

# Milk Wastewater Treatment Design Template

University of Minnesota

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*This spreadsheet was developed as an aid in designing Irrigation Systems or Bark Beds for treating milk house wastewater. The calculations are based on the information found in the Milk house Wastewater Treatment Design Guide also developed at the University of Minnesota. The design guide and other supporting documents and presentations can be found at [www.manure.umn.edu](http://www.manure.umn.edu) and click on **Milk House Waste**.*

*The spreadsheet can be used to design simple irrigation systems with two application areas (multiple zones in each application area) or bark beds. It is still up to the designer to recheck the calculations prior to final design or construction. Default parameters used in the model are based on research conducted in Minnesota, currently being edited for final publication.*

*Information needs to be input into three workbook tabs. The first is the "Site Evaluation " worksheet. This sheet asks for several inputs that are common for design of both the Irrigation and Bark Bed Systems. Other inputs specific for the design of Irrigation or Bark Bed Systems are found on the respective "Design" worksheets.*

*Outputs for the system designs are on separate tabs and are formatted for printing. Most of the parameters used in the design are captured on these "Results" pages.*

*Terms used in this spreadsheet are defined more specifically in the Milk House Wastewater Treatment Design Guide found at [www.manure.umn.edu](http://www.manure.umn.edu) and click on **Milk House Waste**.*

*-David and Kevin*

# Milk House Wastewater Treatment Design Template

Clear All

MHWTD  
UMN Ver 1.0

7/6/2009

## Feedlot Information

Farm name:

Address:

City/Zip:

Phone:

Designer:

Date:

## Treatment Volume Estimation

	Value	Units	Notes
Number of cows for design:	<input type="text"/>	-	<b>Required information for system design</b>
Type of milking equipment:	<input type="text"/>	-	(e.g. Surge, Bomatic, Delaval)
Number of milkings per day:	<input type="text"/>	-	(Typical is 2-3 times per day)
Number of pipeline wash cycles per day:	<input type="text"/>	-	(Typically 1-2 wash/rinse cycles per pipeline wash)
Estimated gallons per wash cycle:	<input type="text"/>	gal	(15-25 gallons typical)
Bulk Tank Size:	<input type="text"/>	gal	<b>Required information for system design</b>
Milk Pick-up schedule:	<input type="text"/>	-	Enter "1" for every day or "2" for every two days
Average wash cycles for bulk tank cleaning:	<input type="text"/>	-	(Typically 1-2 wash/rinse cycles per pipeline wash)
Estimated gallons per wash cycle:	<input type="text"/>	gal	(15-30 gal/cycle typical)
Other was water per day:	<input type="text"/>	gal	Parlor, laundry, etc.
<b>Estimated daily wastewater:</b>	0	gpd	Based on above Inputs
<b>Estimated daily wastewater:</b>	0	gpd	Based on 5 gpd/cow
<b>Estimated daily wastewater:</b>	<input type="text"/>	gpd	Based on water meter information
<b>Design Volume To Treat is (gpd):</b>	<input type="text"/>	gpd	<b>Required information for system design</b>

## Existing System Notes

(Questions reflect general management and need to manage raw milk)

Current destination of milk house wastewater:

Plans for colostrum and treated milk:

Condition of existing waste lines and septic tanks:

## Planned Expansion Notes

(Questions reflect future need for larger, or smaller, system)

Future number of cows:

Future manure storage plans:

## Treatment Area Evaluation

### Option 1 (This data used for system design.)

Area Description or Notes:

Distance from milkhous to primary tank:  ft *noted for possible need to upgrade*

Distance from primary tank to treatment area:  ft **Required for calculating pump size**

Soil Type in Treatment Area: Silt loam  **Required for bark bed calculation**

Depth to Resticting Layer:  ft *noted for potential groundwater issues*

### Option 2 (NOTE: this data is not used in the design calculation )

Area Description or Notes:

Distance from milkhous to primary tank:  ft *noted for possible need to upgrade*

Distance from primary tank to treatment area:  ft *Required for calculating pump size*

Soil Type in Treatment Area: Silt loam  *Required for bark bed calculation*

Depth to Resticting Layer:  ft *noted for potential groundwater issues*

## General Site Notes or Sketches

# Specific Inputs for Design of an Irrigation System

Clear All

This spreadsheet calculates the pump size requirements based on daily design volume and irrigation area layout.

