Rainwater Catchment Systems

Applegate Water Security Forum
3 February 2024

Jim Reiland
Many Hands Builders

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Preview:

Low-Cost Measures First!
Determine Water Demand
Estimate Collection Potential
Catchment System Elements:

- roof
- gutters
- downspouts and screens
- first flush diverters
- conveyances (pipes)
- storage tanks
- distribution

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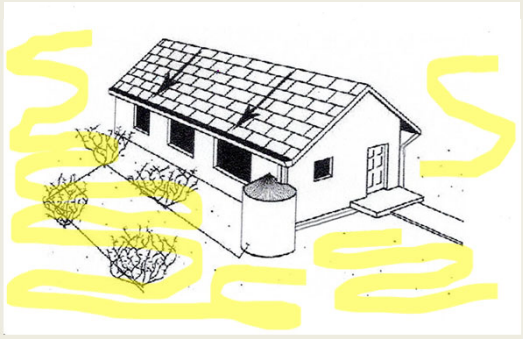
Before you install a RWCS



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How much rainwater do you "manage"?

1 acre = 43,560 square feet

1" of rain = .623 gallons/square foot…

27,137 gallons per acre per inch…

annual rainfall of 20" …

= 542,757 gallons per acre!
(1 acre foot = 325,851 gallons)

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Before installing a rainwater catchment system, consider landscape measures

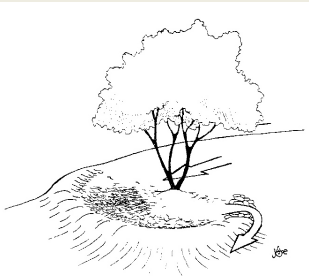

Fig. 2.22. A boomerang berm with one end stabilized with rock and made slightly lower than the other end to act as an overflow spillway

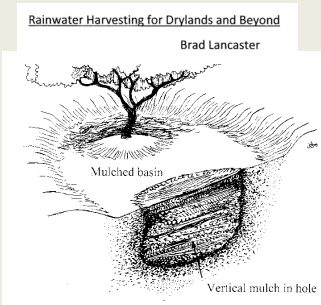

Fig. 7.9. Vertical mulch variation (mulch-filled hole or trench) encouraging infiltration and retention of water deeper into the root zone of the soil

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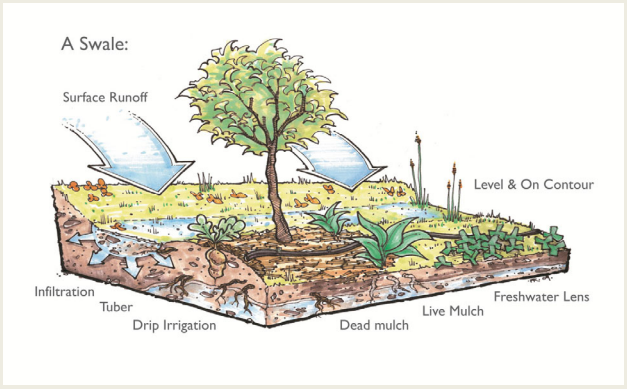

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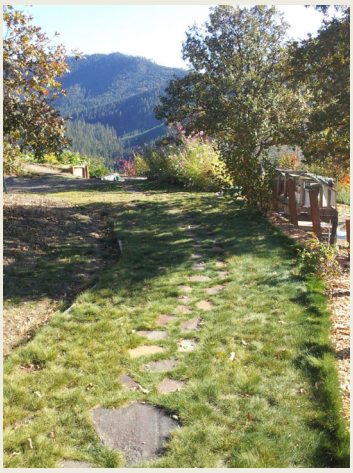
Landscape planting

native species

drought tolerant

fire resistant

fire adapted



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What does it cost to help rain soak in?

+ landscape design	$1,000
+ grading	$1,000
+ planting and seeding	$2,000
+ other	$1,000
Total:	$5,000

divide the total cost by your annual rainfall in gallons, e.g. $5,000/542,757 gallons= .09 cents per gallon...

compare with $75 cents to $3.50 per gallon for a catchment system!

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Design a catchment system for your needs

- gardens and orchards?
- wildfire suppression?
- livestock?
- flushing toilets?
- drinking water?
- storm surge retention?

