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Challenges of Gravity distribution in Septic Systems

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2. Impacts of bad (or good) distribution on septic systems
3. Gravity distribution: key design objectives
4. Distribution methods: characteristics and limitations
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Theory of subsurface dispersal systems (SSDS)

Theory of subsurface dispersal

Subsurface dispersal : The concept of Hydraulic Loading rate

The design hydraulic loading rate is the maximum volume of effluent (gal) per unit of surface (ft^2) that a soil can sustainably absorbs in a day (d). Sometimes referred to a soil Long Term Acceptance Rate.

Designing using loading rates ($gal/ft^2.d$) implicitly demands for uniform distribution of effluent over the entire surface provided

Not providing this = overloading !

This is why effluent distribution should be a critical design criteria

Impacts of bad (or good) distribution on septic systems

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Impacts of soil (contact area) hydraulic overloading?

- Premature clogging of the bed (accelerated biomat development)
- Reduced life expectancy (fast reduction of soil acceptance rate leading to failure)
- Increased risks of effluent ponding, surfacing and backups (major health and safety issue and costly damages)
- Increased risks of water table contamination (not enough vertical separation to treat sufficiently)

Impacts of bad (or good) distribution on septic systems

Most common causes of hydraulic overloading ?

i.e. exceeding the soil hydraulic loading rate (HLR) or long term acceptance rate (LTAR)

- Underestimating the design flow
- Overestimating the soil infiltration capacity (bad soil evaluation, bad identification of a limiting layer, bad selection of HLR, too deep, etc.)
- Or…we can do everything right, but bad **DISTRIBUTION OF EFFLUENT** will cause overload of the contact area

Gravity distribution: key design objectives

Gravity distribution: key design objectives

This is how gravity works:

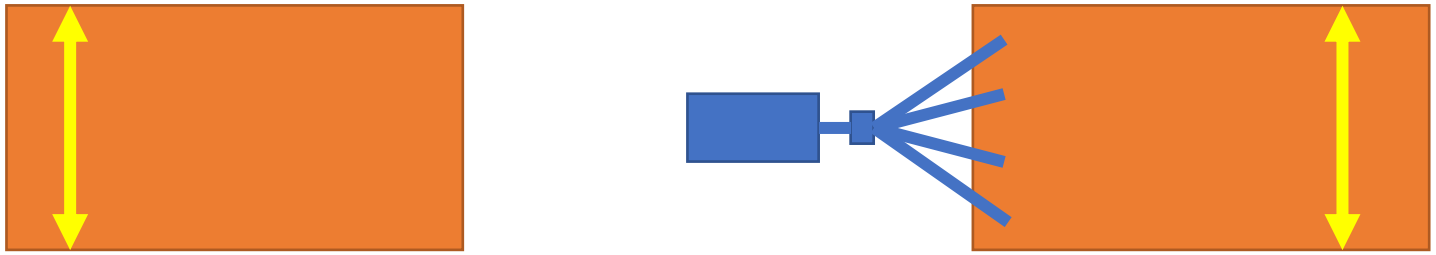
- Gravity always pulls downward;
- Water takes the path of less resistance and offers very little resistance to change in direction;
- Velocity at the septic tank outlet is very slow and results in very little momentum. Often effluent only travels short distances in distribution pipes
- A slight difference in level will change direction of flow (settling, freeze/thaw, slope, etc.)

Gravity distribution: key design objectives

Uniform distribution needs to achieve 2 essential objectives:

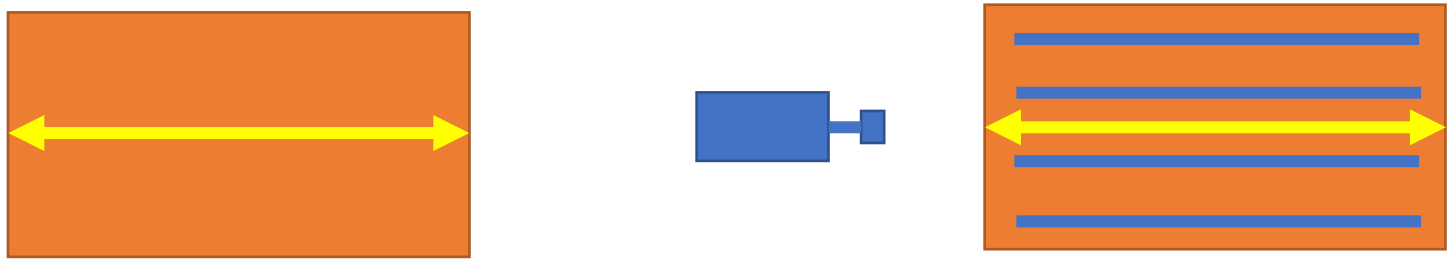
#1: LATERAL DISTRIBUTION

- Distribution of effluent over the width of the system (in each lateral or trenches)



