

Job:  
Designer:

Design number:

Date:  
Option number:

## Worksheet for pressure distribution system design Rev. October 2006

*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 instructions in the Long Form Worksheet (LFW).*

**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 = \_\_\_\_\_ GPD/SQFT

DESIGN LLR = \_\_\_\_\_ LPD/M = \_\_\_\_\_ GPD/FT

DAILY DESIGN FLOW (Q) = \_\_\_\_\_ LPD = \_\_\_\_\_ GPD

AVERAGE FLOW = \_\_\_\_\_ LPD = \_\_\_\_\_ 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

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

#### 2 Establish initial trench layout, Determine lateral lengths

Based on conditions of site select appropriate trench layout and initial manifold position (eg end or center feed or no manifold). Ensure system length meets minimum required.

MANIFOLD TYPE = \_\_\_\_\_

LATERAL LENGTH = \_\_\_\_\_

NUMBER OF LATERALS = \_\_\_\_\_

### MOUNDING

If you are concerned about mounding, beyond a simple consideration of LLR consider using a computer model (eg Nova Scotia mound program). Use average flows for mounding modelling.

### SKETCH:

Draw a sketch of proposed layout, include constraints. Draw a schematic elevation showing the static head and forcemain length, fittings etc. Use pencil until finalized. Show any sub areas (ie areas of field in separate location but to be dosed at the same time) or zones (areas of field dosed separately).

### 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. Based on orifices spaced min. 1/2 of spacing from ends of infiltrators or trenches, and no reduction in trench length for center feed. **If your specification differs, adjust 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 \_\_\_\_\_

Use *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

For trench design spacing at 6 or 10 feet, for beds per design. 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 ( $\gamma$ ) = \_\_\_\_\_ 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, from off float of pump chamber to highest point of network.

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 manifold size or next pipe size up (guide pg 16 LFW) . 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 required 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  $\alpha$  = \_\_\_\_\_ 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  $\beta$  = \_\_\_\_\_ FEET

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

HEAD LOSS PER 100' (from table) = \_\_\_\_\_

FRICITION 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.  $V = \text{Flow (cu ft per second)} / \text{cross sectional area of the inside of the pipe (sq ft)}$ .

TOTAL DYNAMIC HEAD REQUIREMENT

TDHR = \_\_\_\_\_ FEET

This is Static Head + Network Head requirement + Friction Loss In Forcemain(s) + NPSH

PUMP DISCHARGE/HEAD = \_\_\_\_\_ GPM AT \_\_\_\_\_ FEET HEAD

ADDITIONAL SECTIONS OF FORCEMAIN, ZONE VALVES, EXTRA ORIFICES

Add sheets as required for additional forcemain sections, zone valves etc.

## 2 System curve

NUMBER OF ORIFICES = \_\_\_\_\_ ( $\gamma$ ) 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 $\gamma$ )	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)

Use pump curves and system curves to select pump and determine operating point. Be careful to avoid undesirable pipeline velocities (too high or too low). Ensure pump will provide minimum required squirt height.

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 1/2 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 ( <b>minimum</b> )	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 = min \_\_\_\_\_ times per day

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

\_\_\_\_\_ gpd ÷ \_\_\_\_\_ times per day

DOSE VOLUME = \_\_\_\_\_ GALLONS

Check dose volume against draining volume of network and any part of force main that drains. Ensure dose volume is at least 5 x the draining volume. If not, consider constraints (soil type etc) and redesign manifold location etc to achieve this. Use *VOLUME OF PIPE* table, page 16 LFW.

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

TOTAL DRAINING VOLUME = \_\_\_\_\_ GALLONS

DOSE VOL. ÷ TOT DRAINING VOL. = \_\_\_\_\_ G ÷ \_\_\_\_\_ G = \_\_\_\_\_ (5 to 10)

Check pump run time per dose.

PUMP RUN TIME = Dose volume ÷ Pump flow rate  
= \_\_\_\_\_ G ÷ \_\_\_\_\_ GPM = \_\_\_\_\_ MINS

Note that in climates where freezing may occur in undrained laterals it may be difficult to attain very small doses, equal distribution is the primary priority. Note other steps to be taken to improve distribution. **Use smallest dose/most frequent dosing possible.**

Notes for lateral hole positions and draining:

## 5. Size pump vault

SPM guideline for small systems; minimum vault sizes for demand activation volume 1 day design flow, for timed dosing 2 times daily flow.

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

DOSE VOLUME = \_\_\_\_\_ GAL From (B 4)

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 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, consider higher value for case where water flow can occur during power outage or in remote area, this may also include reserve volume provided by surcharge of the septic tank.

TOTAL MINIMUM VOL. = \_\_\_\_\_ GAL Estimate pump chamber size for initial design trial.

PUMP VAULT(S) SIZE(S) = \_\_\_\_\_  
Nominal size and manufacturer designation.

PUMP MINIMUM WATER LEVEL = \_\_\_\_\_ FT From (B 3) above.

DEPTH REQUIRED FOR PUMP SPACER = \_\_\_\_\_ FEET

Use this information and the **float setting worksheet** (below) 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

CHECK AGAINST VAULT INTERNAL DEPTH \_\_\_\_\_ Iterate as required

SEPTIC TANK SURCHARGE FOR ALARM VOL. \_\_\_\_\_ (If used)

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.

