Rainwater Harvesting for Irrigation

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ARCSA-AP and Trainer

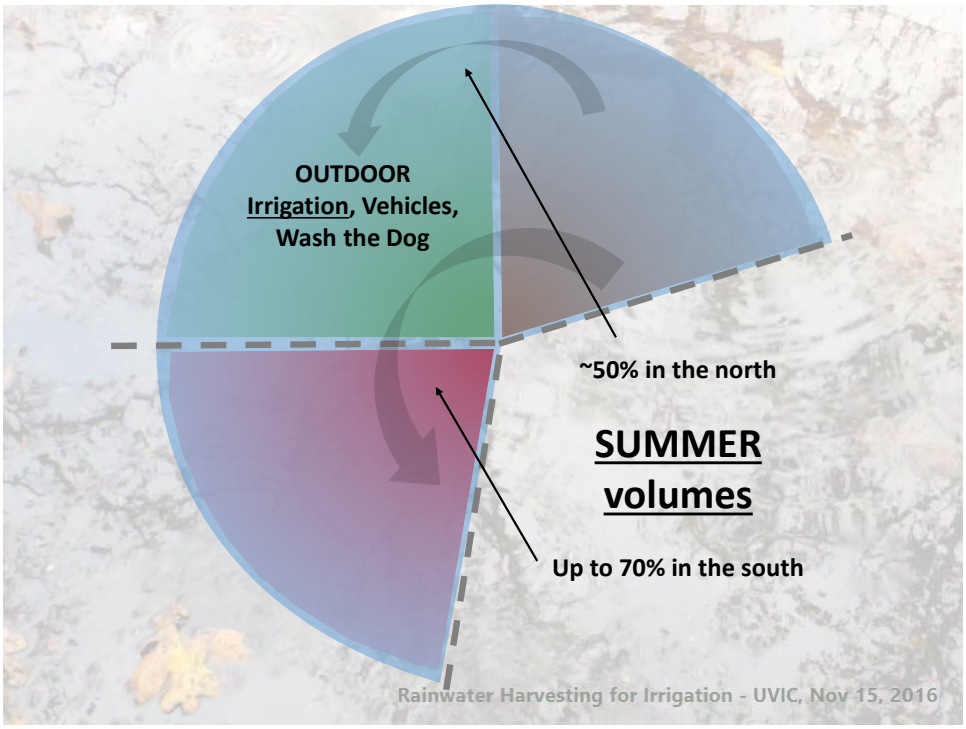
U of Guelph, Ridgetown Campus	1994 to 2010
Gaia College, 'Rainwater Harvesting and Management', online	2012 (ongoing)
CANARM/ARCSA	2012 (ongoing)
Pacific Design Academy	2016 (ongoing)

Rainwater Harvesting for Irrigation

Overview
Quality and Volume
Backflow Prevention
Irrigation Systems
Pumps and Pressure
More notes……

RAINWATER HARVESTING SYSTEMS
of good quality and suitablity:

- ARE NOT OFF-THE-SHELF PRE-PACKAGED
- ARE NOT THE SAME FOR NEAR-IDENTICAL SITES
- ARE NOT ROCKET SCIENCE, BUT REQUIRE CAREFUL CONSIDERATIONS and CALCULATIONS
- ARE NOT ALWAYS THE BEST SOLUTION to water-related problems
- MAY NOT RESEMBLE ANYTHING YOU WILL SEE IN THIS PRESENTATION
- WEB-BASED INFO CAN BE GOOD or BAD, no guarantees



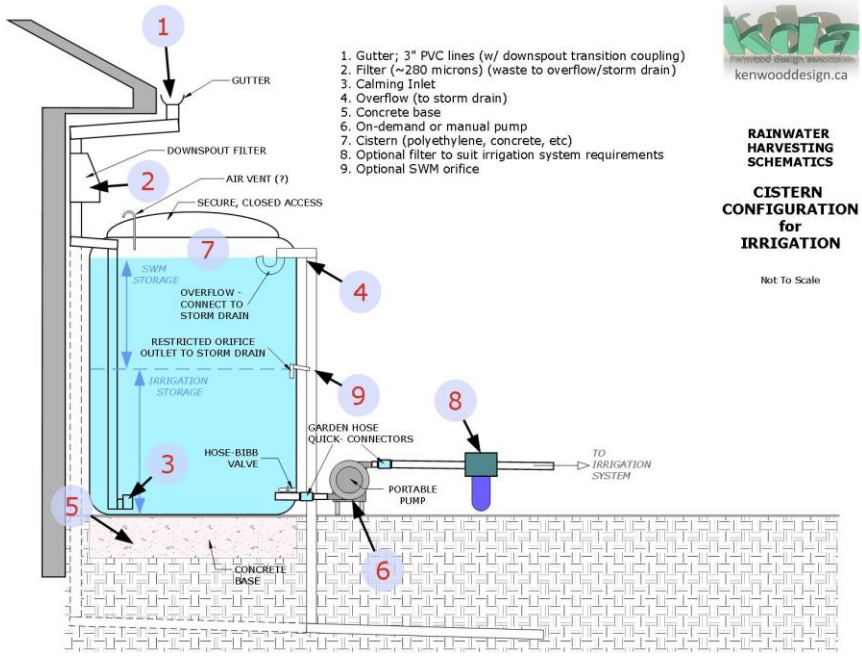
Overview

- **Alternative to potable water supplies**
  - Reduces costs for sourcing, treatment, distribution
- **Less/zero restrictions during drought periods**
- **'Natural processes' duplicated for plant growth**
- **Nitrogen is contained in rainwater**
- **Slightly acidic, may affect piping considerations**
- **Simple, no plumber unless going inside or CCC* required**