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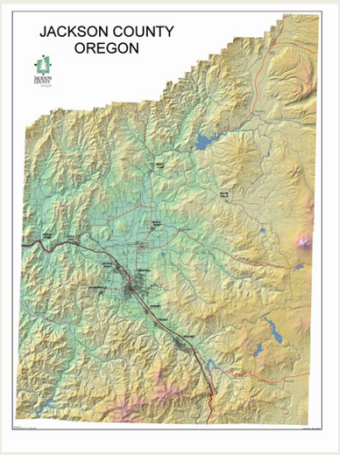
How much precipitation do you receive?



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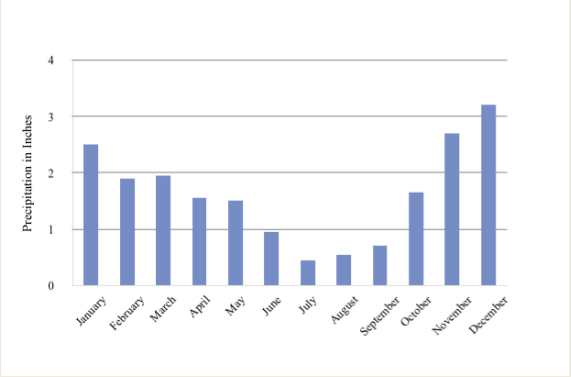
Local Precipitation



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Rain Harvest Systems in Jackson County: What Permit is Required When?

Condition	Permit Requirements
• Irrigation only system	• No permit required unless other conditions in this table apply.
• Potable water system	• Plumbing permit. Requirements are per Oregon Plumbing Specialty Code Appendix K that applies to single-family residential use. Multi-family, commercial, and industrial potable use is not recognized under the plumbing code.

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Rain Harvest Systems in Jackson County: What Permit is Required When? (…continued)

Condition	Permit Requirements
• Non-potable water system (except irrigation), e.g., cooling water and toilet flushing	• Plumbing permit. Requirements are per Oregon Plumbing Specialty Code Chapter 16.
• Electrical equipment (such as power supply for pumps)	• Electrical permit. Applies to any permanent facilities; not mobile plug-in equipment.
• Storage tank larger than 5,000 gallons	• Building permit. May be required depending on site specific conditions. Factors include slope of the land and relationship to structures. Consult with County.

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Rain Harvest Systems in Jackson County: What Permit is Required When? (…continued)

Condition	Permit Requirements
• Any facilities or development located in a 100-year floodplain.	• The County land Development Ordinance Section 7.2 requires a Floodplain Development Review with the Planning Department. If approved any applicable building, electrical, and plumbing permits would be required.

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Jackson Soil and Water Conservation District Grant

- Grant funding for (large) rainwater catchment systems
- Grant writing assistance

Contact:

Kora Mousseaux
Community Water Resource Conservationist

kora.Mousseaux@jswcd.org

541-423-6181

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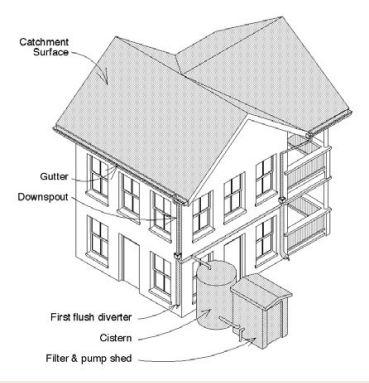
Rainwater Catchment System Overview



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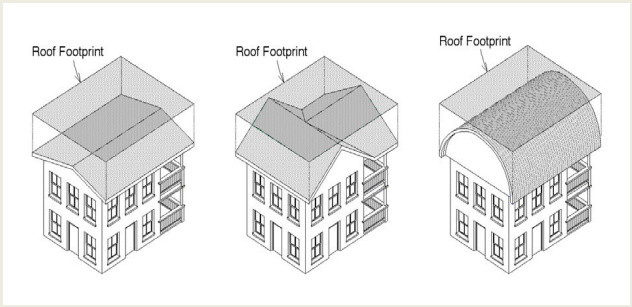
Estimating Collection Potential



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GoogleEarth, et. al.