#2: LONGITUDINAL (length wise) DISTRIBUTION

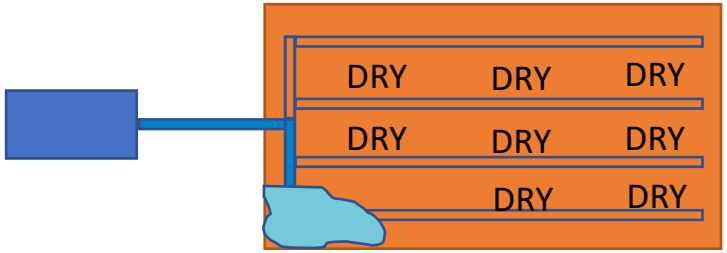
- Distribution of effluent over the length of the system.
- This requires sufficient volume and momentum (movement energy), things rarely found in gravity systems.

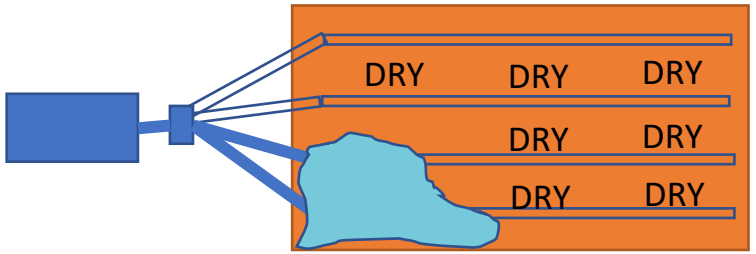


Gravity distribution: key design objectives

EXAMPLES OF IMPERFECT LATERAL DISTRIBUTION

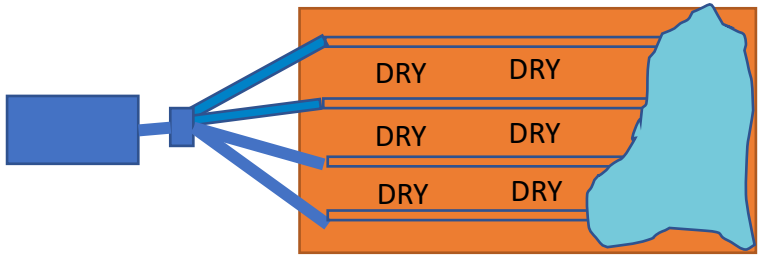
- Header or D-box not perfectly level or has shifted over time or has uneven outlet or pipe level, header has “blind fittings”, etc.

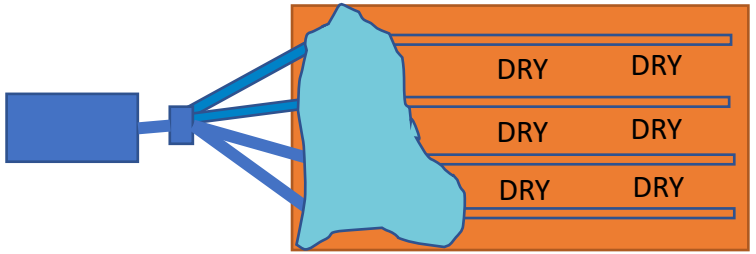




EXAMPLES OF IMPERFECT LONGITUDINAL (length wise) DISTRIBUTION

- Inconsistency in pipes slopes, limited volume and/or momentum entering the laterals