The spreadsheet is limited to one type of winter zone using wobbler heads and two types of summer zones, one with wobblers and one with impact heat

## Primary Treatment Calculations

	Value	Units	Notes
Daily flow:	0	gpd	Design flow volume from INPUT page
Minimum Hydraulic Retention Time (HRT):	3	days	Default minimum HRT
Minimum primary tank volume:	1000	gal	Maximum of 3 day HRT, Bulk tank volume or 1000 gallons
Design primary tank volume:		gal	Designer has the option of a specifying a larger tank
Secondary tank volume:		gal	Designer has the option of adding an additional tank for settling.
Pump tank:		gal	Maximum of daily flow or 500 gallons
Calculated HRT:	#DIV/0!	days	Calculated HRT using designer inputs

## Application Area Calculations

	Area 1	Area 2	Units	Notes
Application Area Labels:			-	e.g. Winter, Summer, Cropland, Pasture, etc.
Crop grown:			-	See "Table Values" Tab for Crop Uptake Guidelines
Crop nitrogen requirement:			lbs per acre	Required input (see "Table values" tab for crop uptake guidelines)
Crop P205 requirements:			lbs per acre	Required input (see "Table values" tab for crop uptake guidelines)
Calculated elemental P requirements:	0	0	lbs per acre	Default value from typical milkhouse wastewater
Annual TKN in effluent:	0	0	lbs/year	Default value from typical milk house wastewater
Nitrogen loss per year:			percent	Required input (50-60% loss is typical)
Annual phosphorus in effluent:	0	0	lbs/year	Default value from typical milkhouse wastewater
Total area needed based on crop nitrogen uptake:	#DIV/0!	#DIV/0!	sq ft	
Total area needed based on crop P uptake:	#DIV/0!	#DIV/0!	sq ft	
Design should be based on N or P:			-	Required input If slopes >15% and not in grassland then use P based
Minimum total area used for design:	#DIV/0!	#DIV/0!	sq ft	Based on selection of P or N based rates from above
Number of months applying to Area 1:	12		months	Required input
Area 1 required:	#DIV/0!		sqft	Based on number of months applying to Area 1
Area 2 required:		#DIV/0!	sqft	Based on number of months applying to Area 2
Hydraulic loading:	#DIV/0!	#DIV/0!	in/day	Average depth of wastewater applied per day
Hydraulic loading:	#DIV/0!	#DIV/0!	in/wk	Average depth of wastewater applied per week

## Layout of Irrigation Area

	Type 1	Type 2	Units	Notes
Application Area:	0	0	-	Copied from above
Type of irrigation head:			-	e.g. Wobbler # 18 or Impact #52
Diameter spread per head:				Specification from manufacture (or see "Table Values" tab)
Pressure per head:				Specification from manufacture (or see "Table Values" tab)
Flow per head:				Specification from manufacture (or see "Table Values" tab)
Mounting height:				Elevation of installed irrigation head
Fraction of circle:				Impact heads can be set to partial circle spread pattern
Radius overlap or spray pattern:				Percent of spread pattern radius overlap
Calculated head spacing along length:	0	0	ft	Spacing of heads along distribution line using overlap percent
Equivalent spacing between distribution lines:	0	0	ft	For percent spray pattern overlap given above
Designed distribution line spacing:				Designer choice of distribution line spacing
Number of heads per Distribution Lines (NL):				Number of heads per distribution line
Number of Distribution Lines (NW):				Number of distribution lines
Effective area per zone:	0	0	sqft	Effective application area based on input parameters
Number of similar zones:				Can have multiple similar zones
Calculated total effective application area:	0	0	sqft	Application area based on current design
Required design area:	#DIV/0!	#DIV/0!	sqft	Value copied from section above for winter and summer
Design area check:	#DIV/0!	#DIV/0!	-	Comparison of required area to current design