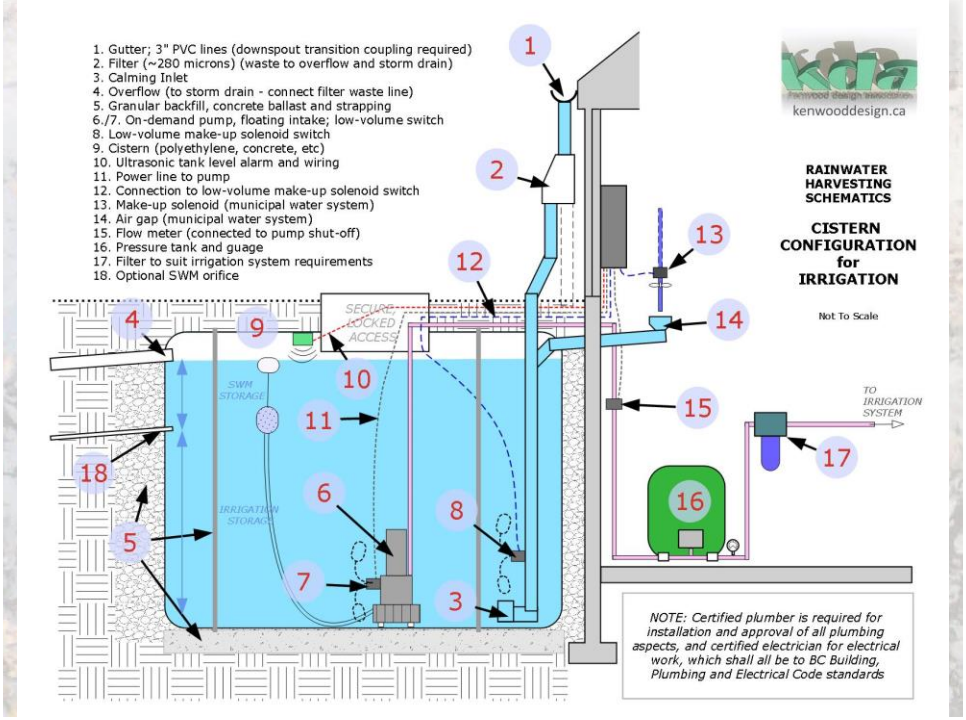
*CCC – Cross Connection Control, mandated in most jurisdictions

Overview

- CATCHMENT
- FILTRATION
- CONVEYANCE
- STORAGE
- PRESSURE
- FILTRATION
- CROSS-CONNECTION CONTROL (BACKFLOW PROTECTION)



1. 3” PVC and fittings to transition from DOWNSPOUT
   - Could be incorporated into the debris filter, or actual adaptor
2. Filter: Debris Filter, or ~280 micron filter with waste diversion
3. Calming inlet: reduces turbulence/provides quiescent flow
4. Overflow: connected to storm drain, or to raingarden, or to …..
5. Base: water is heavy, shifting of the cistern is not desirable
6. Pump: to suit volume, flow and pressure demand
7. Cistern: usually polyethylene, could be other materials
8. Filter: to suit irrigation (150 microns for drip systems)
9. Optional SWM limited-flow orifice, connected to storm drain



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2. Filter: Debris Filter, or ~280 micron filter with waste diversion
3. Calming inlet: reduces turbulence/provides quiescent flow
4. Overflow: connected to storm drain, or to raingarden, or to …..
5. Base: firm footing, ballast and tie-downs; backfill with clean material
6. Pump: to suit volume, flow and pressure demand
7. Floating intake, and low-volume switch
8. Make-Up Low Volume switch (ON = adds municipal water)
9. Cistern: usually polyethylene, could be concrete
10. Optional Tank level gauge and alarm

11/12. Electrical connections: pump and make-up solenoid

13/14. Make-up system air gap*

15. Flow meter: connects to pump shut-off
16. Pressure tank: maintains desired pressure, pump runs less often
17. Filter: to suit irrigation (150 microns for drip systems)
18. Optional SWM limited-flow orifice, connected to storm drain

**Note: Backflow Prevention is created with 13/14 AIR GAP; approval may also require an additional cross-control connection (CCC) device on the incoming municipal line, as with irrigation systems connected to the potable water supply.*

Water Quality

Leaves/needles and plant parts (twigs, bark, flowers, moss)
- **"compost (gutter) tea"**
- **organic, affect colour, taste, odour**
- **fruit/nuts, pollen**
- **some parts can be poisonous**

