Job: Date:
Designer: Design number: Option number:

Worksheet for pressure distribution system design
Short form *Rev. August 2007*

This is an iterative process, so each step may have to be repeated before final design. To be used with the ***Design Inputs Worksheet*** *and the* ***Long Form Worksheet (LFW)*** *instructions and tables.*
Units: Worksheet and tables are in US gallons. See page 10 for conversions.

A. Design of the Distribution Network:

1 Establish Field length

Refer to Design Inputs Worksheet and enter appropriate values below.

SOIL TYPE = ______________________

DESIGN **HLR** = _________ LPD/SQM **x 0.0245** = ____________GPD/SQFT

DESIGN **LLR** = _________ LPD/M **x 0.0805** = ____________GPD/FT

DAILY DESIGN FLOW (Q) = _________LPD **x 0.264** = _____________GPD

AVERAGE FLOW = _________LPD **x 0.264** = _____________GPD

SYSTEM LENGTH GUIDE, L minimum = FIELD DESIGN FLOW (Q) ÷ LLR

= _______ gal per day ÷ _________gal per foot = _______________FEET **MINIMUM**

AIS = FIELD DESIGN FLOW / HLR = _______________SQUARE FEET
Remember AIS for seepage beds multiply x 1.35

TOTAL LENGTH OF TRENCHES/BED = _______________FEET

WIDTH OF TRENCH/BED = _______________FEET
Use decimal feet. Is AIS divided by length

NETWORK TYPE (dispersal system piping) = _________________ (eg trench, bed)

2 Establish initial trench layout, Determine lateral lengths

Ensure system length meets minimum needed.

MANIFOLD TYPE = ______________________

LATERAL LENGTH = ___________ ____________

NUMBER OF LATERALS = ___________ ____________
SKETCH:

3 Determine orifice size, spacing, position.

ORIFICE SIZE = ____________FRACTIONAL INCHES __________

ORIFICE SPACING = ____________FEET __________

4 Determine lateral pipe diameter and pipe class
Using tables *LATERAL DESIGN TABLES* (Page 17 *LFW* onward).

LATERAL DIAMETER = ________________INCHES ____________

LATERAL PIPE CLASS = ________________ ____________

5 Determine number of orifices per lateral

Divide orifice spacing from (A 3) above into lateral length from (A 2) above, and round to nearest whole number.

(___________ ft ÷ ___________ft) + _________ = ___________

ORIFICES PER LATERAL = _______________ ____________

6 Determine lateral discharge rate

Select distal pressure (pressure at last orifice of longest lateral), minimum is 3 feet for 3/16" and larger or 5 feet for 1/8 and 5/32" orifices. This is the **"Squirt Height"**.

DISTAL PRESSURE = _________________FEET ____________

Orifice discharge from *ORIFICE DISCHARGE RATE DESIGN TABLE* (page 13 *LFW*), or calculation.

ORIFICE DISCHARGE = ________________GPM ____________

Orifice discharge x number of orifices per lateral from (A 5) above to give

LATERAL DISCHARGE = ________________GPM ____________

CENTER OR END FEED? = ________________ ____________

NUMBER OF LATERALS = ________________ ____________

7 Select spacing between laterals and determine manifold length

Use information in (A 2) above.

SPACING BETWEEN LATERALS = ____________FEET

MANIFOLD LENGTH = ____________ FEET __________

8 Calculate manifold size

Using information from (A 2) and (A 7) determine manifold length and then use *MAXIMUM MANIFOLD LENGTHS* tables (pages 22 and 23 *LFW*) to select minimum manifold size, using lateral discharge from (A 6) above, Orifice size from (A 3) above and lateral spacing from (A 7) above. For center feed, flow per lateral on either side of manifold is used in table.

MANIFOLD SIZE = _________________INCHES __________

MANIFOLD PIPE CLASS ______________

9 Determine distribution network discharge rate

Multiply lateral discharge rate from (A 6) above x number of laterals from (A 6) above, check against total number of orifices X orifice discharge rate.

NETWORK DISCHARGE RATE = _________________GPM ____________

TOTAL NUMBER OF ORIFICES (γ) = ____________ X ______gpm = ___________GPM

B. Design of the Force Main, Pressurization Unit (Pump or Siphon), Dose Chamber and Controls.

1. Develop a system performance curve.

Distal pressure (from (A 6) above) X 1.31 __________FEET X 1.31 =

NETWORK HEAD REQUIREMENT = _______________FEET ____________

Determine static head
STATIC HEAD (Indicate if anti siphon required) = __________FEET SIPHON?_______

NETWORK DISCHARGE (from (9) above) = ____________________GPM

NETWORK 2 DISCHARGE (if more than 1 sub area or zone 2) = _____________GPM

NETWORK 3 DISCHARGE (if more than 1 sub area or zone 3) = _____________GPM

NETWORK 4 DISCHARGE (if more than 1 sub area or zone 4) = _____________GPM
Add more as required.