## Pump Calculations

	Type 1	Type 2	Units	Notes
Season:	Winter	Summer	-	Value copied from above section
Head Type:	Wobbler	Wobbler	-	Value copied from above section
Number of Zones:	0	0	-	Value copied from above section
Number of heads per zone:	#DIV/0!	#DIV/0!	-	Value copied from above section
<b>Total pump flow required:</b>	#DIV/0!	#DIV/0!	gpm	Calculated value
Distribution pipe diameter:				Input allows only "2" or "3" pipe
Longest pipe length:				Distance from pump to last head
Additional friction loss:				% additional pipe length added for friction (typically 10-25%)
Head loss in pipe:	#VALUE!	#VALUE!	ft H2O	Calculated value
Elevation Difference:				Distance from bottom of tank to irrigation head
Pressure required by head(s):	0	0	ft H2O	Value copied from above section
<b>Total hydraulic head required:</b>	#VALUE!	#VALUE!	ft H2O	Calculated value

# Irrigation Summary and Results

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7/6/2009

Farm name:	0
Address:	0
City/Zip:	0
Phone:	0

Designer:	0
Date:	1/0/1900

## Design Parameters Summary

Design based on:	Phosphorus	-			Elevation (ft)	Distance (ft)
	Daily flow:	0	gpd		0	0
Nitrogen concentration:	65	mg/l	0.54	lbs/1000 gal	0	0
Phosphorus concentration:	55	mg/l	0.46	lbs/1000 gal	#REF!	#REF!
Summer application time:	0	months				
Summer applied to:	0	-				
Winter application time:	12	months				
Winter applied to:	0	-				
					Mainline Diameter:	0 in
					Distance to Treatment Area:	0 ft

## Detailed Results

Area:	#DIV/0!	sqft
Area:	#DIV/0!	sqft

# Zones	# Heads/zone	# rows/zone	Width Space (ft2)	# heads per row	Length Space (ft)	Effective Area (ft2)	Pump Sizing	
							Pressure (ft H2O)	Flow (gpm)
0	#DIV/0!	0	0	0	0	0	#VALUE!	#DIV/0!
0	#DIV/0!	0	0	0	0	0	#VALUE!	#DIV/0!

## Specific Inputs for Design of Bark Bed

Clear All

This spreadsheet calculates the bark bed and pump size requirements based on daily design volume and soil types.

### Primary Treatment

	Value	Units	Notes
Daily Flow:	0	gpd	Design flow volume from INPUT page
Primary Tank Minimum:	1000	gal	Maximum of 3 day HRT, Bulk tank volume or 1000 gallons
Designed Primary Tank Size:		gal	<b>Designer has the option of a specifying a larger tank</b>
Secondary Tank Minimum:		gal	Maximum of 3 day HRT, Bulk tank volume or 1000 gallons
Secondary Tank:		gal	<b>Designer has the option of a specifying a larger tank</b>
Pump Tank:	500	gal	Maximum of daily flow or 500 gallons
Calculated HRT:	#DIV/0!	days	Calculated value

### Infiltration Area

	Value	Units	Notes
Soil Type:	Silt loam	-	Required data copied from "INPUT" page
Hydraulic Loading Rate (HLR):	0.12	gal/sqft	
BOD to treat:	0.00	lbs/day	Pounds per day of BOD going to Bark Bed
Minimum infiltration area required:	0	sqft	Value based on HLR
Designed Infiltration Area:		sqft	<b>Input the desired design area (could be larger than minimum)</b>
Organic Loading Rate or OLR:	#DIV/0!	lbs/sqft	
Desired Bed Width:	30	ft	10, 20, or 30 ft width
Number of distribution lines:	3	-	Calculation assumes 5 feet of bark on either side of distribution line
Bed Length:	0	ft	Total length of infiltration area
Distribution Pipe length:	-10	ft	Additional five feet of bark on each end of pipe
Perforation spacing:	5	ft	Standard of 3, 4, or 5 feet
Perforation size:	0.25	inches	Default of 0.25 inches
# Perforations per Distribution Pipe:	-1	-	
Center or End Distribution:	End	-	<b>If bed length is too long then the manifold has to be in the center</b>
Depth of Bark:		ft	Caution: Minimum of two feet required
Total amount of Bark Required:	0	cubic yds	Includes 10% ocerage to account for losses