Animal feces (birds, squirrels, racoons, rats, etc)

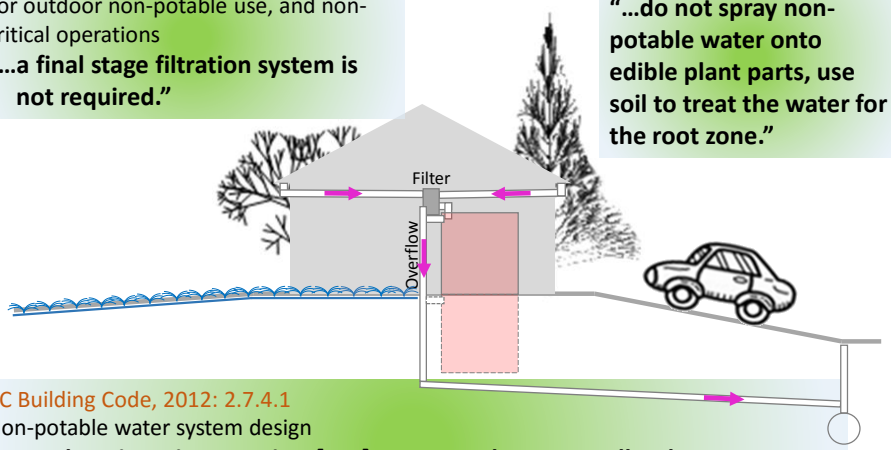
Dust and particulate matter (construction, industry)

Ambient chemicals (agriculture, landscape, cleaning)

Codes/Standards

ARCSA/ASPE/ANSI 63 – 2013
For outdoor non-potable use, and non-critical operations
"…a final stage filtration system is not required."

Rule of Thumb (VIHA, etc):
"…do not spray non-potable water onto edible plant parts, use soil to treat the water for the root zone."



BC Building Code, 2012: 2.7.4.1
Non-potable water system design
"…good engineering practice, [see] ASHRE and ASPE Handbooks, CAN/CSA-B128.1, 'Design and Installation of Non-Potable Water Systems'."

Volume

Plant Type(s) (Crop)

Soil Type

Season

Temperature

Wind

Humidity

Lawns, Ornamentals:

Rule of Thumb =

1" per week average, including natural precipitation

Monthly catchment supply
- **monthly irrigation demand**
= **monthly rainwater demand***

3,900 litres – 4,500 litres = 600 litres*

*always use a positive number

Volume

Plant Type(s) (Crop)

Soil Type

Season

Temperature

Wind

Humidity

Food garden:

(based on) **Rule of Thumb =**

2" per week average, including natural precipitation

Monthly catchment supply
- **monthly irrigation demand**
= **monthly rainwater demand***

3,900 litres – 9,000 litres = 5,100 litres*

*always use a positive number

Volume

Plant Type(s) (Crop)

Volume

Plant Type(s) (Crop)

Soil Type

Season

Temperature

Wind

Humidity

Sandy soil (large pore spaces, weak attraction of water molecules, low fertility)

Sandy loam soil (less pore space, more attraction of water molecules, fertile)

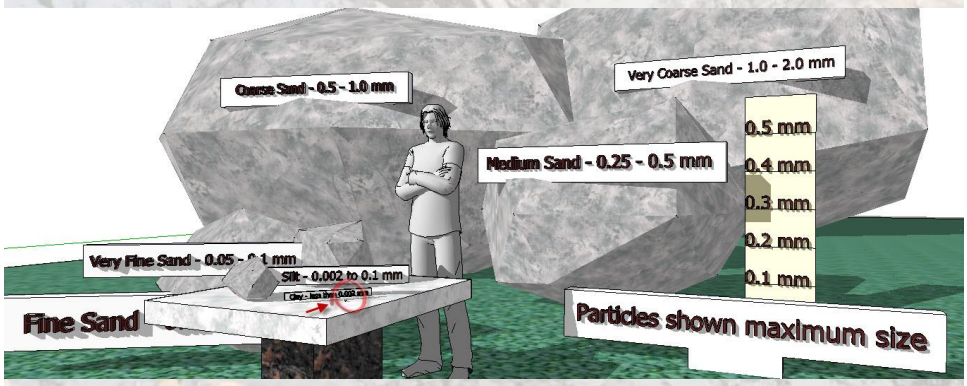
Clay loam soil (less pore space, more attraction of water molecules, fertile)

Clay soil (least pore space, highest attraction of water molecules, fertile)

INFILTRATION / PERCOLATION RATE is key

Volume

Soil Type (structure)



Volume

Soil Texture	Table 6.5 Maximum Infiltration Rate in Inches / Hour							
	0 - 5% slope		5 - 8% slope		8 - 12% slope		12% + slope	
	Cover	*Bare*	*Cover*	*Bare*	*Cover*	*Bare*	*Cover*	*Bare*
Sandy soil	2.00	2.00	2.00	1.50	1.50	1.00	1.00	0.50
Light sandy loam	1.75	1.00	1.25	0.80	1.00	0.60	0.75	0.40
Silty loam	1.00	0.50	0.80	0.40	0.60	0.30	0.40	0.20
Silty clay loam and Clay soil	0.20	0.15	0.15	0.12	0.12	0.08	0.10	0.06

