist	20%
B	8 to 45 in.	Fine Sandy Loam (FSL)	HT and Lab	Light brown.	None.	None.	Blocky	3	Friable	Moist.	10%
B	45 to 60 in.	Silt Loam (SIL)	HT	Light brownish grey.	At 4.5 ft saturated and gleyed.	4 to 5 ft many prominent distinct mottles noted throughout.	Prismatic	2	Friable to firm.	Moist to Wet below 4.5 feet.	<1%
C	60 to 96 in.	Sandy Clay (SC)	HT	Light to dark grey.			Massive	0	Firm	Moist to wet.	<3%

Depth to Groundwater	4.5 feet.	Restricting Soil Layer Characteristic	Sandy clay restricts downward effluent movement as massive and contains saturated conditions.
Depth to Seasonally Saturated Soil	4 feet.	Depth to restrictive Soil Layer	4 feet.
Site Topography	Slightly undulating.	Depth to Highly Permeable Layer Limiting Design	Not encountered in this soils assessment and design.
Key Soil Characteristics applied to system design effluent loading	The grain size analysis conducted by the lab for this sample from 8 to 45 inches determined that the sand fraction in the Sandy Loam is fine grained. It is the key soil horizon for effluent loading design considerations.		

Weather Condition notes: Slightly overcast with moderate wind – no rain or other conditions that would impact soils assessment were encountered.

Comments (such as root depth and abundance or other pertinent observations): This test pit location has limited suitability for an onsite sewage system. A treatment field is not acceptable because of less than 5 ft vertical separation. A treatment mound could be designed for this location if required.

Appendix B - Alberta Private Sewage Treatment System Soil Profile Log Form

Smith Residence Soil Assessment

Legal Land Location								Test Pit GPS Coordinates	
LSD-1/4	Sec	Twp	Rg	Mer	Lot	Block	Plan	Easting	Northing
SE	9	71	5	W6M	12	1	123450	65024	34535

Investigation Date: October 5th, 2009.	Vegetation notes: Prairie grasses.	Overall site slope %	Variable across site.
		Slope position of test pit:	Nominally flat.

Test hole No.	Soil Subgroup	Parent Material	Drainage	Depth of Lab sample #1	Depth of Lab sample #2
Test Pit #2				30 – 36 in.	

Hori -zon	Depth (cm) (in)	Texture	Lab or HT	Colour	Gleying	Mottling	Structure	Grade	Consistence	Moisture	% Coarse Fragments
A	Surface to 24 in.	Loamy Medium Sand (LMS)	HT	Dark brown.	None.	None.	Single Grain	0		Moist	40%
B	24 to 60 in.	Fine Sandy Loam (FSL)	HT and Lab	Light brown.	None.	None.	Blocky	3	Friable	Moist to dry.	5%
B	60 to 84 in.	Silt Loam (SIL)	HT	Light brownish grey.	None.	None.	Prismatic	2	Friable to firm.	Moist.	<1%
C	84 to 96 at end of test pit.	Sandy Clay (SC)	HT	Light to dark grey.	At 7.5 ft saturated and gleyed.	7 to 7.5 ft Many distinct prominent mottles.	Massive	0	Firm	Moist to wet.	<5%

Depth to Groundwater	7.5 feet.	Restricting Soil Layer Characteristic	Massive Structured Sandy Clay restricts downward effluent movement and creates saturated conditions.
Depth to Seasonally Saturated Soil	7 feet.	Depth to restrictive Soil Layer	7 feet.
Site Topography	Slightly undulating.	Depth to Highly Permeable Layer Limiting Design	Not encountered in this soils assessment and design.
Key Soil Characteristics applied to system design effluent loading	The lab grain size analysis of the sand portion in the Sandy loam soil from 24 to 60 inches determined the sand fraction is fine grained. This is the key soil horizon the system design must use.		

Weather Condition notes: Slightly overcast with moderate wind – no rain or other conditions that would impact soils assessment were encountered.

Comments (such as root depth and abundance or other pertinent observations): Preferred trench depth is 18 to 24 inch. Roots extend to 6 feet (very fine at that depth) indicating no obvious limiting characteristic in the soil.

Appendix B - Alberta Private Sewage Treatment System Soil Profile Log Form

Smith Residence Soil Assessment

Legal Land Location								Test Pit GPS Coordinates	
LSD-1/4	Sec	Twp	Rg	Mer	Lot	Block	Plan	Easting	Northing
SE	9	71	5	W6M	12	1	123450	64964	34557

Investigation Date: October 5th, 2009.	Vegetation notes: Prairie grasses.	Overall site slope %	Variable across site.
		Slope position of test pit:	Nominally flat.

