

RAINWATER

compared to

TAP WATER

for

URBAN-FRIENDLY  
AGRICULTURE

prepared by,  
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WaterShed Designs LLC

## WHAT IS SUSTAINABILITY?

I grew up with the threat of atomic annihilation and the promise of energy too cheap to meter. I watched The Dalles dam drown Celilo Falls on the mighty Columbia River, generating power to smelt aluminum and bringing irrigation to the cherry orchards in the hills above town.

For centuries, sustainability meant steady economic expansion achieved by harnessing the natural world to serve our own purposes. America excels at this, and we could promise our children a better quality of life, generation after generation. Now, with decades of unintended consequences under our belts, that promise is no longer guaranteed.

The fact that we are exhausting our natural resources is not news. That's been forecast for fifty years, back when there were only 3.4 billion of us on the planet. Now there are twice as many people, but we still haven't changed our behaviors.

**“We have met the enemy, and he is us!”** *Walt Kelly, Earth Day 1970.*

**“Sustainability**—social and environmental practices that protect and enhance the human and natural resources needed by future generations to enjoy a quality of life equal to or greater than our own.” *U. S. Environmental Protection Agency.*

As long as Americans can still afford to go to the grocery store, we don't think about it much. We flip a switch and the lights come on. We turn on the tap and the water flows. We are concerned, of course. Planting tomatoes and beans in the back yard seemed like a good idea, until we got the water bill.

We do know that the world our children and grandchildren will inherit depends on the choices we make today. We are growing food again, remembering back to the victory gardens of WWII. Gardens are taking root in back yards and common spaces in cities and towns across the country. Just add tap water.

“As a greater proportion of economic activity is concentrated in urban areas, competition for scarce natural resources increases, and the development of new resources of water will be needed. Alternative water resources for use in the city include rainwater and waste water.” *Resource Centers on Urban Agriculture and Food Security.* ([www.ruaf.org](http://www.ruaf.org))

“Urban agriculture improves food security and economic stability, especially for lower income households. Urban gardens contribute to sustainable, healthy, low-maintenance communities. Worldwide, urban farming already provides food for 700 million people, and direct earnings for at least 100 million folks.” *UN Food and Agriculture Organization.*([www.fao.org](http://www.fao.org))

In light of the situation, the WaterShed team took a fresh look at harvesting rainfall. The result is a wealth of knowledge and the freestanding rainwater harvester. The WaterShed employs simple technology to harvest, store and distribute substantial quantities of high-quality water to support urban-friendly agriculture.

