Bark Bed Design Worksheet Version 3

Draft 06/10/09

1. Design Flow and Septic Tanks		
Determine daily wastewater usage (gallons per day (gpd)) *Measured using water meter or estimated using 5 gallons per cow per day (# cows x 5 g/cow/day)*		
1 a.	Daily wastewater usage (# cows _____ x 5 gal/cow/day) ☐ Measured (_____ months) of water meter data ☐	_____gpd
Calculate minimum septic tank capacity. Select larger of: *6-day HRT of daily water usage (1a x 6) (_____gallons)* ☐ *Bulk tank volume (_____gallons)* ☐ *1000 gallon minimum* ☐		
1 b.	Minimum total septic tank capacity	_____g
Each septic tank chamber should allow for 2 or 3 days HRT (prefer 3-day). Calculate the minimum sizes of the chambers. This does not include pump tank volume. Make sure total volume of all septic tanks is at least the calculated minimum value (1b). Septic tank sizing is also a function of the manufacturer's actual tank size options. Typical sizes are multiples of 250 gallons.		
1 c.	Chamber 1 (daily water usage (1a) x 2 or 1a x 3)	_____g
1 d.	Chamber 2 (daily water usage (1a) x 2 or 1a x 3)	_____g
1 e.	If needed, chamber 3, (daily water usage (1a x 2 or 1a x 3)	_____g
1 f.	Total chamber volume: (1c + 1d + 1e)	_____g
The pump tank volume is the minimum of 500 gallons ☐ *or daily water usage* ☐		
1 g.	Pump tank volume	_____g
2. Sizing of Infiltration Area		
Determine the size of the infiltration area based on soil type. After determining the soil type, divide the daily water usage by the corresponding soil loading rate to determine the total size of the infiltration area. Note that the infiltration area could be <u>larger</u> than the calculated minimum value. *Course sand, medium sand, and loamy sand = 0.32 gpd/ft^2* *Fine sand, sandy loam or loam = 0.16 gpd/ft^2* *Silt loam silt or clay loam = 0.12 gpd/ft^2* *Sandy clay, silty clay or clay = 0.06 gpd/ft^2*		
2 a.	Soil type _____ infiltration rate in area	_____gpd/ft^2
2 b.	Minimum infiltration area: (daily water usage (1a) ÷ loading rate (2a))	_____ft^2
2 c.	Design bed area: (this could be larger than minimum area, 2b)	_____ft^2
3. Piping Requirements and Layout		
Bed length and width are a function of the individual site conditions and limits of pumps and piping. Effective infiltration area per lateral is 10 feet (5 feet on either side of the distribution lateral). Calculate bed lengths for one, two, or three lateral lines.		
3 a.	Bed length with one lateral: (Bed area (2c) ÷ 10)	_____ft
3 b.	Bed length with two laterals: (Bed area (2c) ÷ 20)	_____ft
3 c.	Bed length with three laterals: (Bed area (2c) ÷ 30)	_____ft
Maximum length of a lateral distribution pipe (from the manifold to the end of the pipe using 2 inch pipe with ¼ inch holes, Table 2) is 110 feet (22 holes spaced at 5 ft intervals). As such, the maximum		