Test hole No.	Soil Subgroup	Parent Material	Drainage	Depth of Lab sample #1	Depth of Lab sample #2
Test Pit #3				35 to 45 in.	

Hori-zon	Depth (cm) (in)	Texture	Lab or HT	Colour	Gleying	Mottling	Structure	Grade	Consistence	Moisture	% Coarse Fragments
A	Surface to 22 in.	Loamy Medium Sand (LMS)	HT	Dark brown.	None.	None.	Single Grain	0		Moist	45%
B1	22 to 63 in.	Fine Sandy Loam (FSL)	HT and Lab	Light brown.	None.	None.	Blocky	3	Friable	Moist to dry.	5%
B2	63 to 84 in.	Silt Loam (SIL)	HT	Light brownish grey.	None.	None.	Prismatic	2	Slightly friable.	Moist to dry.	4%
C	84 to 96 in.	Sandy Clay (SC)	HT	Light to dark grey.	At 7.5 ft is saturated and gleyed.	At 7 to 7.5 ft many prominent distinct mottles	Massive	0	Firm	Moist to wet.	<2%

Depth to Groundwater	7.5 feet.	Restricting Soil Layer Characteristic	Sandy clay restricts downward effluent movement as massive and contains saturated conditions.
Depth to Seasonally Saturated Soil	7 feet.	Depth to restrictive Soil Layer	7 feet.
Site Topography	Slightly undulating.	Depth to Highly Permeable Layer Limiting Design	Not encountered in this soils assessment and design.
Key Soil Characteristics applied to system design effluent loading	The lab grain size analysis of the sand portion in the Sandy loam soil from 22 to 63 inches determined the sand fraction is fine grained. This is the key soil horizon the system design must use. Test pits 2 and 3 are consistent in their characteristics.		

Weather Condition notes: Slightly overcast with moderate wind – no rain or other conditions that would impact soils assessment were encountered.

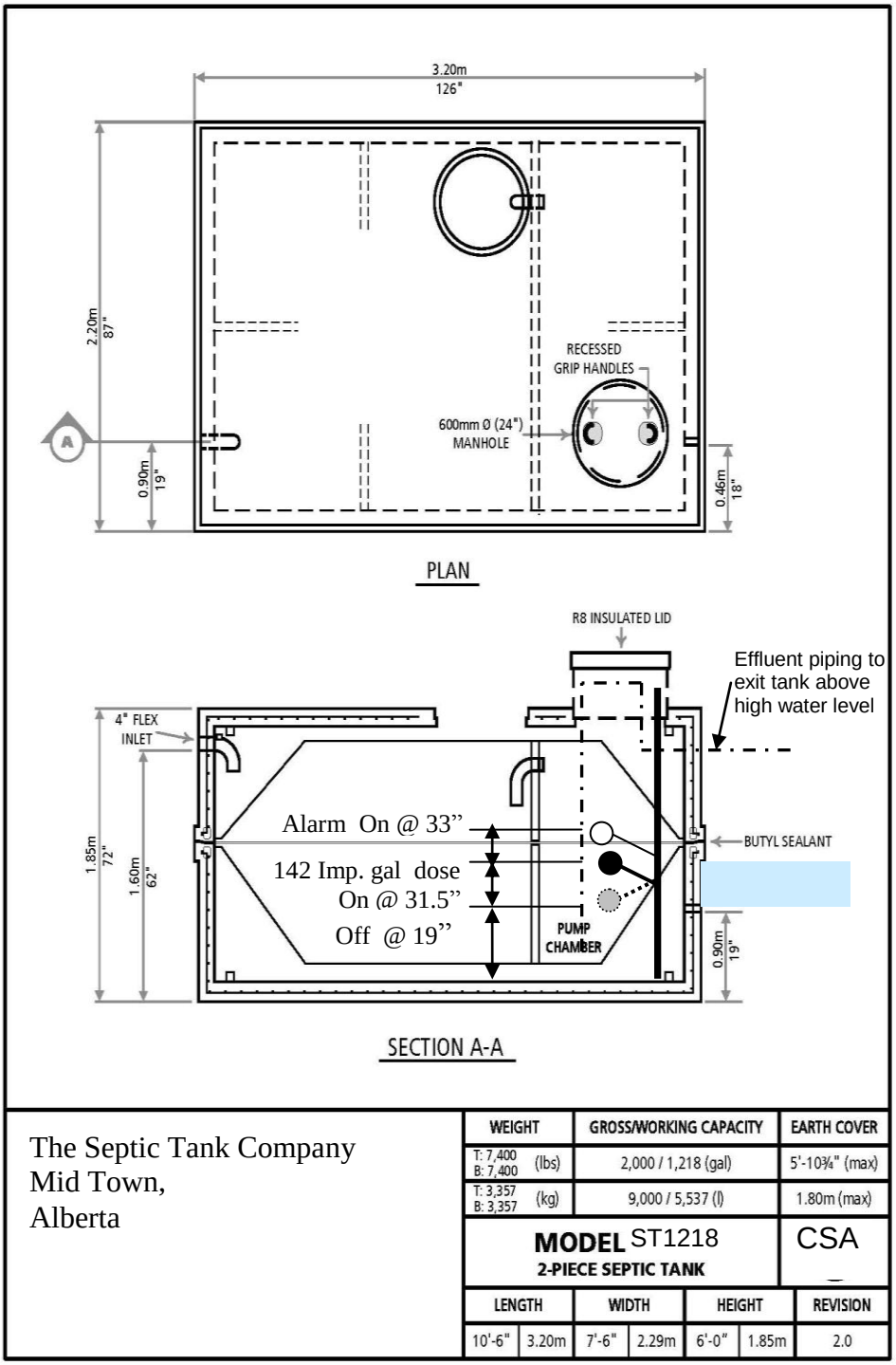
Comments (such as root depth and abundance or other pertinent observations): The sand particle size in the Sandy Loam soil of the B1 horizon as identified by lab tests is fine sand. This is the soil horizon most affecting design of the system with the preferred trench depth from 18 to 24 inches.