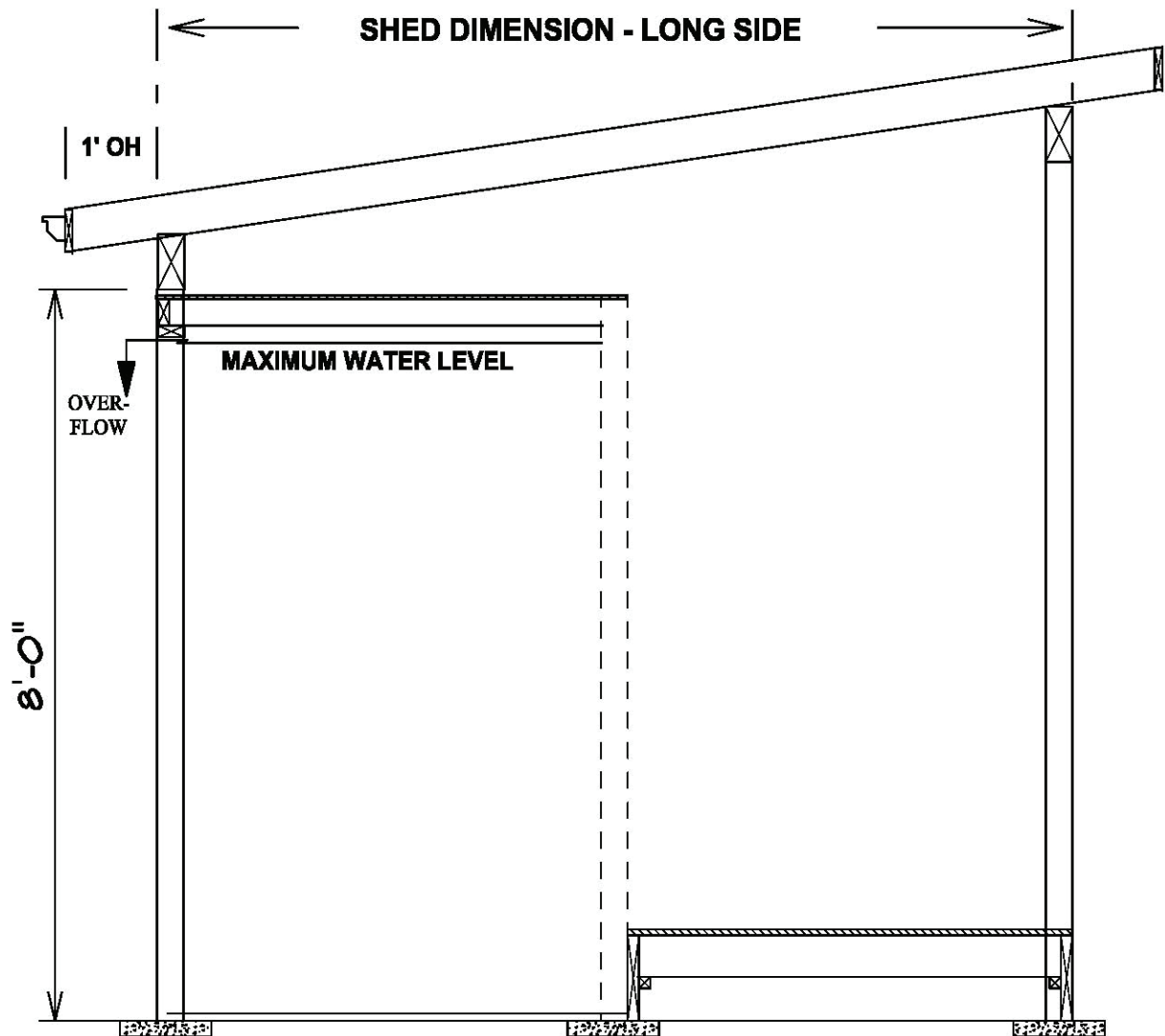
We simply can't take the municipal water supply for granted any more. Creating urban-friendly gardens that depend entirely on tap water will inevitably result in unintended and unwelcome consequences down the road.

Please follow along as we take a look at an example of a sustainable community garden irrigated entirely with harvested rainwater. Of course, The WaterShed is also perfect for the backyard garden.

## WHAT IS A WATERSHED?

*The WaterShed is a freestanding structure that harvests, stores and distributes significant quantities of high-quality water to irrigate urban-friendly gardens.*

**Freestanding Rainwater Harvesters** come in four sizes from 6' x 8' to 12' x 16', and harvest from 1,000 to 7,000 gallons of rainwater. WaterSheds do not require building permits (in Oregon), as long as the local zoning and set-back requirements are met. WaterShed products are built to code (ORSC) and built to last, and will perform for many years with very little maintenance.