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What is your system potential?

exercise:

roof size in square feet
x .623 gallons (gallons/inch/sq. ft.)
x annual rainfall depth
x safety factor (e.g. 5% or 10% splash, waste) =

catchment system potential

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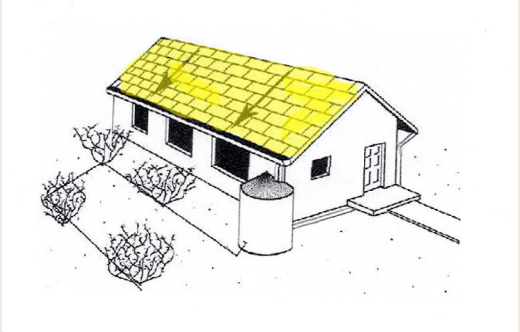
Roofs



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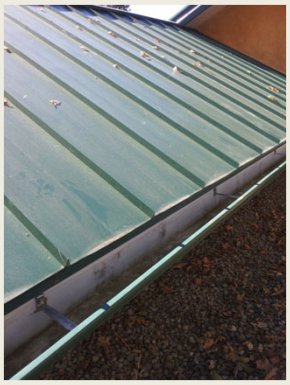
Roof Material



metal, tile,
asphalt shingle
(in order of preference)

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Snow
brakes/guards

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Gutters

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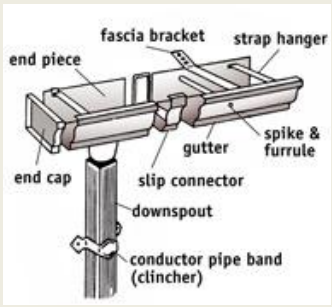
Gutter Anatomy



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Gutter Sizing

Need to Know:

– rainfall intensity for a 60-minute, 100-year storm event

(Medford =1.3", or .013 gpm/sq. ft.)

– catchment area

– consult the "International Association of Plumbing and Mechanical Codes-2000"

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Table 10.1. Sizing of gutters (International Association of Plumbing and Mechanical Codes (Source: IAPMO) 2000).

Slope of gutter	Diameter of gutter in.	Maximum allowable horizontal projected roof areas in square feet at various rainfall rates				
		2 in./hr	3 in./hr	4 in./hr	5 in./hr	6 in./hr
⅛ in./ft	3	480	320	240	192	160
	4	1,020	681	510	408	340
	5	1,760	1,172	880	704	587
	6	2,720	1,815	1,360	1,085	905
	7	3,900	2,600	1,950	1,560	1,300
	8	5,600	3,740	2,800	2,240	1,870
	10	10,200	6,800	5,100	4,080	3,400
¼ in./ft	3	680	454	340	272	226
	4	1,440	960	720	576	480
	5	2,500	1,668	1,250	1,000	834
	6	3,840	2,560	1,920	1,536	1,280
	7	5,520	3,680	2,760	2,205	1,840
	8	7,960	5,310	3,980	3,180	2,655
	10	14,400	9,600	7,200	5,750	4,800
½ in./ft	3	960	640	480	384	320
	4	2,040	1,360	1,020	816	680
	5	3,540	2,360	1,770	1,415	1,180
	6	5,540	3,695	2,770	2,220	1,850
	7	7,800	5,200	3,900	3,120	2,600
	8	11,200	7,460	5,600	4,480	3,730
	10	20,000	13,330	10,000	8,000	6,660

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Sloping Gutters

- influenced by roof size, downspout placement, fascia height, aesthetics

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Potable Water

Oregon's Appendix M (replaced by Appendix K in 2018)

M4.7 Continuous Grade. Gutters shall have a continuous grade with a minimum slope of 1/16"/foot to the outlet leader with no sags or flat portions where water will collect or stand….

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…excluding things that collect in gutters

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Gutter Strainers and Screens

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Stainless Steel Mesh

- Inflammable
- Keeps out fine debris
- Durable
- Minimal maintenance

- Costs more
- Water can flow over

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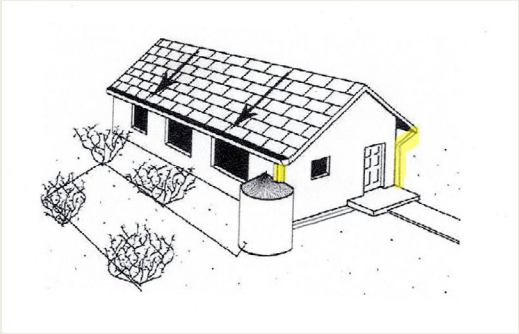
Downspouts



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Downspouts

Assume:

- the rainfall intensity for a 60-minute, 100-year storm event (1.3"/hour, or .013 gpm/sq. ft.)
- catchment area
- consult the "International Association of Plumbing and Mechanical Codes-2000"

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Table 10.2. Sizing roof drain, leaders, and vertical rainwater piping (Source: IAPMO, 2000).