(APPENDIX B)

Insert lab analysis results of soil samples taken for determining soil texture!

Appendix C - Manufacturer's and Design Specifications for System Components

Septic Tank Specifications and Float Setting Details.



The Septic Tank Company
Mid Town,
Alberta

WEIGHT	GROSS/WORKING CAPACITY	EARTH COVER
T: 7,400 B: 7,400 (lbs)	2,000 / 1,218 (gal)	5'-10¾" (max)
T: 3,357 B: 3,357 (kg)	9,000 / 5,537 (l)	1.80m (max)
MODEL ST1218 **2-PIECE SEPTIC TANK**		CSA

LENGTH		WIDTH		HEIGHT		REVISION
10'-6"	3.20m	7'-6"	2.29m	6'-0"	1.85m	2.0

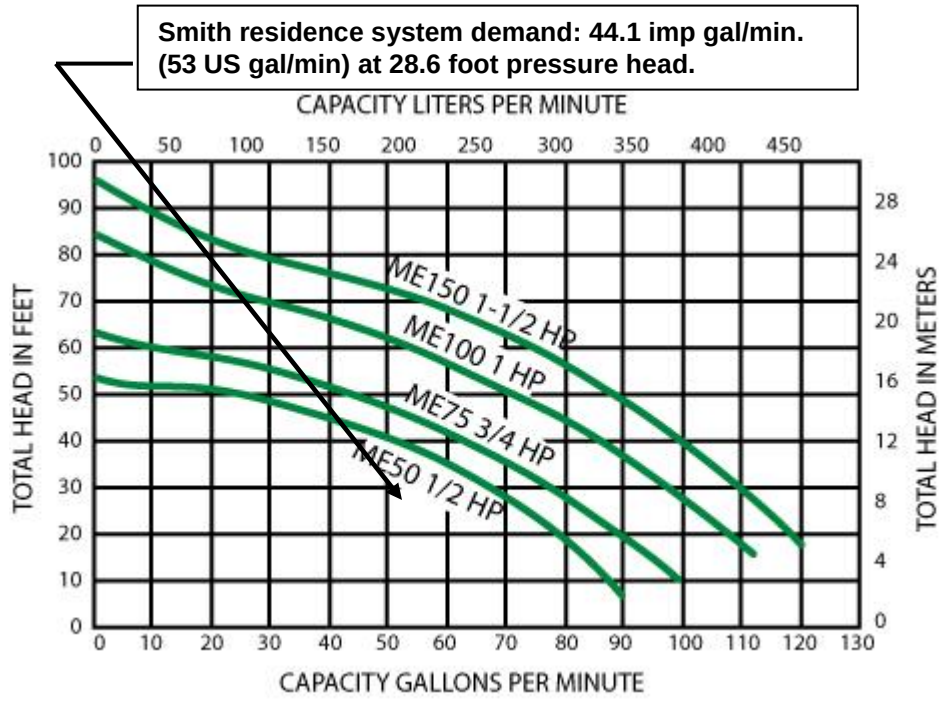
Appendix C - Pump Specifications

Myers Model ME50 (1/2 Hp) Selected

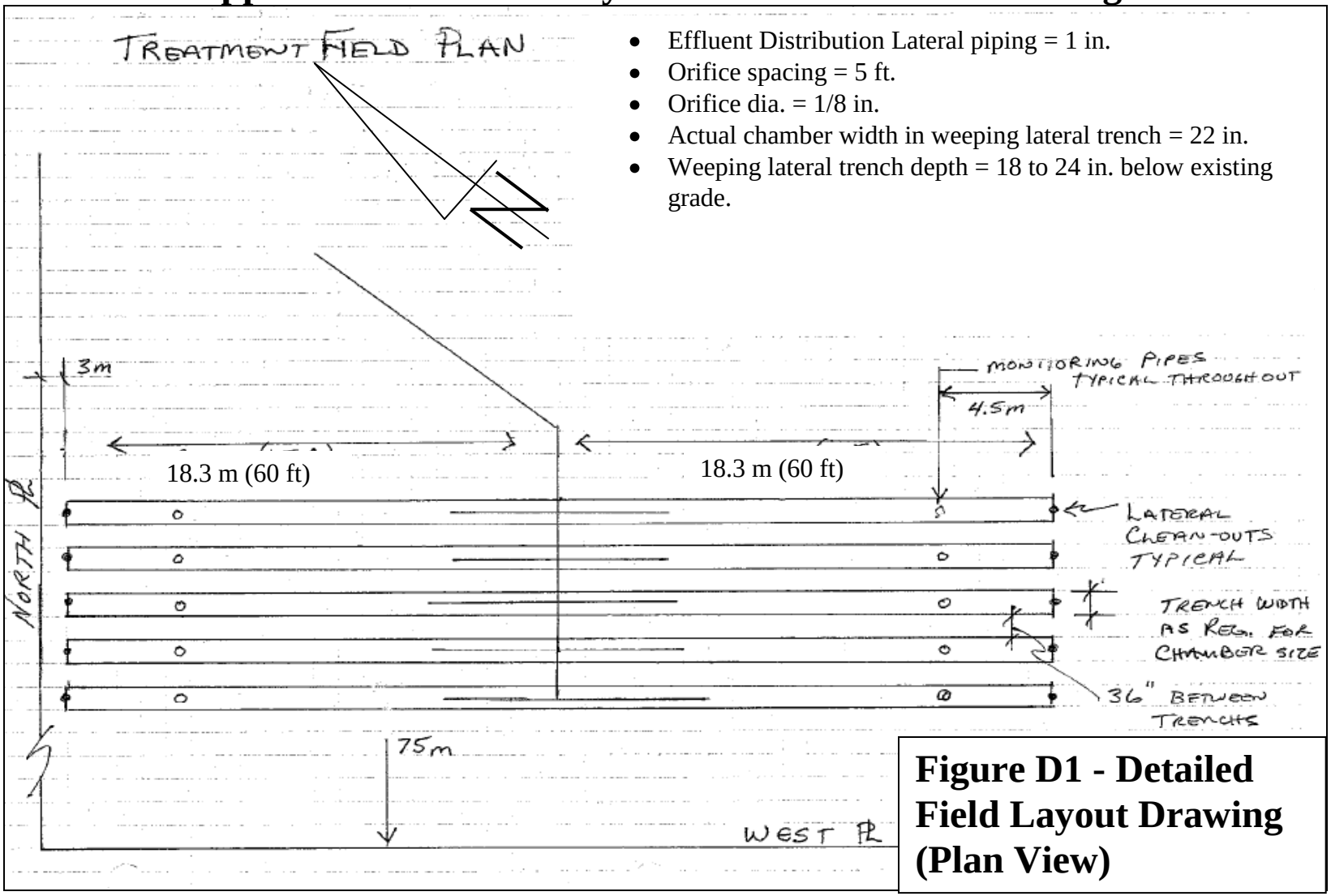
Product Capabilities

Capacities:	**120 GPM**	**454 LPM**
Shut-Off Head:	**95 ft.**	**28.9 m**
Max. Spherical Solids:	**3/4 in.**	**19 mm**
Liquids Handling:	**domestic effluent and drain water**	
Intermittent Liquid Temp.:	**up to 140°F**	**up to 60°C**
Motor Electrical Data:	**1/2 HP, 115V, 1Ø, 1/2 to 1-1/2 HP, 230V, 1Ø, 208/230/460/575V, 3Ø, oil-filled, permanent split capacitor type, 1Ø, 3450 RPM, 60Hz**	
Acceptable pH Range:	**6–9**	
Specific Gravity:	**.9–1.1**	
Viscosity:	**28–35 SSU**	
Discharge, NPT:	**2 in.**	**50.8 mm**
Housing:	**cast iron**	
Min. Sump Diameter: **Simplex** **Duplex**	**24 in.** **36 in.**	**61.0 cm** **91.4 cm**
Power Cord:	**10 ft.**	

Product Performance Chart



Appendix D – Detailed System Schematics and Drawings



- Effluent Distribution Lateral piping = 1 in.
- Orifice spacing = 5 ft.
- Orifice dia. = 1/8 in.
- Actual chamber width in weeping lateral trench = 22 in.
- Weeping lateral trench depth = 18 to 24 in. below existing grade.

Figure D1 - Detailed Field Layout Drawing (Plan View)