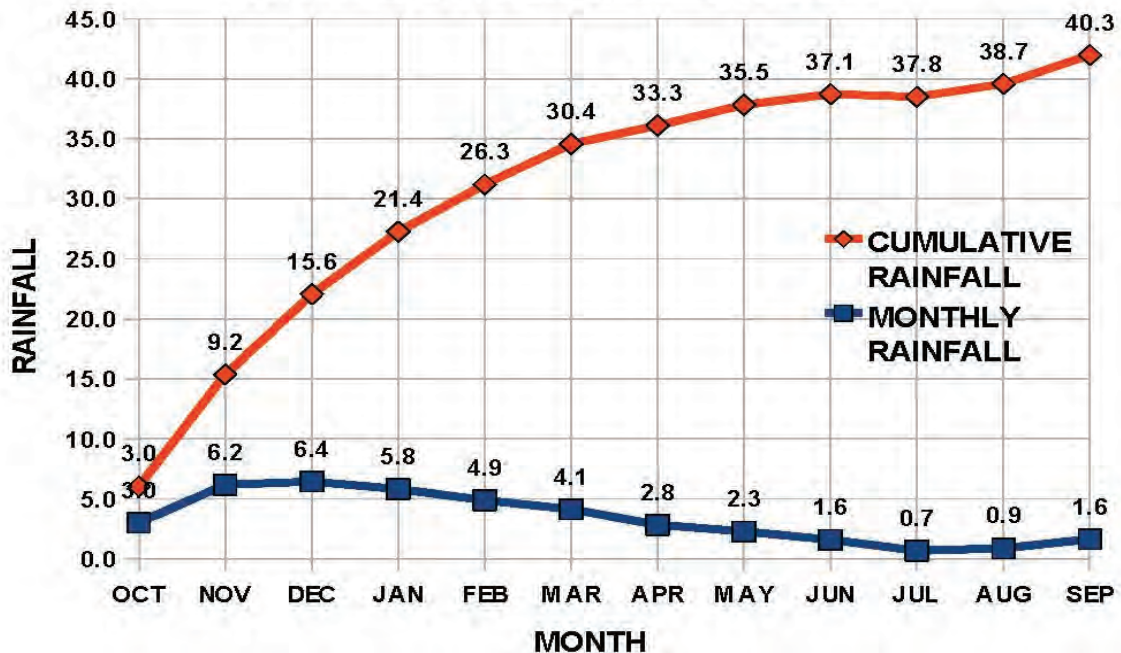


**MODEL WS A-SERIES  
CROSS SECTION WITH SHED ROOF**

**WaterShed**<sup>®</sup>  
*The Original*  
**Freestanding Rainwater Harvester**<sup>®</sup>  
WaterShed Designs LLC [watersheddesigns.com](http://watersheddesigns.com)

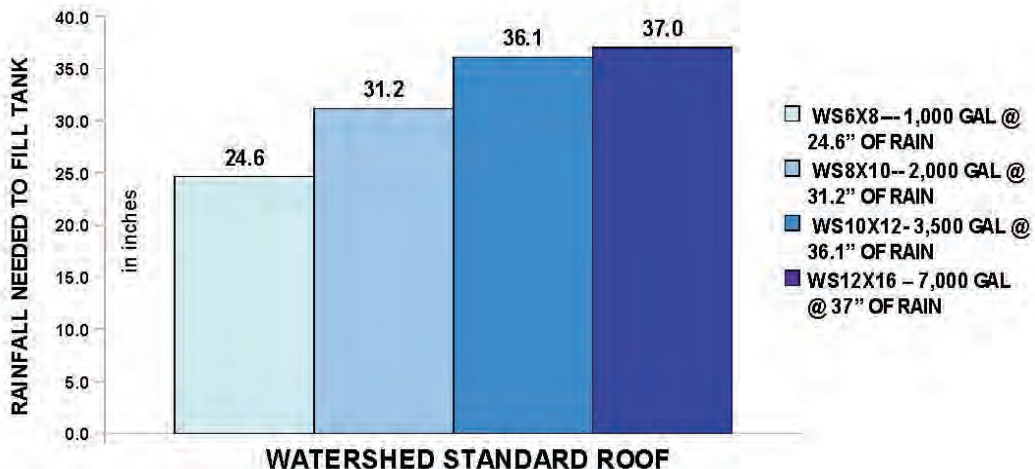
# HARVESTING RAINFALL IN THE NORTHWEST

## NORTHERN WILLAMETTE VALLEY



On the chart above, the lower line shows the average monthly rainfall for the Northern Willamette Valley (Hillsboro, Oregon City, Portland and Salem); wet in the winter and dry during the summer months. The upper line shows the accumulation of rainwater beginning in October.

The chart below shows the amount of rainfall necessary to fill the tank to capacity for each of the four WaterShed models. The rain from October through April is enough to fill the tank for each of the models.



Here in the Northwest, rainfall in June, July and August totals just over 3 inches. That's only  $\frac{1}{4}$  inch per week, average. Edible gardens need an inch per week to produce a healthy crop. Irrigation is mandatory to grow food here.