ANTI SIPHON/PRIMING ORIFICE DISCHARGE (if used) = _____________GPM

PUMP DISCHARGE Required = ____________________GPM

Determine friction loss in force main (transport line to field), first select initial force main sizing, use pipe velocity guide (page 16 *LFW*) to select forcemain initial size Base on maximum **network** discharge.

Check that flow velocity is over 2 and under 10 feet per second using table *FRICTION LOSS IN PLASTIC PIPE* (page 14 *LFW*) assuming use of PVC Sch 40, then use that table to provide head loss for force main based on system discharge and length,. Add equivalent length for fittings as needed from *EQUIVALENT LENGTHS OF FITTINGS* Tables (page 15 *LFW*). **OR** use other friction loss/flow velocity calculation. Note that for end suction pumps it is necessary to also consider losses in the suction piping and fittings, using the same methods.

FORCE MAIN LENGTH α = _______________________FEET

FORCE MAIN DIAMETER = ___________ INCHES

FORCE MAIN TRUE INTERNAL DIAMETER = ___________ INCHES
Only required if not using Sch 40 pipe and the table.

Fittings used, including size.	Number	Equivalent length per fitting	Total equivalent length

FITTINGS EQUIVALENT LENGTH β = ___________________ FEET

TOTAL EQUIVALENT LENGTH $(\alpha + \beta) / 100$ = **L** = ___________________ FEET / 100

HEAD LOSS PER 100' (from table) = ________________ Ft/100ft

FRICTION LOSS IN FORCE MAIN = ____________________ FEET
This is Head loss per 100' times Total Equivalent Length (L).

SUCTION HEAD LOSS (if applicable) = ______________FEET

SUCTION LIFT (if applicable) = ______________FEET

NET POSITIVE SUCTION HEAD REQUIRED (NPSH) = ______________FEET
Add lift plus suction head losses.

CHECK FLOW VELOCITY = __________FEET PER SECOND
If not using PD table

TOTAL DYNAMIC HEAD REQUIREMENT
TDHR = _________________FEET
This is Static Head + Network Head requirement + Friction Loss in Forcemain + NPSH

PUMP DISCHARGE/HEAD = __________GPM AT __________FEET HEAD
Develop more than one option if required, to examine impact of changes to network, piping, pump type etc.

ADDITIONAL SECTIONS OF FORCEMAIN, ZONE VALVES, EXTRA ORIFICES

NOTES

2 System curve

NUMBER OF ORIFICES = ______________________(γ) From (A 9) above.

TOTAL EQUIVALENT PIPE LENGTH (**L**) = ________________FT/100 From (B 1) above.

Squirt height (Distal Head)	Orifice flow at squirt height	Network discharge = (flow per orifice x γ)	Pump/anti siphon orifice discharge, if used	Friction factor (ft loss per 100')	Force main(s) head loss (ft) = friction factor x **L**	Network head required (1.31 X squirt ht.) (ft)	Static head (ft) plus other losses	TDHR (ft)	Total flow (gpm) = network discharge + pump orifice (if used)

Static head stays the same for all cases except for if using an anti siphon orifice. Add NPSH if necessary, use separate sheet for zone valves, extra forcemains etc.

3 Select pump (or siphon)

ITERATE UNTIL PUMP AND FORCEMAIN ARE ECONOMIC.

PUMP SELECTED = __________________________Voltage and max. current: ___________

Discharge diameter: _________ Height: __________ ft Minimum water level:________ ft
(Recommended is full pump ht, often min. is ½ pump motor submerged).

OPERATING POINT = _______________ GPM at ___________ FT head.

4 Determine dose volume

Based on soil type select type of dosing and minimum/desired dose frequency.

Dosing frequency (**minimum**)	Soil type
Timed dosing	Coarse sand, gravels, sand mounds etc, certain clays
4 X per day	Medium sand, fine sand, loamy sand, Sandy Clay, silty clay or clay
2 X per day	Sandy loam, Loam, Silt Loam, Clay Loam

TYPE OF DOSING (demand or timed) = ____________________

DOSE FREQUENCY = minimum________________ times per day

Determine draining volume, use *VOLUME OF PIPE* table, page 16.:

VOLUME OF LATERALS (if draining) = _______ft x _______gallons per ft = ______g
Total length of laterals x volume per foot.