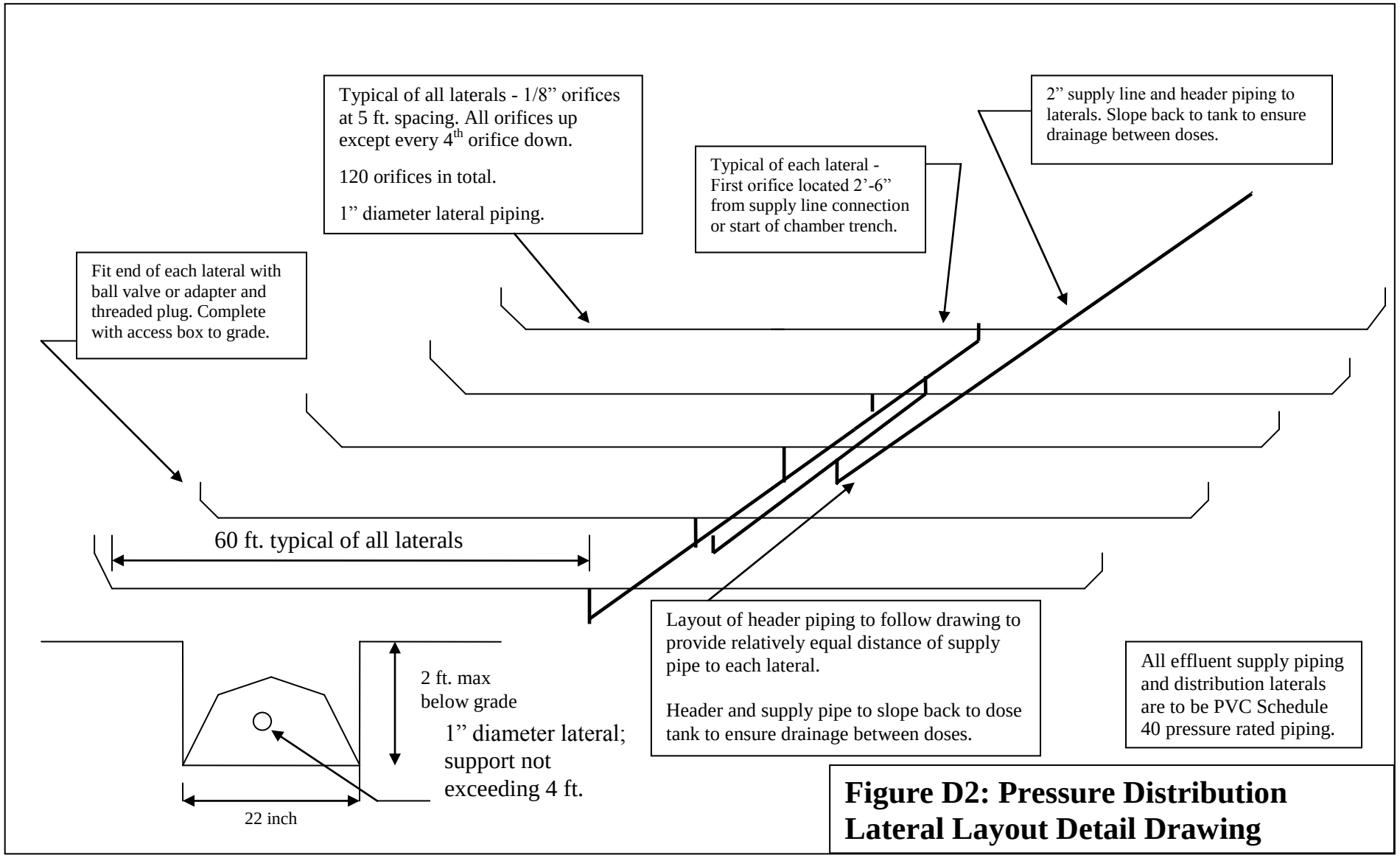
