

Determining Leach Field Sizes:

Determining Leach Field Locations:

The team considered a few different locations for leach fields. The leach field for the greywater system was always seen as fitting best on the lower sandy area. The leach field for the blackwater system had a couple possibilities. It was considered to place this leach field on the long narrow stretch on the outside of the fence facing the kick-about. With the advice and concerns of Dr. Kevin Winter, a professor at the University of Cape Town (UCT), it was determined that this location could cause harm to the kick-about if the wastewater seeped through the sand and spread out. Mainly for this reason it was decided to place the blackwater leach field on that lower sandy area next to the greywater leach field. Spacing between the two leach fields was determined to be 5m in order to leave a neutral space in between. This will allow for more controlled testing and ensure that the space in between does not become too saturated with wastewater.

Determining Piping Sizes for Leach Field Systems:

The team chose to use 110mm piping rather than 50mm piping. The larger pipe allows the water to flow through an increased volume, thus decreasing the chance that the water will back up into the system. The pipes will be perforated at 5 o'clock and 7 o'clock. Because of gravity the water will only flow out of the pipe through holes perforated in the bottom half of the pipe. There is no hole at 6 o'clock because if solids are still present in the wastewater then they could clog the holes.

Determining percolation rate

One of the first steps in designing a leach field is to know how quickly the soil will absorb water, this is called a percolation rate.

In figuring out the physical design of a leach field you must have the following information:

- Perc rate of the site (table 1)
- Daily output of the attached facility
- How far down the pipes are going to be buried

6-1. Time to Drain vs Required Drainpipe Wall Area

<i>Rate</i>	<i>Recommended minimum drain pipe</i>
1 minute or less	1.0 sq ft/gal/day*
2	1.5
3	2.0
4	2.5
5	3.0
10	4.0
20	4.6
30	5.2
40	7.0
60	9.-
unsuited	_____

*This figure is for the "active" sides of the trench only. It does not include the bottom of the trench nor the area above the center line of the drain pipe. If you have a trench 10 feet long and the pipe was positioned with its center line just 1 foot above the bottom, that trench would have 20 square feet of active wall area or surface. Note: You might find this table at variance with other published tables on the same subject. These figures are a compromise.

Table 1:Perc Rate

Having those pieces of information you can follow these steps to calculate the optimal size of the fields you would need.

Note: For conceptual purposes we started out with English units and then converted to metric for our target audience. This is not desired and if this process is repeated make sure all units are correct.

1. Calculate the Wall Area needed for the system by using Equation 1

$$\text{Wall Area} = \frac{\text{Calculated Daily Output}}{\text{Perc Rate}}$$

Equation 1: Wall Area

2. Calculate the Area Flow of a section of the trench system using Equation 2.

$$\text{Area per Flow} = \frac{\text{Depth below Middle of the Pipe} * \text{Top of the pipe Below Grade} * 2}{\text{Cross sectional area of column}}$$

Equation 2: Area per Flow

3. Having these quantities you can now calculate the total Lineal Feet of trench space needed using Equation 3.

$$\text{Lineal Feet Of Trench} = \frac{\text{Wall Area}}{\text{Area per Flow}}$$

Equation 3: Lineal Feet of Trench

4. Add in a chosen safety Factor (Equation 4)

$$\text{Revised Total} = \text{Safety Factor} + \text{Lineal Feet of trench (metric)}$$

Equation 4: Revised Total

5. Repeat the above steps for other tank system

Having the total lengths of pipes needed for the system now it is time to decide the number of perforated pipes and non-perforated pipes.

6. Using the total length of pipes find factors that allows you to neatly divide up the number of straights and perforated pipes.

Example:

Total Pipe Needed	6m
# of Perforated Pipes	2m
# of Straight Pipes	3m

7. To find out the number of pipes you would need to buy using equation 5

$$\# \text{ of Pipes Needed} = \left(\frac{\text{Total Length of Pipes}}{\text{Factory Cut Sizes}} \right) + \text{Safety Factor}$$

Equation 5: Number of Pipes Needed

8. To Figure out the cost of the pipes use equation 6

$$\text{Cost of Pipes} = \# \text{ of Pipes Needed} * \text{Cost per Factory Cut Sizes}$$

Equation 6: Cost of Pipes

9. To figure out the total cost of the auxiliary pieces (elbows, T-Pieces, adapters etc) use equation 7.

$$\text{Cost of Auxiliary Pieces} = \# \text{ of Pieces} * \text{Cost Per Piece}$$

Equation 7: Cost of Auxiliary Pieces

10. To accumulate the total cost use equation 8.

$$\text{Total Cost} = \text{Total Cost of Black Water Field} + \text{Total Cost of Grey Water Field}$$

Equation 8: Total Cost

Below is an organized list of all our data using the above equations and formulas.

	Black water Leach Field Calculations	Units
Assumed Perc rate	10	min/in
Conversion	4	ft ² /gal/day
Calculated Daily Output	665	l/day
Conversion to English	175.67305	gal/day
Required wall area	43.9182625	ft ²
Depth Below Middle of Pipe	14	in
Active Area of Trench	2.333333333	ft ² /lineal flow
Lineal Feet of Trench	18.8221125	ft
Conversion to Metric	5.73697989	m
Safety factor	1.5	m
Revised total	7.23697989	m

	Grey water Leach Field Calculations	Units
Assumed Perc rate	10	min/in
Conversion	4	ft ² /gal/day
Calculated Daily Output	1200	l/day
Conversion to English	317.004	gal/day
Calculated Wall Area	79.251	ft ²
Depth Below Middle of Pipe	14	in
Active Area of Trench	2.333333333	ft ² /lineal flow
Lineal feet of trench	33.96471429	ft
Conversion to Metric	10.35244491	m
Safety factor	1.5	m
Revised total	11.85244491	m

	Black Water Field Calculations		Pipe Requirements		Units
Max amount of pipe	8.25	m	Number of perforated pipes	3	
# of Pipes Needed	3		Number of straight pipes	3	
Cost of Pipes Needed	270	R	Length of perforated pipes	2	m
			Length of straight pipes	0.75	m
Cost of Auxiliary Pieces	120	R			

	Grey Water Field Calculations		Pipe Requirements		Units
Max Amount of Pipe	18	m	Number of perforated pipes	5	
Number of Pipes Needed	5		Number of straight pipes	4	
Cost of Pipes Needed	450	R	Length of perforated pipes	3	m
			Length of straight pipes	0.75	m
Cost of Auxiliary Pieces	200	R			
Total Cost(of both fields)	1040	R			

In any trenched arrangement the spacing between the pipes is very important. As a general rule the distance from the outer wall of one trench to the next one should be over 1.5 the distance from the center of the pipe to the bottom of the trench or the effective depth of the trench.

$$\text{Trench separation} = \text{Effective Depth} * 1.5$$

Resources:

Alth, M, & Alth, C. (1992). *Wells and septic systems*. USA: McGraw-Hill Inc.

<http://www.inspectapedia.com/septic/fieldsize.htm>