total length of any bed is 220 feet (using a center manifold). Based on this information and the site restrictions determine which layout and bed dimensions will be used. Also, note that the length of the lateral distribution pipe is 10 feet less than the length of the infiltration area (5 feet on each end of the pipe). Also, if there is a choice, longer narrow areas are preferred over short wider areas.		
3 d.	Final bed width based on site restrictions: (10', 20', or 30')	_____ft
3 e.	Final bed length: (Design bed area (2c) ÷ 3d)	_____ft
3 f.	Distribution pipe length: (Bed length (3e) minus 10 ft)	_____ft
3 g.	If distribution pipe (3f) is longer than 110' then center manifold is required	Center or End
3 h.	Distribution section length if center manifold: (Total pipe length (3f) ÷ 2)	_____ft
3 i.	Sketch bed and pipe layout with dimensions in Figure 1 below	--
4. Bark Requirements		
Bark or wood shred volume is a function of the total bed area and bed depth. Bed depth must be a minimum of 24 inches. In addition, an extra 10% of material should be ordered to account for wastage.		
4 a.	Final infiltration area: (2c)	_____ft^2
4 b.	Depth of bark or chips	_____ in
4 c.	Total volume required: (Bed area (4a) × Depth (4b) ÷ 12)	_____ft^3
4 d.	Final volume: (Media volume (4c) x 1.1÷ 27 ft^3/yd^3)	_____yd^3
5. Flow Rate		
Distribution pump requirements are a function of the system flow rate (gallons per minute or gpm). System flow rate is a function of the number of perforations in the distribution pipe. For ¼ inch holes the flow rate is 1.04 gallon per minute (gpm) per hole. The number of holes is a function of the total length of the distribution pipe and hole spacing. Typically, holes are spaced at 5 feet intervals with the final hole in each lateral distribution pipe section in the end of the pipe. To calculate the number of holes for each total distribution pipe length divide the total bed length by the hole spacing and subtract one.		
5 a.	Distribution pipe length (3f if end manifold or 3h if center manifold)	_____ft
5 b.	Hole spacing	_____ft
5 c.	Total holes per distribution section: (Pipe length (5a) ÷ hole spacing (5b) + 1)	_____
5 d.	Number of distribution sections	_____
5 e.	Total number of holes: (5c x 5d)	_____
5 f.	Total system flow rate: (Total # holes (5e) x 1.04 gpm/hole)	_____gpm
6. Pipe Sizing and Pressure Loss		
Pressure requirements for the distribution system are a function of the elevation difference between the pump and the distribution pipe, pipe diameter from the pump tank to the manifold (or distribution pipe) and the distance from the tank to the distribution pipe. In addition, the pressure requirement in the distribution pipe to get equal flow out of the holes is 2 feet of head. Other losses for pipe connections must also be included.		
6 a.	Required System Pressure (minimum 5 ft H_2O default value)	__5__ ft H_2O
6 b.	Elevation difference between bottom of pump tank and distribution pipe	_____ft
6 c.	Distance from tank to manifold	_____ft
6 d.	Mainline pipe diameter	_____in
6 e.	Pressure loss per 100 ft of pipe from Table 1 (round up to nearest value)	____ft/100 ft

6 f.	Total pressure loss in pipe: (Mainline distance (6c) x friction loss (6e) ÷ 100)	_____ ft
6 g.	Additional friction loss from pipe connections: (maximum of 1.5 ft or (total pressure loss (6f) x 0.25))	_____ ft
6 h.	Total piping pressure loss: (straight pipe (6f) + connections (6g))	_____ft
6 i.	Total pressure requirement: (Pressure (6a) + Elevation (6b) + Friction (6h))	_____ft
7. Pump Selection		
Pump selection is a function of the system flow rate and the system pressure requirements. Using these two values a pump distributor or supplier will help select the correct septic pump.		
7 a.	System flow rate: (5f)	_____gpm
7 b.	System pressure requirements: (6i)	_____ft

Bark bed layout including dimensions as calculated in worksheet.

Table 1. Pipe Friction Loss (for PVC pipe).

	ft head loss per 100 ft of pipe	
	Nominal Pipe Diameter	
Flow (gpm)	2 inch	3 inch
15	0.42	-
20	0.73	-
25	1.11	-
30	1.55	0.23
35	2.06	0.3
40	2.64	0.39
45	3.28	0.48
50	3.99	0.58
60	5.6	0.82
70	-	1.09
80	-	1.39
90	-	1.73

OSTP design manual

Table 2. ¼-inch perforations discharge values to guarantee <10% pipe discharge variation.

	Pipe Diameter (in)	
Perforation Spacing (ft)	**1.5**	**2.0**
	Max # holes	
2.5	18	28
3.0	17	26
3.3	16	25
4.0	15	23
5.0	14	22

OSTP design manual