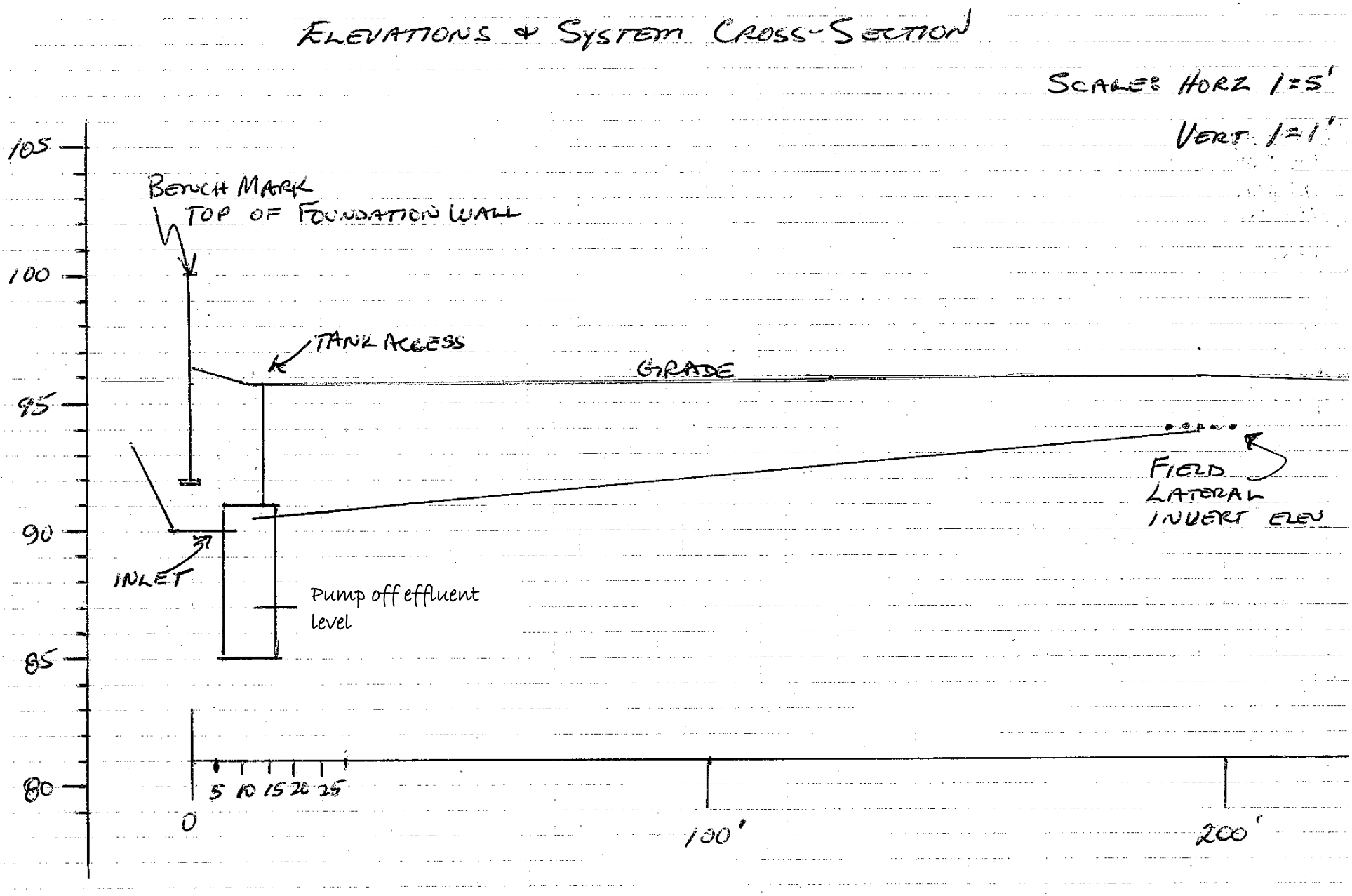