Summer rain comes in a few heavy showers, and the WaterShed catches every drop. The summer recharge collects an additional 170 to 780 gallons, depending on the model.

# RAINWATER compared to TAP WATER: A CASE STUDY



## **From the website of Portland City Commissioner Nick Fish:**

*“People in Portland want to grow their own food. We live in a region abundant with fertile soil and gardening opportunities. Together, we can make it easy for anyone, regardless of age, income, or neighborhood, to grow fresh healthy food. The Climate Action Plan calls for 1,000 new garden plots by 2012.”*

The 1,000 Gardens Initiative and the newly released Multnomah Food Action Plan both promote the expansion of urban-friendly gardening opportunities.

West of the Cascades, we have wet winters and dry summers. Growing fresh, healthy food can't be done without irrigation. Still, 1,000 Gardens, the Multnomah Food Action Plan and most folks here in the Northwest take our tap water for granted.

***Each pound of food grown required 8 gallons, or 60 pounds, of fresh water!***

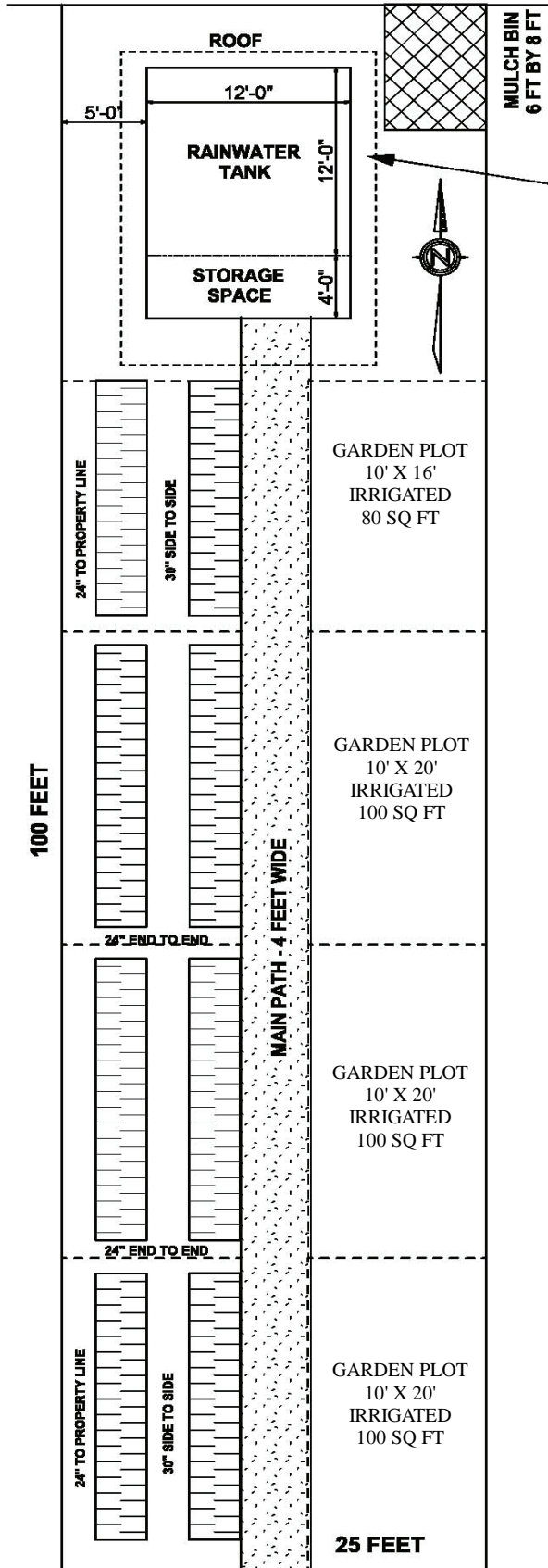
This comparison considers the following questions.

- **Can enough rainwater be harvested to support a community garden?**
- **How does harvested rainwater compare to tap water in terms of installation costs, operating costs and water quality?**

For the sake of comparison, we have designed a new community garden on a 25 foot by 100 foot urban infill lot. In our example garden, the garden plots average 10 feet by 19 feet. Half of this area, about 95 square feet, is actually irrigated. Our example garden has eight garden plots.