### Pumping Requirements

	Value	Units	Notes
Doses per day:		-	<b>Input the desired number of doses per day to the Bark Bed</b>
Minimum flow required:	-4	gpm	For 0.25" hole size
Time per dose:	#DIV/0!	minutes	Based on current input values for flow and pump size
Gallons per dose:	#DIV/0!	gal	Amount of effluent pumped per dose
Elevation difference:		ft	<b>Elevation difference - tank bottom to Distribution Pipe</b>
Required system pressure:		ft	<b>5 ft is minimum</b>
Manifold Losses:		ft	<b>Typically zero because manifold is larger than supply line</b>
Pipe Diameter:		in	<b>Default of 2 inches</b>
Distance tank to treatment area:	0	ft	Value taken from Site Evaluation Sheet
Additional Friction Loss:		%	% of additional pipe length added to determine friction loss in pipe fittings ange between 10 and 25%
Total pipe friction loss:	#VALUE!	ft	Calculated friction loss in pipe
Total head loss:	#VALUE!	ft	Calclated total head loss - used for pump sizing

## Bark Bed Summary and Results

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7/6/2009

Farm name:	0
Address:	0
City/Zip:	0
Phone:	0

Designer =	0
Date =	1/0/1900

### Design Parameters Summary

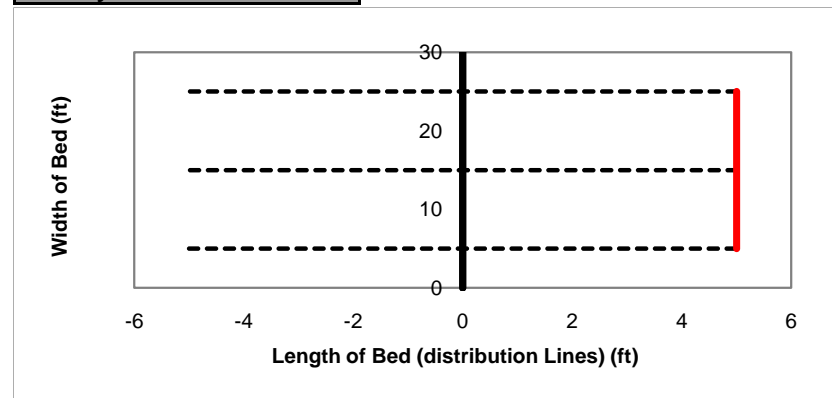
	Value	Units
Daily flow:	0	gpd
BOD concentration:	750	mg/l
TSS concentration:	450	mg/l
Soil type in treatment area:	Silt loam	-
Elevation difference:	0	ft
Main pipe diameter:	0	ft
Distance to Treatment Area:	0	in

### Results

	Value	Units
1st Tank or Compartment size:	0	gal
2nd Tank or Compartment size:	0	gal
Pump Tank size:	500	gal
Hydraulic Retention Time:	#DIV/0!	days
Doses per day:	0	-
Total Area Required:	0	square feet
Bed Width:	30	ft
Bed Length:	0	ft
Bark Depth:	0	ft
Bark Required:	0	cubic yards
Distribution Pipe Length:	-10	ft
Number of Distribution Lines:	3	ft
Spacing of Perforations:	5	ft
# 1/4 inch perforations per Distribution:	-1	-

Pump Sizing		
Minimum Pump Flow Required =	-4	gpm
Pump Pressure Required =	#VALUE!	ft

### Site Layout Sketch



Note: Effluent filter installed between secondary tank and pump tank

## General Design Inputs

	Design	Milkhouse 1st tank	Milkhouse 2nd tank	
BOD	750	1200	750	mg/l
COD	2250	2250	2250	mg/l
O and G	225	110		mg/l
TKN	65	65	55	mg/l
P	55	55	55	mg/l
TSS	450	450	240	mg/l

From UMN Research

## Bark Bed Default Values

### Soil Infiltration Default Values

Soil Texture	Load R. gpd/ft <sup>2</sup>
Coarse sand	0.32
Medium sand	0.32
Loamy sand	0.32
Fine sand	0.16
Sandy loam	0.16
Loam	0.16
Silt loam	0.12
Silt	0.12
Clay loam	0.12
Sandy clay	0.12
Silty clay	0.12
Clay	0.06
Sandy clay	0.06
Silty clay	0.06

### Perforation spacing

vs maximum number of holes.