Hermary, Heidi, 2007, "Working With Nature, Shifting Paradigms", pg. 56, Gaia College, Inc., Duncan, BC

ORGANIC MATTER: "…adding 5% additional organic matter to soil increases water-holding capacity by 4.6 times (460%)…" (paraphrased from) Hermary, Heidi, 2007, "Working With Nature, Shifting Paradigms", pg. 54, Gaia College, Inc., Duncan, BC

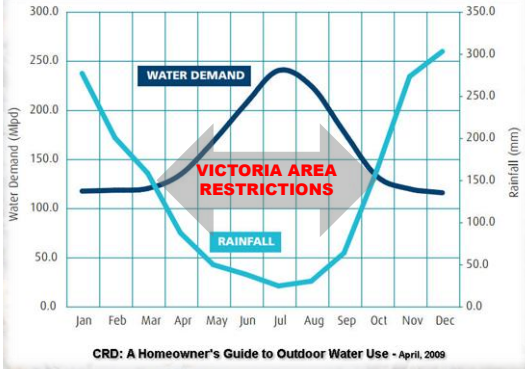
Volume

Season

WINTER:
- **Lots of rain, no plant growth**

SUMMER:
- **Lots of plant growth potential, no rain**

SHOULDER SEASONS:
- **Variable according to year, location**



CRD: A Homeowner's Guide to Outdoor Water Use - April, 2009

Volume

EVAPOTRANSPIRATION (ET)

In nature:
up to 30% evaporation from plants (forest)
10% or more transpiration from plants
50% infiltration, 10% runoff

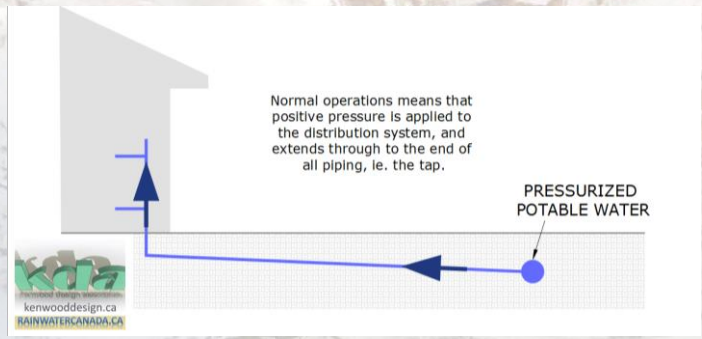
Temperature
+
Wind
+
Humidity

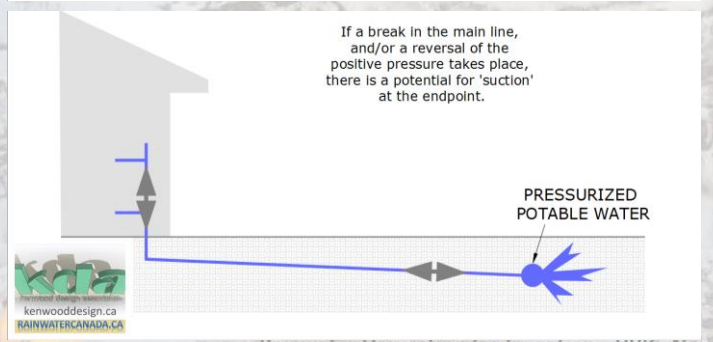
High ET = Higher demand for (irrigation) water

Volume

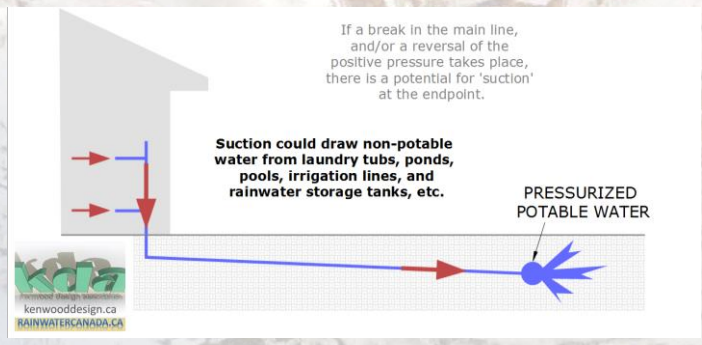
		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
WEEKS		0	0	0	1	2	4	4	4	4	1	0	0	20	
Gonzales		85.2	68.1	45.3	28.5	25.8	20.7	14	19.7	27.4	51.1	95.5	101.9	583	mm
Catchment Volume (based on catchment area =)	SUPPLY	852	681	453	285	258	207	140	197	274	511	955	1,019	5,832	L
Irrigation Volume required (per month, plus allowance =)	DEMAND	0	0	0	1,125	2,250	4,499	4,499	4,499	4,499	1,125	0	0	22,497	L
IRRIGATION FROM STORED RAINWATER	RAINWATER	0	0	0	840	1,992	4,292	4,359	4,302	4,225	614	0	0	20,625	L
Metchosin		148.6	110.2	84.6	53.8	36.7	27.3	17.8	23.9	34.3	96.1	187.9	162.5	984	mm
Catchment Volume (based on catchment area =)	SUPPLY	1,486	1,102	846	538	367	273	178	239	343	961	1,879	1,625	9,837	L
Irrigation Volume required (per month, plus allowance =)	DEMAND	0	0	0	1,125	2,250	4,499	4,499	4,499	4,499	1,125	0	0	22,497	L
IRRIGATION FROM STORED RAINWATER	RAINWATER	0	0	0	587	1,883	4,226	4,321	4,260	4,156	164	0	0	19,598	L