USING OUR EXAMPLE GARDEN,  
LET'S TAKE A FRESH LOOK AT SUSTAINABLE IRRIGATION

# THE EXAMPLE GARDEN



**GREEN STREET**

## The WaterShed

Model WS12X16-A

CAPACITY

7,000 GAL (@ 37" OF RAIN

SUMMER RECHARGE

(JUN, JUL & AUG)

780 GAL @ 3.1" OF RAIN

TOTAL WATER AVAILABLE  
FOR IRRIGATION

7,780 GALLONS

SECURE STORAGE SPACE

~ 48 SF

## THE EXAMPLE GARDEN

25 FT by 100 FT

8 GARDEN PLOTS

2 @ 10' X 16'

6 @ 10' X 20'

AREA OF GARDEN PLOTS

1,520 SQ FT

61% OF THE SITE

IRRIGATED AREA

760 SQ FT

30.5% OF THE SITE

IRRIGATION REQUIRED:

8 GAL / SQ FT

6,080 GALLONS

(78% OF THE WATERSHED  
STORAGE CAPACITY)

COMMON AREA

980 SQ FT

39% OF THE SITE

## RAINWATER compared to TAP WATER OPERATING COSTS

In our Example Garden, the rainwater harvested (7,780 GAL) is sufficient to supply the garden's irrigation needs (6,080 GAL), with 1,700 gallons to spare. That's not much extra. With a limited supply, urban gardeners need to be conscientious and frugal in irrigating crops. This means changing our behaviors.

For most domestic gardeners, watering means hooking the nozzle to the hose and letting the water fly. It's the least efficient way to irrigate, but watering the garden is not just about giving the plants enough water. It is also about the satisfaction that comes from the act of watering itself. Meeting this need often consumes more water than the plants actually use.

Using harvested rainwater to support urban-friendly farming requires that we learn new, more efficient ways of irrigating our urban gardens. Many new options for efficiently delivering precise amounts of water are coming to market.

Providing unrestricted and unlimited municipal tap water to irrigate a new community garden condones the wasteful behaviors described above. Enabling ingrained habits to continue misses an opportunity for community gardeners to learn and practice the thoughtful use of our fresh water resources.

<b>THE EXAMPLE GARDEN – EIGHT NEW GARDEN PLOTS</b>			
TOTAL IRRIGATED GARDEN AREA	760	SQUARE FEET OF RAISED BED GARDENS	
IRRIGATED AREA PER EACH PLOT	95	SQUARE FEET OF RAISED BED GARDENS	
WATER NEEDED ANNUALLY	6,080	GALLONS FOR IRRIGATION	
WATER NEEDED ANNUALLY PER PLOT	760	GALLONS FOR IRRIGATION	
ANNUAL YIELD PER GARDEN PLOT	114	POUNDS OF FRESH VEGETABLES	
<b>ANNUAL COST OF WATER</b>			
MUNICIPAL WATER SUPPLY	\$200	PAID WITH FEES OR WAIVED	
WATERSHED	\$0		
<b>500 NEW GARDEN PLOTS (ABOUT 62 NEW EXAMPLE GARDENS)</b>			
TOTAL IRRIGATED GARDEN AREA	47,500	SQUARE FEET OF RAISED BED GARDENS	
WATER NEEDED ANNUALLY	380,000	GALLONS FOR IRRIGATION	
ANNUAL YIELD	7,125	POUNDS OF FRESH VEGETABLES	
<b>ANNUAL COST OF WATER</b>			
MUNICIPAL WATER SUPPLY	\$12,500	PAID WITH FEES OR WAIVED	
WATERSHED	\$0		
<b>1,000 NEW GARDEN PLOTS (ABOUT 125 NEW EXAMPLE GARDENS)</b>			
TOTAL IRRIGATED GARDEN AREA	95,000	SQUARE FEET OF RAISED BED GARDENS	
WATER NEEDED ANNUALLY	760,000	GALLONS FOR IRRIGATION	
ANNUAL YIELD	14,250	POUNDS OF FRESH VEGETABLES	
<b>ANNUAL COST OF WATER</b>			
MUNICIPAL WATER SUPPLY	\$25,000	PAID WITH FEES OR WAIVED	
WATERSHED	\$0		

**1,000 new garden plots** will consume a minimum of **760,000 gallons** of water annually. The charge for this tap water is estimated at \$25,000 yearly, which must be paid with garden fees or subsidized by the City.