Figure D2: Pressure Distribution Lateral Layout Detail Drawing


ELEVATIONS & SYSTEM CROSS-SECTION
SCALE: HORZ 1"=5'
VERT 1"=1'
105
100
95
90
85
80
BENCH MARK
TOP OF FOUNDATION WALL
TANK ACCESS
GRADE
FIELD
LATERAL
INVERT ELEV
INLET
Pump off effluent
level
5 10 15 20 25
0
100'
200'

Appendix E – System Design Worksheets

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) to determine expected volume of sewage per day.
Provide allowance for additional flow factors as detailed in Table 2.2.2.3. (p.32)

Assess the initial sewage strength against the requirements of 2.2.2.1.(2) (p 30)
Effluent quality must meet the requirement of Article 8.1.1.6(1)(a) [p. 97].

Expected Peak Volume of Sewage per Day: 450 **F1**

Step 2) Determine the design soil effluent loading rate:

Texture	&	Structure	&	Grade	=	Soil Effluent Loading Rate [From >30 - 150 mg/L column]	
FSL	&	BK	&	3	=	0.32 Imp. gal/sq.ft./day	F2

If result is less than 0.2 gal/sq.ft./day a treatment field cannot be used. Article 8.2.1.13

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 Peak Volume of Sewage per day	÷	Soil Effluent Loading Rate	=	Soil Infiltration Area Required	
450 Imp. gal/day (From F1)	÷	0.32 Imp. gal/sq. ft/day (From F2)	=	1407 sq.ft.	F3

* For a **Pipe & Rock** design utilizing **pressure distribution**, Article 8.2.1.8. allows a 20% reduction in the surface infiltration area. **DO NOT USE THIS STEP IF THE DESIGN UTILIZES CHAMBERS.**

Soil Infiltration Area Required	x	Reduction Factor	=	Reduced Soil Infiltration Area Required	
sq.ft. (From F3)	x	0.8	=	sq.ft.	F3A

This reduction cannot be utilized for soils with soil textures Coarse Sand (COS), Medium Sand (MS), Loamy Coarse Sand (LCOS), Loamy Medium Sand (LMS) and;
Coarse Sandy Loam (COSL) or Medium Sandy Loam (MSL) having Prismatic, Blocky or Granular structure

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 credits for trench bottom width:

Primary treated effluent requires a minimum 5 feet Vertical Separation below infiltration surface area.

Trench width credits cannot be taken for soils with textures Coarse Sand (COS), Medium Sand (MS), Loamy Coarse Sand (LCOS), Loamy Medium Sand (LMS) and;
Coarse Sandy Loam (COSL) or Medium Sandy Loam (MSL) having Prismatic, Blocky or Granular structure of

	Actual Width in Feet (From F4)			=	Credited Width of Trench (feet) (3 ft. Maximum)	
Pipe & Rock Trench		X	1	=		F5
Chambers - Gravity Feed	Width of Chamber in Feet (From F4A)	X	1.1	=	3 ft. Maximum	F5A
Chambers - Pressure Distribution	1.83	X	1.3 or 1.25*	=	2.38 (3 ft. Maximum)	F5B

* **A credit of 1.25 max. is used for soils with textures Fine Sand (FS), Very Fine Sand (VFS), Loamy Fine Sand (LFS) or Loamy Very Fine Sand (LVFS) in order to not exceed the effluent hydraulic loading rates for secondary treated effluent for these soils [**

Step 6) Determine total weeping lateral trench length required:

Infiltration Area Required		Credited Width of Trench		Total Weeping Lateral Trench Length Required	
1407 sq. ft. (From F3 or F3A)	÷	2.38 ft. (From F5, F5A or F5B)	=	591 feet	F6

Step 7) Select number of weeping lateral trenches and determine length of each of trench:

Total Weeping Lateral Trench Length Required		Number of Individual Weeping Lateral Trenches		Length of Each Weeping Lateral Trench	
591 ft. (From F6)	÷	5 (F7 Designer Determination)	=	120 feet	F8

It is good practice to make the overall field area long and narrow when possible on a particular site.