Drain, leader, or pipe size	Flow	Maximum allowable horizontal projected roof areas in square feet at various rainfall rates					
Inches	gpm*	1 in./hr	2 in./hr	3 in./hr	4 in./hr	5 in./hr	6 in./hr
2	23	2,176	1,088	725	544	435	363
3	67	6,440	3,220	2,147	1,610	1,288	1,073
4	144	13,840	6,920	4,613	3,460	2,768	2,307
5	261	25,120	12,560	8,373	6,280	5,024	4,187
6	424	40,800	20,400	13,600	10,200	8,160	6,800
8	913	88,000	44,000	29,333	22,000	17,600	14,667
Millimeters	**L/s****	**25 mm/hr**	**50 mm/hr**	**75 mm/hr**	**100 mm/hr**	**125 mm/hr**	**150 mm/hr**
50	1.5	202	101	67	51	40	34
80	4.2	600	300	200	150	120	100
100	9.1	1,286	643	429	321	257	214
125	16.5	2,334	1,117	778	583	467	389
150	26.8	3,790	1,895	1,263	948	758	632
200	57.6	8,175	4,088	2,725	2,044	1,635	1,363

Notes: 1. The sizing data for vertical conductors, leaders, and drains is based on the pipes flowing 7/24 full. 2. For rainfall rates not listed, determine the allowable roof area by dividing the area given in the 1 inch/hour (25 mm/hour) column by the desired rainfall rate. 3. Vertical piping may be round, square, or rectangular. A square pipe should be sized to enclose its equivalent round pipe. A rectangular pipe should have at least the same cross-sectional area as its equivalent round pipe, except that the ratio of its side dimensions should not exceed 3 to 1.
*Gallons per minute
**Liters per second

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downspout screens

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First Flush Diverters

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How much to flush?

How dirty does the roof get between rainfall events?

Is it downwind from a dust or other particulate source? Freeway? Farm field? Overhanging trees?

Generally: 1 – 4 gallons for each 100 square feet of roof space.

example: 1000 sq. ft. roof--10 to 40 first flush gallons

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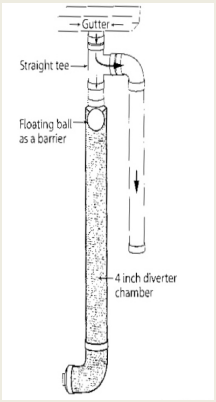
Pipe Capacity for First Flush Diversion

a one-foot length of Sch. 80

- 3” pipe* = .37 gallons
- 4” pipe* = .7 gallons
- 6” pipe = 1.5 gallons
- 8” pipe = 2.6 gallons
- 12” pipe = 6 gallons

(*kit from RainHarvest Systems)



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Downspout First Flush Diverter

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In-Ground First Flush Diverter

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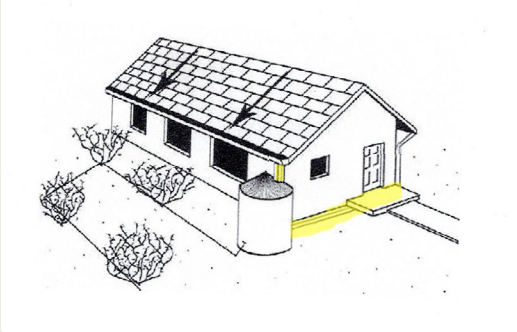
Conveyance Pipes



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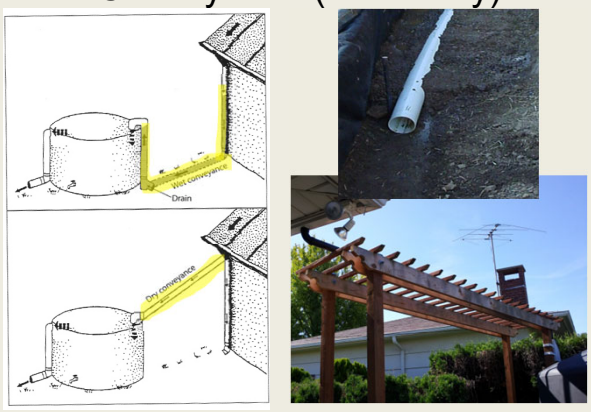
Conveyance (wet or dry)



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Conveyance Pipe Sizes/Slope

Pipe flow capacity must meet or exceed downspout capacity! **In the Rogue Valley** (1.3"/hour):

- 3" diameter pipe sloped 1/8"/foot drains 2,500 square feet
- 3" diameter pipe sloped ¼"/foot drains 3,500 square feet
- 3" diameter pipe sloped ½"/foot drains 5,000 square feet

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Table 13.3. Sizing of horizontal rainwater piping (Source: International Association of Plumbing and Mechanical Codes, 2000).