The WaterShed freestanding rainwater harvester harvests, stores and delivers substantial quantities of high-quality rainwater to support urban-friendly agriculture year after year.

**The WaterShed water is free, and it costs nothing to operate!**

# RAINWATER compared to TAP WATER

## INSTALLATION COSTS

Our example garden is on a street that already has a water main, but no water meter to the site. Installation of City Water is based on information from the Portland Water Bureau and construction estimates. WaterShed costs are based on the current price list.

The expenses listed are only part of the cost. The Community Garden Toolkit estimates the cost of a new community garden as high as \$50,000.



The WaterShed at Juneberry Lane.  
The 1,770 gallon capacity serves twelve raised bed gardens.

The Juneberry Lane project offers affordable home ownership in Oregon City through Clackamas Community Land Trust

<b>THE EXAMPLE GARDEN – EIGHT NEW GARDEN PLOTS</b>		
INSTALL CITY WATER METER		<b>\$4,290</b>
INSTALL WATER LINE & FREEZE-PROTECTED HOSE BIBS		<b>\$2,500</b>
BUILD GARDEN STORAGE SHED ON SITE		<b>\$2,500</b>
SDC CHARGES		<b>\$2,565</b>
TOTAL COST TO ACCESS CITY WATER		<b>\$11,855</b>
COST PER NEW GARDEN PLOT		<b>\$1,482</b>
ANNUAL WATER EXPENSES		<b>\$200</b>
<b>WS12X16A WATERSHED</b>		
CAPACITY 7,000 GALLON @ 37" OF RAINFALL		
STORAGE SPACE – FLOOR AREA – 48 SQUARE FEET		
SOLAR POWERED DISTRIBUTION SYSTEM		
TOTAL COST TO HARVEST, STORE & DISTRIBUTE RAINWATER		<b>\$9,500</b>
COST PER NEW GARDEN PLOT		<b>\$1,188</b>
ANNUAL WATER EXPENSES		<b>\$0</b>
<b>500 NEW GARDEN PLOTS (ABOUT 62 NEW EXAMPLE GARDENS)</b>		
<b>CITY WATER</b>		
TOTAL COST TO ACCESS CITY WATER		<b>\$740,938</b>
ANNUAL WATER EXPENSES		<b>\$12,500</b>
<b>THE WATERSHED</b>		
TOTAL COST FOR 62 WS12X16A WATERSHEDS		<b>\$593,750</b>
ANNUAL WATER EXPENSES		<b>\$0</b>
<b>1,000 NEW GARDEN PLOTS (ABOUT 125 NEW EXAMPLE GARDENS)</b>		
<b>CITY WATER</b>		
TOTAL COST TO ACCESS CITY WATER		<b>\$1,481,875</b>
ANNUAL WATER EXPENSES		<b>\$25,000</b>
<b>THE WATERSHED</b>		
TOTAL COST FOR 125 WS12X16-A WATERSHEDS		<b>\$1,187,500</b>
ANNUAL WATER EXPENSES		<b>\$0</b>

# RAINWATER compared to TAP WATER

## WATER QUALITY

Most gardeners notice that their gardens look especially good after a rain, even if they have been routinely irrigating with tap water. Rainwater is good for plants in a variety of ways, including a relatively low pH level.

**Rainwater is mildly acidic, with a pH of 5.5 to 6.0.** This lower pH makes it easier for plants to absorb nutrients from the soil and encourages the activity of beneficial microorganisms in the soil.