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

Use *VOLUME OF PIPE* table, page 16 LFW.

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 / feet

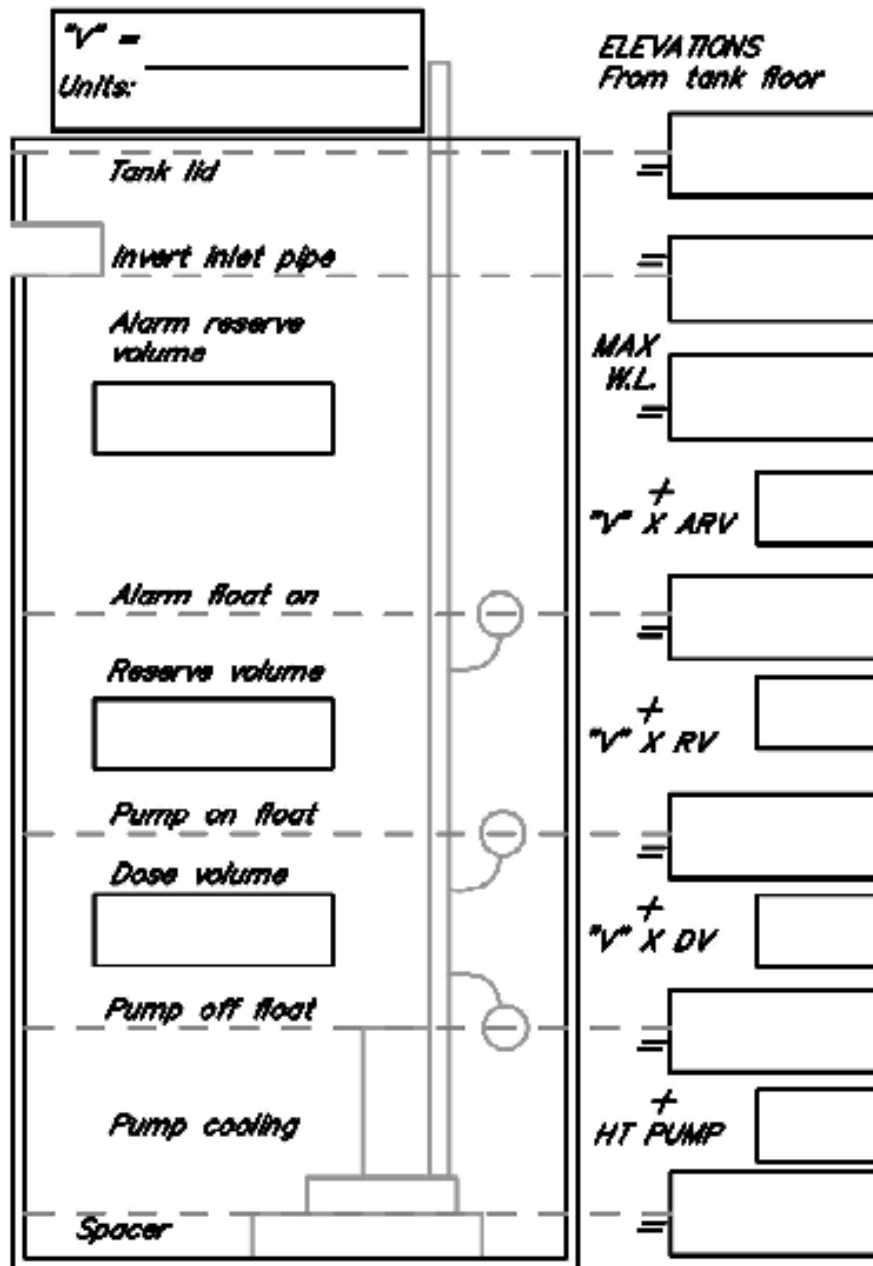
INTERNAL FLOOR AREA = (L - 2 X wall thickness) X (W - 2 X wall thickness) = \_\_\_\_\_ SQ FEET

VOLUME IN ONE FOOT OF DEPTH = \_\_\_\_\_ CU FT X 7.48 = \_\_\_\_\_ US G PER FOOT

"V" = 1 ÷ VOLUME PER FOOT = 1 ÷ \_\_\_\_\_ = \_\_\_\_\_ FEET PER US GALLON

"V" X VOLUME = HEIGHT

HEIGHT ÷ "V" = VOLUME



Tank dimensions:

HT: \_\_\_\_\_

L: \_\_\_\_\_

W: \_\_\_\_\_

Wall thickness: \_\_\_\_\_

Lid thickness: \_\_\_\_\_

Base thickness: \_\_\_\_\_

Inlet invert: \_\_\_\_\_

Internal heights:

Inlet invert: \_\_\_\_\_

Tank lid: \_\_\_\_\_

NOTES

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

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		

## 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. **To be used only with instructions in the Long Form Worksheet (LFW).**

For Converse's papers see:

<http://www.wisc.edu/sswmp/>

For Washington State guidelines see:

<http://www.doh.wa.gov/ehp/ts/WW/>

See also

<http://www.traxdev.com/ES930/>

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