Size of pipe	Flow, gpm	Maximum allowable horizontal projected roof area (square feet) at various rainfall rates					
In.	⅛ in./ft slope	1 in./hr	2 in./hr	3 in./hr	4 in./hr	5 in./hr	6 in./hr
3	34	3,288	1,644	1,096	822	657	548
4	78	7,520	3,760	2,506	1,880	1,504	1,253
5	139	13,360	6,680	4,453	3,340	2,672	2,227
6	222	21,400	10,700	7,133	5,350	4,280	3,566
8	478	46,000	23,000	15,330	11,500	9,200	7,670
10	860	82,800	41,400	27,600	20,700	16,580	13,800
12	1,384	13,3200	66,600	44,400	33,300	26,650	22,200
15	2,473	238,000	119,000	79,333	59,500	47,600	39,650
In.	¼ in./ft slope	1 in./hr	2 in./hr	3 in./hr	4 in./hr	5 in./hr	6 in./hr
3	48	4,640	2,320	1,546	1,160	928	773
4	110	10,600	5,300	3,533	2,650	2,120	1,766
5	19	18,880	9,440	6,293	4,720	3,776	3,146
6	314	30,200	15,100	10,066	7,550	6,040	5,033
8	677	65,200	32,600	21,733	16,300	13,040	10,866
10	1,214	116,800	58,600	38,950	29,200	23,350	19,450
12	1,953	188,000	94,000	62,600	47,000	37,600	31,350
15	3,491	336,000	168,000	112,000	84,000	67,250	56,000
In.	½ in./ft slope	1 in./hr	2 in./hr	3 in./hr	4 in./hr	5 in./hr	6 in./hr
3	68	6,576	3,288	2,192	1,644	1,310	1,096
4	156	15,040	7,520	5,010	3,760	3,010	2,500
5	278	26,720	13,360	8,900	6,680	5,320	4,450
6	445	42,800	21,400	14,267	10,700	8,580	7,140
8	956	92,000	46,000	30,650	23,000	18,400	15,320
10	1,721	165,600	82,800	55,200	41,400	33,150	27,600
12	2,768	266,400	133,200	88,800	66,600	53,200	44,400
15	4,946	467,000	238,000	158,700	119,000	95,200	79,300

Notes:
1. The sizing data for horizontal piping is based on the pipes flowing full.
2. For rainfall rates other than those listed, determine the allowable roof area by dividing the area given in the 1 inch/hour

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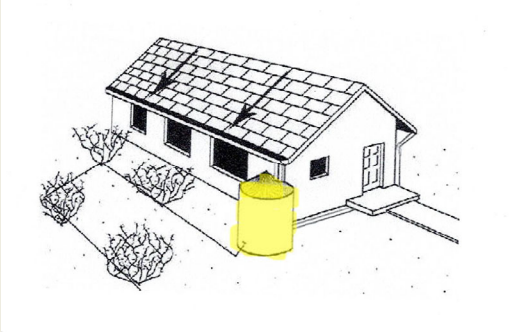
Tanks



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Tank Siting: Above Ground

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…Below Decks

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...Below Patios

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...Under Ground

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Ferro-Cement Tanks

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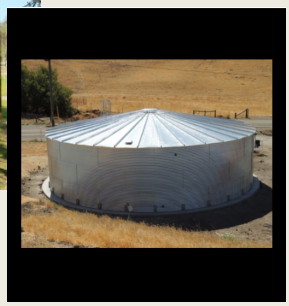
Steel
(with vinyl liner)



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Plastic Tanks
(polyethylene)

- vented access port
- Inlet (1 ½")
- outlet (2")
- overflow (?)
- color (dark)

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Weight and Placement

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Tank Pads

What does water weigh?

At 8.34 lbs./gallons…a full 2,500 gallon tank weighs nearly 11 tons! (21,700 lbs.)

Construct tank pads to bear the weight. Use native soil or well compacted gravel for smaller tanks; reinforced concrete for larger tanks.