The Portland Water Bureau adds sodium hydroxide to increase the pH of the water to reduce corrosion of plumbing systems. Most municipal water systems do this. **The pH of Portland's tap water is between pH 7.2 and pH 8.2.**

### THESE VEGETABLES GROW BEST FROM pH 5.5 TO pH 6.5

Asparagus, beans, beets, bok choy, broccoli, Brussel sprouts, carrot, collard greens, corn, garlic, grape, lettuce, lima bean, mustard, okra, onion, parsley, pea, peppers, pumpkin, radish, rhubarb, rutabaga, soybean, spinach, squash, sunflower, Swiss chard, tomato, turnip.

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Portland's **tap water** is disinfected using chlorine. Next, ammonia is added to form chloramines which ensure that disinfection remains adequate throughout the distribution system. Rainwater is free of these additives, which are typically found in municipal tap water.



Installation of municipal water & annual operating costs  
for a community garden are hard costs.

The WaterShed costs less to install, harvests the rain,  
& provides high-quality water for irrigating edible gardens.

## How does The WaterShed work?

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**The WaterShed** does not require building permits (in Oregon), as long as the local zoning and set-back requirements are met. The WaterShed has only one moving part, the water pump. WaterSheds are built to Code (ORSC) and built to last, and can perform for many years with very little maintenance.

The WaterShed comes in four standard sizes from 6' X 8' up to 12' X 16'. Harvesting capacities range from 1,000 to more than 7,000 gallons. (Shown: WS8X10-A, with selected options, at the Juneberry Lane Community Garden in Oregon City.)

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### THE COLLECTOR

The galvanized steel roofing provides a neutral surface for water collection. There are no chemicals or contaminants present in the roofing materials that can leach out into the rainwater.

Water collected in the gutter passes through a galvanized metal screen installed over the top of the gutter. The screen filters out larger debris like leaves and twigs.



### THE FILTER

The harvested rainwater is intended for growing food crops, so we want the water to be as clean as possible. A first flush filter limits contaminants by flushing the first water that comes off the roof down into a drop pipe. This discarded water slowly drains out of the drop pipe, along with any contaminants rinsed off by the first rainfall. The harvested rainwater is exposed to copper, which is a natural algacide, as it fills the tank. The water is never exposed to sunlight.

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### THE STORAGE TANK

The structure of the WaterShed forms the storage tank. Both the WaterShed and the integrated tank are designed for long-lasting and continuous performance over decades. The tank itself is a rugged combination of wood and steel with a durable aquatic-grade lining installed inside the tank. The floor of the tank, and the weight of the water, rests on the ground.



### THE DISTRIBUTION SYSTEM

100% of the power for the WaterShed comes from the solar panel. The electricity generated charges the battery, and the stored electricity powers the pump. When the faucet valve is open, the pump automatically delivers water. The electrical system also powers an interior 12V DC light. The light is a typical RV overhead double fixture that uses standard auto bulbs. Longer-lasting LED light fixtures are optional, as are exterior photovoltaic lights.

# WaterShed Designs LLC

## Rainwater Harvesting Consulting Services

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**Everybody is talking about harvesting rainwater. Folks are putting rain barrels under their down spouts, only to find that 50 gallons doesn't go far when summer comes around and the rain stops falling.**

- How much water is needed for irrigation?
- How much water can be collected?
- Is the water from the roof safe for the garden?
- Where does it get stored, and how?
- How does the water get where it needs to go?
- How much is all of this going to cost?

### **Let us help you figure it out!**

- Irrigation Needs Assessments
- Rainwater Harvesting Analysis
- Water Quality Evaluations
- Rainwater Storage Solutions
- Water Distribution Systems
- Applied Irrigation Design

### **for Commercial, Residential & Community-based Projects**

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**David Bonn** is the managing member of WaterShed Designs LLC. He is also the principal of Bonn Design, and is the architect of many infill and affordable housing projects in the Portland Area, including Juneberry Lane. ([www.bonndesign.com](http://www.bonndesign.com))

David is a LEED AP in Building Design & Construction. Both David & Josh are certified Earth Advantage Sustainable Homes Professionals.

WaterShed Designs LLC is based in Portland and provides design and consulting services on rainwater harvesting, storage and distribution solutions. Give us a call!

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### **The WaterShed**



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