Step 8) Summary:

F1	450	Imp. gal/day - Daily Flow, including any additional fixtures.
F2	0.31	Imp. gal/sq.ft./day - Effluent Loading Rate.
F3 or F3A	1407	Sq. Ft. - Total Soil Infiltration Surface Area.
F4 or F4A	1.83	Ft. - Actual width of Gravel Trench or Chamber.
F5, F5A or F5B	2.83	Ft. - Credited Width of Gravel Trench or Chambers.
F6	591	Ft. - Total Weeping Lateral Trench Length Required.
F7	5	Number of Individual Weeping Lateral Trenches.
F8	120	Ft. - Length of Each Weeping Lateral Trench.

Pressure Distribution, Orifice, Pipe & Pump Sizing

This design worksheet was developed by Alberta Municipal Affairs and Alberta Onsite Wastewater Management Association.

The completed installation is to comply with Alberta Private Sewage Standard of Practice 2009.

This worksheet is for use in Alberta to: size the orifices in distribution lateral pipes, size effluent delivery piping, and to calculate the required capacity and pressure head capability of the effluent pump.

It can be used for: calculating delivery of effluent to laterals in disposal fields, mounds and sand filters.

This worksheet does NOT consider all of the mandatory requirements of the Standard.

It is intended for use by persons having training in the private sewage discipline.

Note: Page numbers refer to the Private Sewage Systems Standard of Practice 2009.

Use only Imperial units of measurement throughout (feet, inches, Imperial gallons, etc…).

Step 1) Select the pressure head to be maintained 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 | 5 | **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 | 1/8 | **in.** | **P2**

Note: larger sizes 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		**Spacing of Orifices selected for design**		**Resulting number of orifices per lateral**	
60	**ft.** ÷	5	**ft.** =	12	**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)

12	X	10	=	120	**P3b**
From P3a		Number of Laterals		Total Number of Orifices 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
1/8	in.	60	ft.	12
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.

Size of Distribution Lateral Pipe From Table A.1.A. 1 **in.** P4

Step 5) Determine the total flow from all orifices:

Total Number of Orifices in all laterals		Gal/min for each Orifice at Head Pressure Selected		Total flow from all lateral orifices	
120	X	0.34	Imp. gal /min. =	40.8	Imp. gal /min. P5
From P3b		From Table A.1.B. (pp 144 & 145)			

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

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	
PVC	2	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:

Insert total from Worksheet "A" on last page (p.5) of this Pressure Distribution Worksheet

Equivalent Length of All Fittings

69.0 **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)	
205	+	69.0	=	274	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 Loss		Friction Loss per 100 feet of pipe		Delivery Piping Pressure Head Loss	
274 Divide by 100 ft.	x	3.7 ft.	=	10.1 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	10.1 ft.	From **P9**	
+			
Lift distance of effluent from effluent level in tank to orifices	7 ft.	Measure from lowest effluent level in tank to elevation of orifices.	
+			
Design pressure at orifices	5 ft.	From **P1**	
+			
Head loss allowed if an inline filter is used in pressure piping	5.48 ft.	**Explain Pressure Loss Allowed if Applied**	A pressure loss of 0.48 ft across filter and 5 ft until alarm goes off.
+			
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	28.6 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 using Head Pressure at Drain Back Orifice			Flow from all lateral orifices			Total Imp. Gallons per Minute from the pump		
1/4	in.	3.3	Imp. gal /min	+	40.8	Imp. gal /min	=	44.1	Imp. gal /min	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)
44.1	@	28.6
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)

52.9

Step 13) Consider the pumping demands of the system. If they are considered excessive, redesign the pressure distribution system and recalculate the pump demands.

Worksheet "Appendix A" Determine Equivalent Length of Pipe due to fittings in piping system.

Determine the equivalent length of pipe to allow for friction loss due to fittings in the piping system:

	Number of Fittings		Friction loss as per Table A.1.C.5 or 6 (p. 150)		Total
90° Elbows	5	x	5.7	=	28.5
				+	
45°Elbows		x		=	
				+	
Gate and Ball Valves		x		=	
				+	
Tee-on-Branch (TOB)	3	x	12.0	=	36.0
				+	
Tee-on-Runs (TOR)		x		=	
				+	
Male Iron pipe Adaptors (M/F Threaded Adaptors)	1	x	4.5	=	4.5
				=	

Total Equivalent Length of pipe to allow for fittings in piping system **(Enter this total, Box P7)** 69.0