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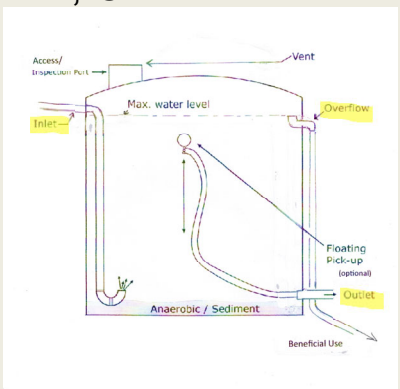
Inlets, Outlets, Overflow



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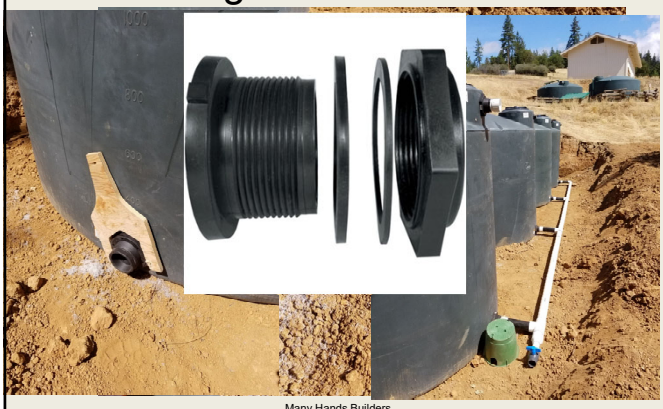
Working with Plastic Tanks



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Entering Tanks

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Connecting Tanks

Tank manifold includes:

- flexible connectors
- shut-off valves
- protect pipes from foot traffic and freezing—place box over each valve, cover area with soil or mulch

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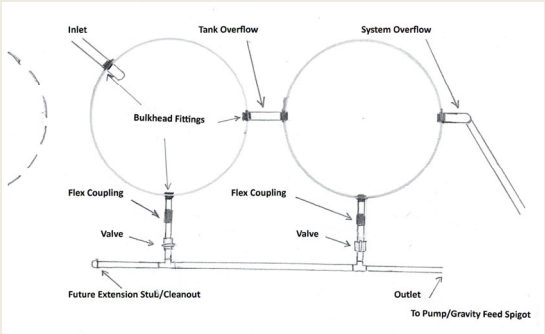
Tank Manifolds



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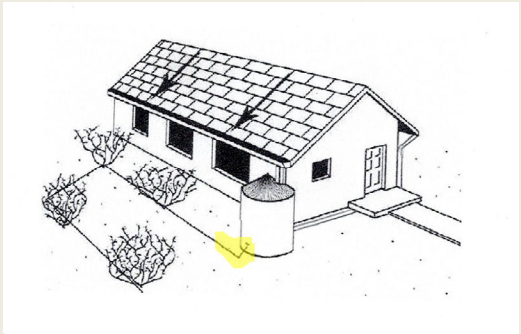
Outlets



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Outlet Options

- gravity feed (.43 PSI per 1' elevation)
- submerged pump inside the tank
- external shallow well pump with pressure tank, or variable speed constant pressure pump
- fire hose pump above tank or fire hose threaded outlet
- combination of above

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Gravity... .43 lbs./ft. elevation

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Submerged Pump in Tank

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External Pump and Pressure Tank

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Fire Hose Thread

NH or NST

1 ½”, 1”, ¾”

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Post-Tank Filtration

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Overflow (= inflow)

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Safety Issues

- Call the local DIG hotline before trenching to avoid severing phone or electric cables
- tanks are confined spaces—follow OSHA guidelines
- lock tank access doors and lids against unauthorized entry (children)
- paint a purple stripe on all buried pipes, write “rainwater – not potable” every 2’, or wrap with purple tape
- label faucets “non-potable”

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Labels

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System Maintenance

- clean and maintain roof and gutters
- clean and maintain filters
- check first flush
- monitor water level
- check for leaks

and if for potable use…

- maintain sanitation regime
- test water annually

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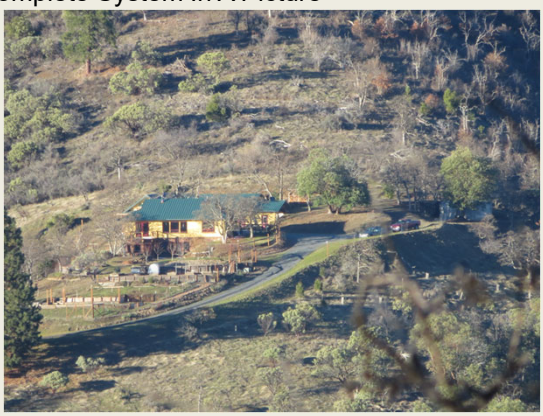
Complete System In A Picture



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Thank You!

Questions?

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