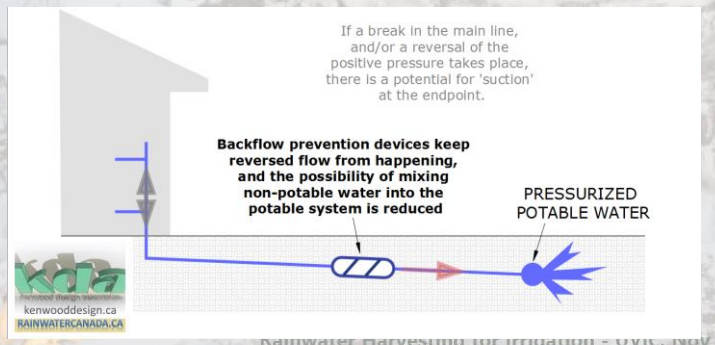
Backflow Prevention





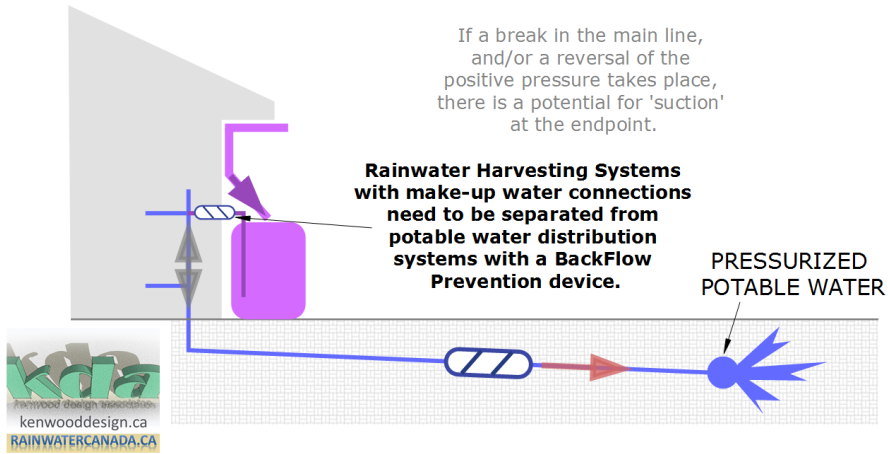
Backflow Prevention





Backflow Prevention

BACKFLOW PREVENTION



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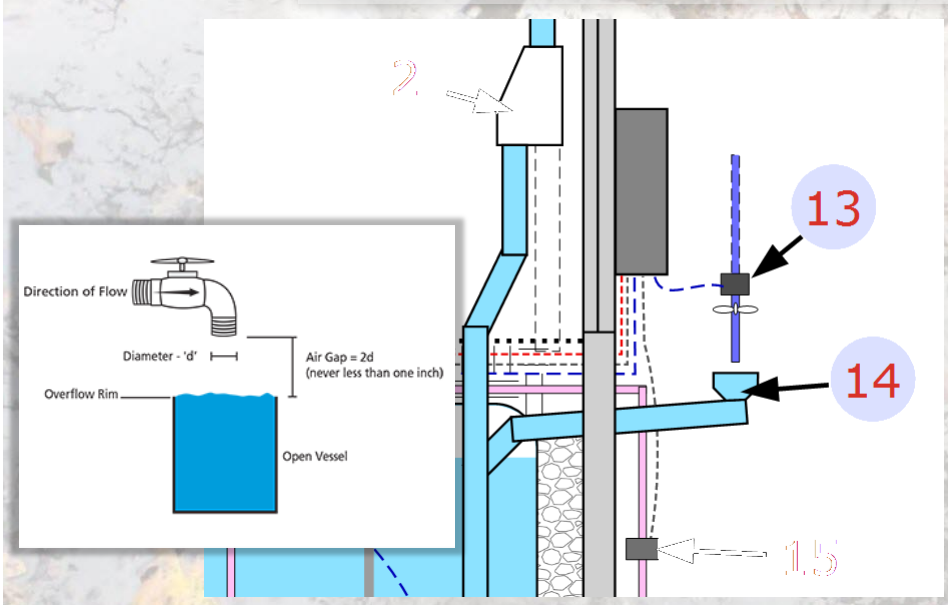