Perforation Spacing (ft)	Pipe Diam
	number holes
1.5	
3	17
4	15
5	14

From OSTP design manual

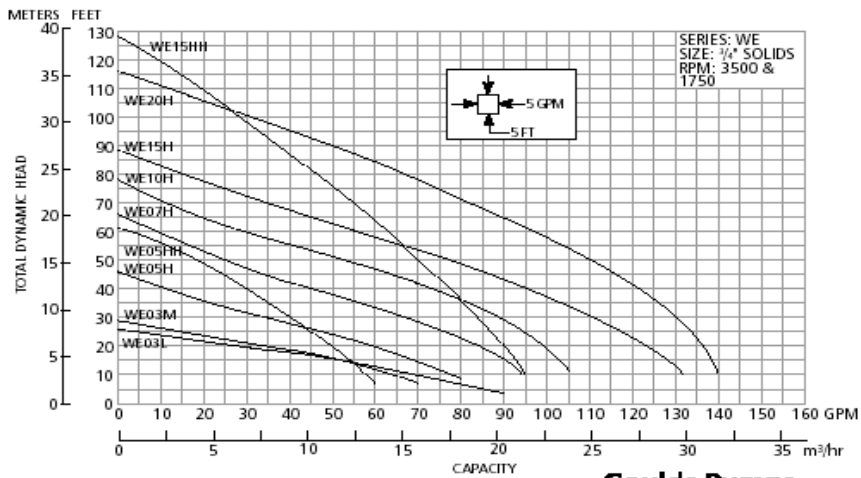
## Irrigation Default Values and Tables

### Crop Nutrient Removal Table

Crop	Yield range	N removed	P <sub>2</sub> O <sub>5</sub> removed	*Elemental P removed
Corn	Corn 100-200 bu/acre	~0.8 lbs/bu	0.34 lbs/bu corn	0.15 lbs/bu
		(80-160 lbs/acre)	(34-68 lbs/acre)	(15-30 lbs/acre)
Soybeans	Soybeans 30-50 bu/acre	3.5 lbs/bu	0.82 lbs/bu	0.36 lbs/bu
		(105-175 lbs/acre)	(25-41 lbs/acre)	(11-18 lbs/acre)
Corn-Soybean Rotation (2-yr average)		92.5-167 lbs/acre/yr	29-54.5 lbs/acre	13-48 lbs/acre
Pasture or Grass	2-5 tons/acre	27 lbs/ton	8.9 lbs/ton	3.9 lbs/ton
		(54-135 lbs/acre)	(18-45 lbs/acre)	(7.9-19.8 lbs/acre)

meter (in)
2
number holes
26
23
22

### Sample Pump Curves



Goulds Pumps



www.goulds.com

### Sample Irrigation Head Specifications

Wobbler	#18 purple 9/32 head					
psi	10	15	20	25	30	35
gpm	7.23	8.85	10.2	11.4	12.5	13.5
dia (3ft ht)	52	54.5	55.5	56	56.5	57
Wobbler	Rainbird Part Circle 85EHD-LA 1-1/4 inch, 0.5 inch nozzle					
psi	25	30	35	40	45	
gpm	33.8	37.1	40.1	42.9	45.6	
dia (6ft ht)	120	134	142	150	154	

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*Please send edits or corrections to David Schmidt UMN at [schmi071@umn.edu](mailto:schmi071@umn.edu)*

*This spreadsheet has been left blank for doing additional calculations  
Values can be copied from other spreadsheets into this page*