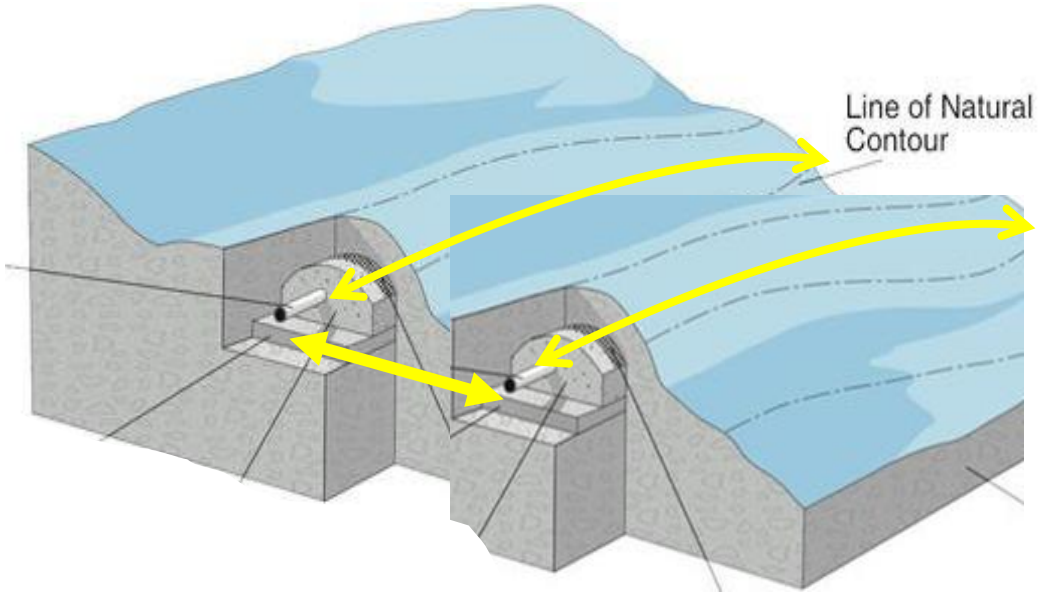




Gravity distribution: key design objectives

TO KEEP IN MIND : Distribution of effluent must be a **<u>2-dimensions dispersal</u>**

- Lateral or width wise (even distribution between the laterals)
- Longitudinal or length wise (even distribution over the length of distribution pipe)



Distribution methods: characteristics and limitations

Distribution methods ranked

BEST: Low pressure distribution (non-gravity method)

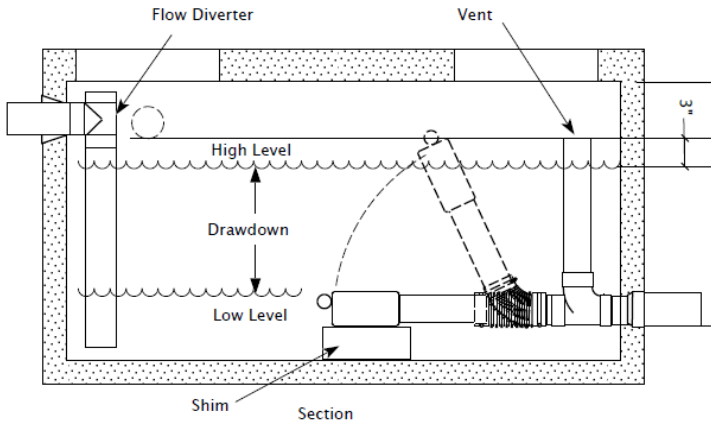
- Uniform distribution over the entire contact area usually within 10% between proximal and distal orifices
- Controlled volume per dose promotes resting periods and replenishes oxygen levels
- Self-cleaning velocities maintain long lasting performances of distribution (cleaning ports provided if needed)
- Pressure overcome risks of uneven level of pipes from settling, freeze/thaw, installation mistakes, etc.
- Can be used in all types of topography
- More expensive

Distribution methods ranked

<u>Better</u>: Surge box or flush type devices (siphons, floating dosing systems, flush valves, tipping buckets, etc.)