Irrigation Systems

Irrigation Systems

SPRAYS

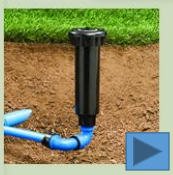
ROTORS

DRIPPERS

MICRO SPRAYS

BUBBLERS

DRIP TUBE



Spray Heads

Standard, pressure regulating, x-flow and more

Rotors

Small, mid range and commercial

Drippers

Laminar, Turbulent, Pressure Compensating and adjustable

Micro Sprays

Misters, Foggers, Mini-Sprinklers and Jets

Bubblers

Multi ported distributors

Drip Tube

Emitter Line, Drip Tape and Sub Surface

http://www.irrigation.ca/products.htm

Irrigation Systems

SPRAYS

Pop-Up
Extendable
Adjustable
- **distance**
- **circle**
- **square(ish)**

Product Catalogue
More Info

Product Catalogue
More Info
MPR Nozzle

Product Catalogue
Standard Popup
X-Flow - PRX
MPR Nozzle
Variable Nozzle

Rainbird 1800 Series

Product Catalogue
More Info
MPR Nozzle
Variable Nozzle

Toro Precision Nozzles

Product Catalogue
More Info

Irrigation Systems

ROTORS

Stream
Adjustable
Popup

Toro Precision Rotator

Product Catalogue
More Info

Hydro Rain HRX

Product Catalogue
More Info
Instruction Manual

Nelson MP Rotator

Product Catalogue
More Info
Water Conservation
Nursery Use

Rainbird 3500

Product Catalogue
More Info
Instruction Manual

Rainbird 5000

Product Catalogue
More Info
Instruction Manual

Rainbird Falcon

Product Catalogue
More Info
Instruction Manual

Irrigation Systems

DRIP

Low pressure

Pressure compensating

AG Dripper

Product Catalogue
More Info

Flag Dripper

Product Catalogue
More Info

Midi Dripper

Product Catalogue
More Info

NGE Dripper

Product Catalogue
More Info

Mini Inline Dripper

Product Catalogue
More Info

Shrubbler

Product Catalogue
More Info

Irrigation Systems

MICRO

Sprays

Extensions

Wing Jet

More Info

Mini-Sprinkler

More Info

Spectrum

More Info

Two Piece

More Info

Vary Spray

More Info

Rotor Max

More Info

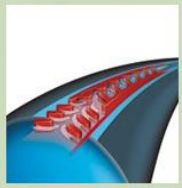
Irrigation Systems

DRIP LINE

Subsurface

Surface

Aqua Trax Drip Tape



More Info

1/4" Drip Line

More Info

1/2" Drip Line

More Info

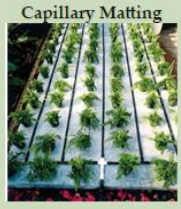
Sub Surface Drip Line

More Info

12mm Techline

More Info

Capillary Matting



More Info

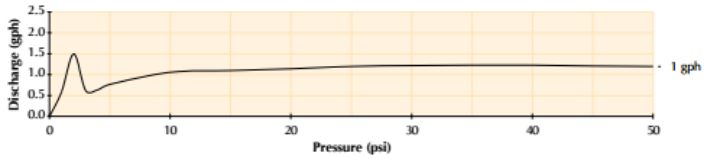
Irrigation Systems

DripPets® Frog
1 gph PC

Performance	1 gph
PRESSURE (psi)	DISCHARGE (gph)
5	0.77
10	1.06
15	1.10
20	1.14
25	1.20