VOLUME OF MANIFOLD (if draining) = _______ft x _______gallons per ft = ______g

VOLUME OF PART OF FORCEMAIN = _______ft x _____gallons per ft = ______g
(if draining)
TOTAL DRAINING VOLUME = ____________________GALLONS

Determine dose volume, two possible methods:

Method 1; Determine dose volume based on dose frequency, and then check against draining volume of network and any part of force main that drains.

Dose volume is determined by dividing frequency into DAILY DESIGN flow (from A(1)). For more conservative design, use AVERAGE flow

_____________ gpd ÷ ___________ times per day

DOSE VOLUME = ____________________GALLONS

Then, ensure dose volume is minimum 5 x the draining volume. If not, consider constraints (soil type etc) and redesign manifold location etc to achieve this.

DOSE VOL. ÷ TOT DRAINING VOL. = ________G ÷ ________G = _______ (min. 5)

Method 2; Determine minimum dose volume as 5 times the draining volume of network and any part of force main that drains, then check that this meets minimum number of doses per day.

TOT DRAINING VOLUME X 5 = ___________ G Minimum dose volume

DESIGN FLOW ÷ MINIMUM DOSE VOLUME = ___________ Doses per day at minimum dose volume. Check that this is greater than minimum needed.

Check pump run time per dose.

PUMP RUN TIME = Dose volume ÷ Pump flow rate

= _______G ÷ ________GPM = ____ MINS

Use smallest dose/most frequent dosing possible.

Notes: For lateral hole positions, draining and distribution:

5. Size pump vault

Timed dosing worksheet is also available.

DESIGN FLOW = ______________ GPD From section (A 1), peak flow

DOSE VOLUME = ______________ GAL From (B 4)
For time dose this is the timer allow volume.

RESERVE VOLUME = ______________ GAL To alarm float from pump on float level. Minimum 15% of peak flow for demand dosed systems, per design for timed dose (Minimum 67% peak flow with timed dose for small systems with lag/override operation).

*RESERVE VOLUME TO LAG FLOAT = _______ GAL For **timed** dose systems only.*

ALARM RESERVE VOLUME = _______________GAL Above alarm float to highest allowable liquid level. Minimum 50% of peak flow.

DEPTH REQUIRED FOR PUMP SPACER = _________INCHES
With effluent filter spacer is only required to prevent rock chips etc from entering pump. Some pumps have suitable legs.

Use this information and the **float setting worksheet** (below) or timed dosing worksheet to determine float or other control setpoints. Ensure the above volumes will fit in the vault, iterate until satisfactory.

PUMP CONTROL FLOAT = ________________________________
If direct control, ensure float is of sufficient capacity.

FLOAT TETHER LENGTH = __________ INCHES

SEPTIC TANK SURCHARGE FOR ALARM VOL. ______________________________(If used)

PUMP CHAMBER "**V**" VALUE = __________________________ INCHES/USGAL

After installation check that the floats switch as designed. Mark "**V**", float types, heights, ranges (including tether lengths if required) and dose volume on headworks for future reference.

NOTES:

Calculating the Dose Volume For Systems Designed to Drain Back to Pump Chamber:

When draining system back to pump chamber, the volume of effluent in the manifold and transport pipe should be added to the dose volume and considered when sizing the pump chamber Use *VOLUME OF PIPE* table, page 16.

If only part of the system drains back, use appropriate pipe lengths.

Volume in manifold = manifold length x volume in gallons per foot

Volume in manifold = ______________________ GAL

Volume in Transport Pipe = Transport pipe length x volume in US gallons per foot

Volume in transport pipe = ____________________________ GAL

Total drain back volume = Manifold volume + Transport pipe volume

TOTAL DRAINBACK VOLUME = ___________________ GAL
Add this volume to dose volume and use per dose volume in worksheet.