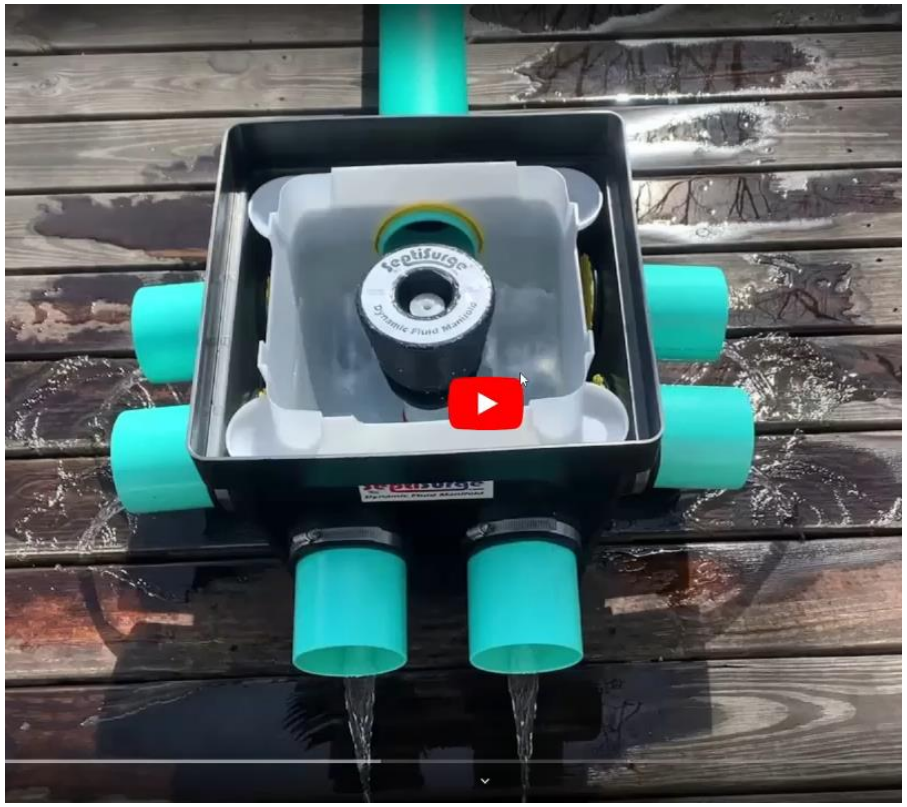
- Uses gravity but with momentum and volume improving lateral and longitudinal effluent distribution
- Water surges reduces the risks associated with uneven level of pipes from settling, freeze/thaw, installation mistakes, etc.
- Intermittent dosing promotes resting periods
- Can be accessed for inspection and cleaning if needed
- Surge velocities reduces clogging of pipes and need for maintenance
- They are dynamic but still passive, no electricity

Distribution methods – Surge/Flush devices



Flout floating dosing system

Siphon



SeptiSurge
Dynamic Fluid Manifold

Distribution methods ranked

<u>Limited</u>: D-boxes, Flow Splitters, Splitter tees, etc.

- Uses strictly gravity with no momentum or volume resulting in limited longitudinal distribution
- Can achieve proper lateral distribution if perfectly level (almost impossible to maintain overtime). Usually very susceptible to change in level resulting in impacts on lateral distribution.
- D-box can be combined with adjustable weirs. Good option only if they are inspected regularly and adjusted when needed.
- Devices are accessible and can be cleaned.
- They are passive, no electricity

Distribution methods – D-box, Flow Splitters, etc.

D-box

Flow Splitter / Splitter Tees

Distribution methods ranked

<u>Bad</u>: Pipe headers (use of tees and elbows to split effluent evenly)

- Uses strictly gravity with no momentum or volume resulting in very limited longitudinal distribution
- Impossible to provide perfect level. A slight difference in the header or pipe level immediately impact lateral and longitudinal distribution.
- Use of blind fittings in headers is close to useless (intermediate tees in header feeding a lateral)
- Not accessible.
- The most inexpensive method (as much inexpensive as it is inefficient)
- Passive, no electricity

Distribution methods – Pipe headers

Distribution methods: characteristics and limitations

Suggested reading

Water Air Soil Pollut (2008) 191:55–69
DOI 10.1007/s11270-007-9606-7

A Comparison of Gravity Distribution Devices Used in On-Site Domestic Wastewater Treatment Systems

T. Patel · N. O'Luanaigh · L. W. Gill

ONSITE INSIGHTS

Sara Heger, Ph.D., is a researcher and instructor with the Onsite Sewage Treatment Program in the Water Resources Center at the University of Minnesota. She is also a certified designer and service provider. Send questions for Sara to editor@onsiteinstaller.com

It's Time for Tough Talk About Gravity Distribution

Systems are sized assuming even distribution along drainfield lines. How often do the results match the assumption?

By Sara Heger

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Questions

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