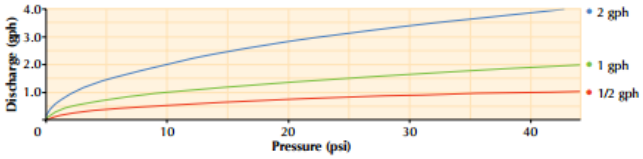
DripPets® Ladybug
1 gph PC

Discharge Rate: DripPets®



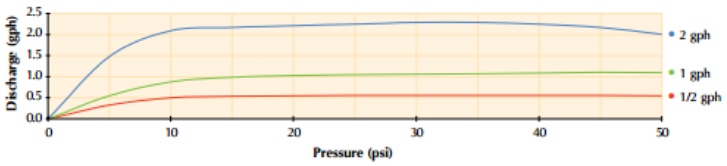
Irrigation Systems

Discharge Rate: Standard Drip Emitters



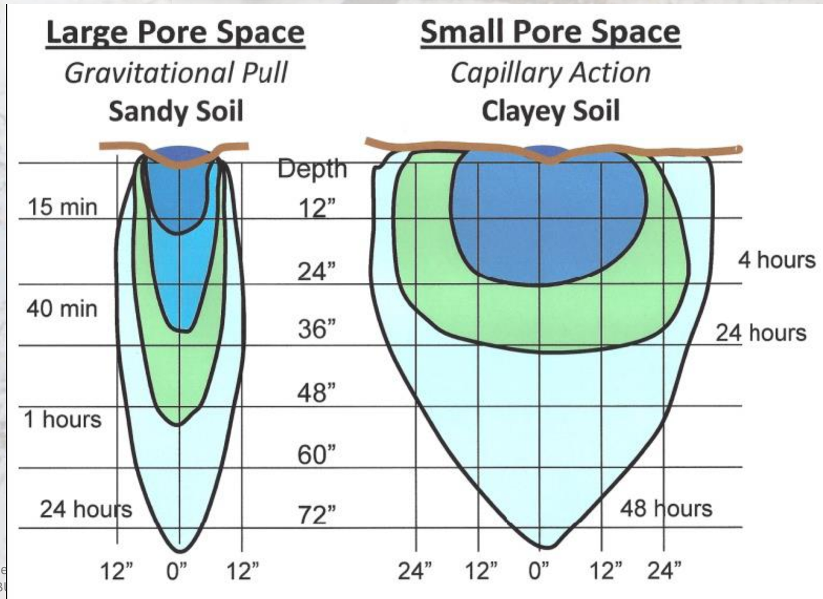
Agri Drip™ Pressure
Compensating Emitter

Discharge Rate: Pressure Compensating Drip Emitters



Rainwater Harvesting for Irrigation - UVIC, Nov 15, 2016

Irrigation Systems



https://www.google
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59719714&source=iu&pf=m&fir=3aNcWUHuNon3nM%253A%252CUtuRcwy97NkizM%252C_&usg=__Qzf4EmE1g9Vb10XZIeSMWigmKlA%
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Pumps and Pressure

EXTERNAL	**outside the cistern/tank**
SUBMERSIBLE	**inside the cistern/tank**
PUMP and MOTOR	**Motor provides the power** **Pump propels the water**
PRESSURE	**makes the water work** **(uphill, through valves, out the sprayhead)**
FLOW	**is the measure of the volume in time** **(litres per minute, gallons per hour)**

Pumps and Pressure

PRESSURE

normal irrigation system requires 50 psi

drip irrigation can work at 15 to 25 psi

---

final pressure requirement (50, or 15, or 25, eg)
+
friction loss due to piping, valves, corners
+
overcome gravity (uphill push or pull)
=
required pressure

FLOW

normal zone is 8 gpm (36 litres per minute)

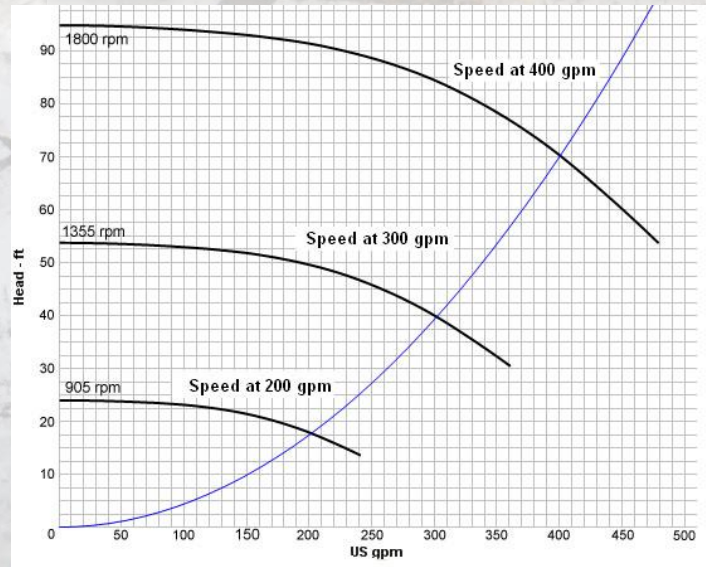
Pumps and Pressure

PRESSURE

FLOW

FLOW

PRESSURE



https://www.google.ca/search?q=pump+curve+images&safe=off&espv=2&biw=1360&bih=648&tbm=isch&tbo=u&source=univ#imgrc=hGenvCKKIn0iLM%3A

Pumps and Pressure

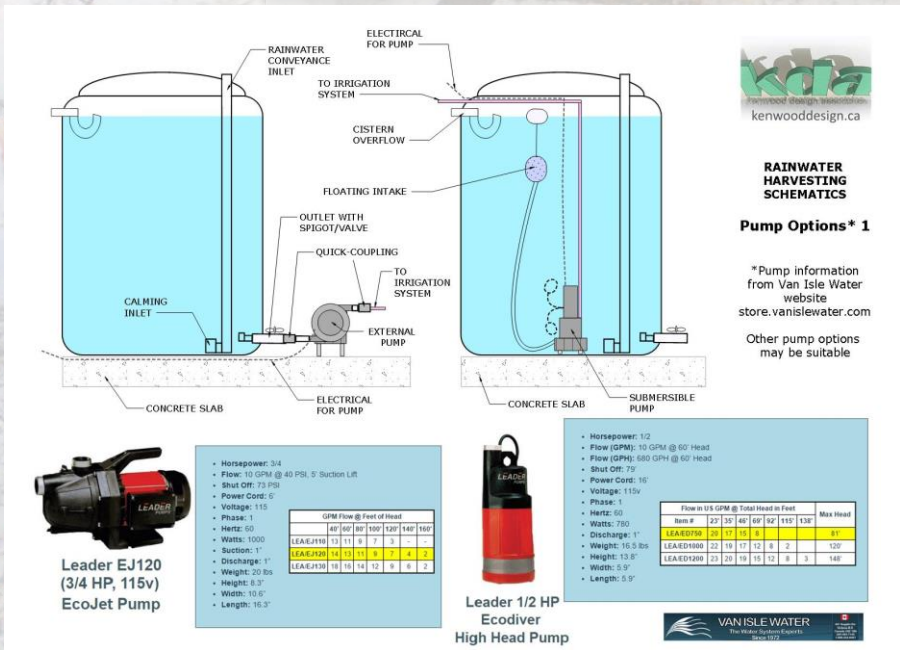
FLOW **normal zone is 8 gpm (36 litres per minute)**