TANK FLOAT SETTING WORKSHEET

JOB NAME ______________ DATE ___________

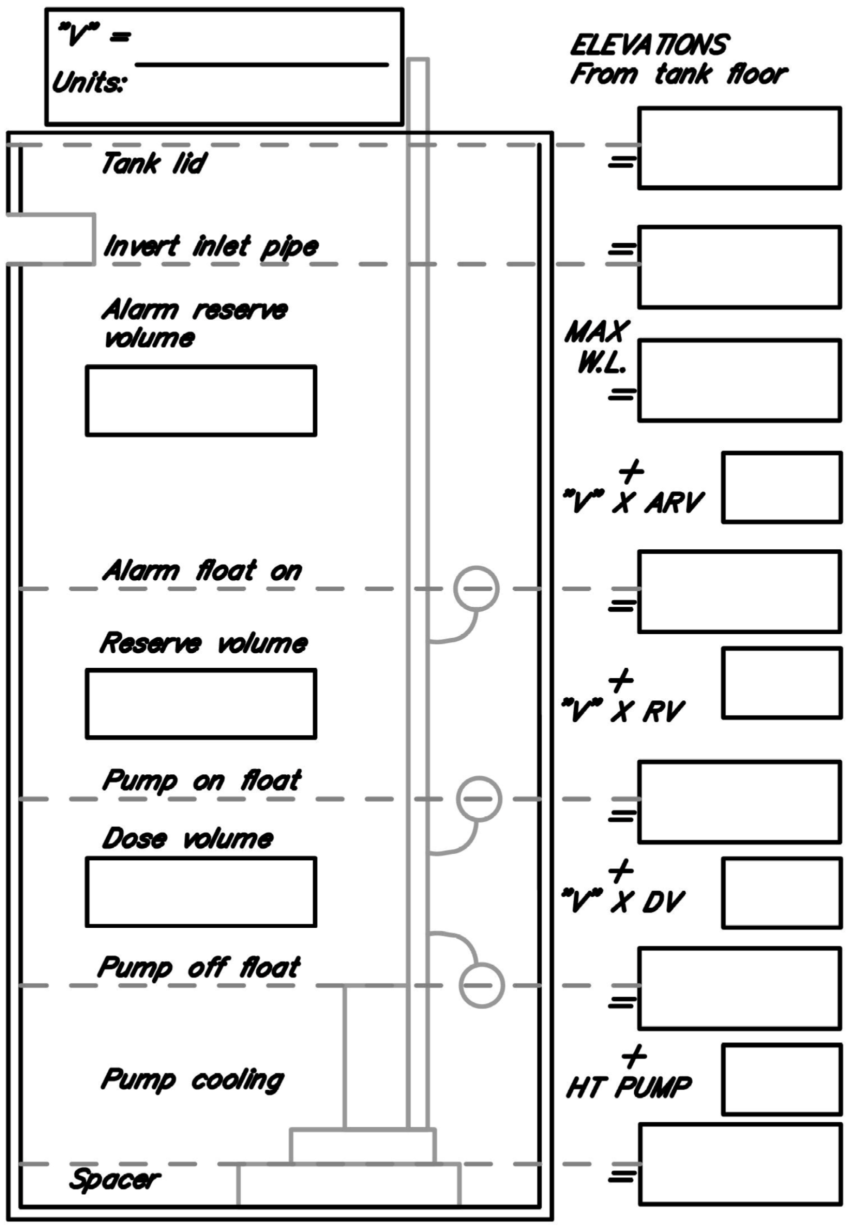
TANK SELECTED ________________________ UNITS us gal / inch

INTERNAL FLOOR AREA = (L - 2 X wall thickness) X (W - 2 X wall thickness) = ____________ SQ IN

VOLUME IN ONE INCH OF DEPTH =___________ CU IN X 0.00433 = ____________US G PER IN

"**V**" = 1 ÷ VOLUME PER INCH = 1 ÷ ___________ = ______________ FEET PER US GALLON

"V" X VOLUME = HEIGHT HEIGHT ÷ "V" = VOLUME



CU FT X 7.48 = US GALS ~ CU IN X 0.00433 = US GALS
CU METERS X 1000 = LITERS ~ INCHES X 0.0254 = METERS

Tank dimensions:

HT:________________

L: _________________

W: ________________

Wall thickness: ______

Lid thickness: _______

Base thickness: _____

Inlet invert: _________

Internal heights:

Inlet invert: __________

Tank lid: ____________

NOTES

NOTES

Conversions

Gallons in this worksheet are US unless shown as "IG".

US unit	X	= Metric Unit	X	= US Unit	X	= secondary unit
Gallons	3.785412	Litres	0.264172	Gallons	0.8326738	Imperial Gal.
feet	0.3048	meter	3.28083	ft of head	0.4329004	PSI
Atmosphere	101.325	Kpa	0.1450377	PSI	0.06894757	Bar (=100 Kpa)
				Gallons	0.1336806	cu ft
		Cu m	35.31467	cu ft	7.480519	gallons
GPD/sqft	40.74648	Lpd/sqm	0.024542	GPD/sqft		
GPD/ft	12.418	Lpd/m	0.080528	GPD/ft		
Sq ft	0.0929	Sq m	10.76391	Sq ft		
Inches	0.0254	Meters	39.36996	Inches		
Feet	0.3048	Meters	3.28083	Feet		

References

This worksheet developed by Ian Ralston, TRAX Developments Ltd. Based on *Pressure Distribution Network Design By James C. Converse January, 2000* and *Recommended Standards and Guidance For Pressure Distribution, by Washington State Department of Health*.

See also

http://www.traxdev.com/

For the most current version of this worksheet, the Design Inputs Worksheet, Timed Dosing Worksheet, and for the long form version of this worksheet, with tables and instructions.