Example:

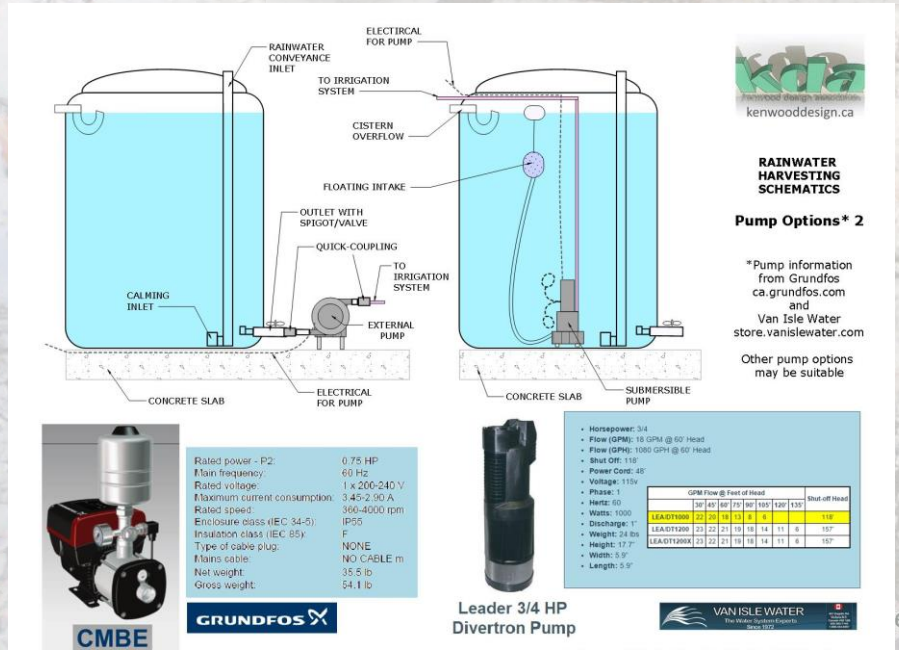
10 sq m garden area
25 mm (1 inch) per week
250 litres per week (55 gal per week)

Irrigation time is about 7 minutes

Pumps and Pressure



Pumps and Pressure



Pumps and Pressure

GRAVITY PRESSURE

psi **pounds per square inch (kiloPascals used in metric)**

1 psi	=	6.895 kPa
0.14503 psi	=	1 kPa

psi

1 psi	=	2.31 ft of water
0.433 psi	=	1 ft of water

50 psi (without considering friction losses, etc) requires

50 x 2.31 = 115.5 ft of height

More Information

SWITCHING

PUMP	**ON**	**@ demand (when needed)**
	OFF	**@ tank level too low**
	OFF	**@ line open (broken)**
REFILL	**OFF**	**@ tank level OK**
	ON	**@ tank level too low**
ALARM	**ON**	**@ tank level critical / too low**
	ON	**@ tank level overfull (overflow blocked?)**
	ON	**@ line open (broken)**

More Information

IRRIGATION DEMAND	**crop, soil, area, ET, season**
RAINWATER SUPPLY	**area, efficiency, climate data**
STORAGE CAPACITY	**100%, or less?** **3 months requirement?** **1 month requirement?**
PRESSURE and FLOW	**irrigation system type (heads)** **flow rate required (gpm, lpm)** **piping, distance, grade change**
Post Storage TREATMENT	**150 micron for drip irrigation** **200 to 300 for normal systems**

More Information

Van Isle Water 561 Dupplin St, Victoria
www.vanislewater.com 250 383 7145

Wes-Tech Irrigation #5 – 625 Alpha St, Victoria
www.irrigation.ca 250 361 1573

Down Under (Victoria) 250 995 2827
http://www.downunderirrigationsystems.com/

Tempest Rainwater (Saanich) 250 884 4876
http://www.tempestrainwater.com

Raindrop Harvesting (Nanaimo) 250 933 6335
http://www.raindropharvesting.ca/

Rainwater Harvesting for Irrigation

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Slides: www.rainwatercanada.ca/about-rainwatercanada/information-and-links
Presentations, UVIC