Rainwater Harvesting Requirements —Living Well Community
October 2016/Harvey Harman

Four main reasons Rainwater Harvesting is part of Sustainable Development and Green Building:

1. Resource conservation of an important element (water):
   Rainwater Harvesting captures and makes use of an essential natural resource at its initial point of contact with the earth and saves energy because the water used does not need to be pumped from a distance or go through energy intensive treatment. Also rainwater often has fewer issues with pollution, other byproducts, or unwanted trace materials that can be present in other water sources.
2. Minimizes storm water impacts:
   Catching and storing rainwater, slows down how much water from rain events gets concentrated and flows across landscapes thus reducing erosion, flooding, and other negative environmental impacts of heavy rain events. It also helps to mitigate the impacts of impervious surfaces like houses, roads, and human development.
3. Rainwater is almost always of better water quality than surface runoff water:
   Rainwater usually has few if any pollutants, and is usually a very soft water without hard minerals or chemicals requiring less soap for washing, and is nourishing for plants, especially young plants that are sensitive.
   The pH of rainwater is often slightly acidic, but rainwater that is stored is usually less acidic because of reaction with the roof and if stored in concrete, the lime in cement further neutralizes the water. **(Note: Some areas of the U.S. have rainwater that is more acidic and in those areas more attention needs to be paid to making the water less acidic before using it for certain purposes)**
4. Leads to Resilience and local self reliance:
   Water is an essential element for daily living and life itself. If other water sources become unavailable or compromised in some way because of a natural disaster, human caused destruction, drought, power outage, water main break, etc. then rainwater harvesting provides an important way that a household and a community can continue to have access to water for daily needs as well as for health and safety.

What are the Rainwater Harvesting Requirements for Living Well Community?:

While Rainwater Harvesting and methods for slowing down and cleaning up water flowing across the landscape are varied, the specific requirement from the Green Building Requirements from the "Declaration of Covenants, Conditions, and Restrictions for Living Well Community", are the following:

> *Final site plan should address permanent ways to slow down, filter, hold, and minimize negative stormwater effects. Specifically, each building should*

incorporate an above ground or below ground cistern with a capacity of at least 1000 gallons per 2000 square foot of roof space. This cistern should have a system for using the water within the house or outside the house so the cistern always has capacity for the next storm event.

How to figure out square footage of roof space:
You can figure out your square footage of roof space in at least two different ways:

1) Take the square footage of space under roof (include heated space, porches, etc.) and add to that the extra space for overhangs of the roof to get your total square footage of roof space. Please note that for square footage of space you are looking at the roof as if it were flat to get the square footage that rain is falling on.

2) A second way is to measure the distance of each side of the house plus the roof overhangs and then figure out square footage through normal geometric area calculations.

As an example if you have a house that is 20 ' x 20' in width and length, but the roof overhangs 2' all the way around then the actual roof area is 24' x 24' (two extra feet on each side, or four extra feet in both the width and length of the building. For a square or rectangle then the Area = Width x Length. In this case the roof catchment area for this building is 24' x 24' = 576 square feet. Using our ratio of *1000 gallons per 2000 square foot of roof space* and solving for "x" we use the equation " x " / 576 square feet = 1000gallons / 2000 square feet to get our answer for this house of "x" = 288 gallons.

If this house was the same dimensions but two stories high the calculation would be the same because the roof area is the same, even though the square footage of the house is twice as large.

How Big is a Water Tank, or how much space does one gallon of water take up and how much does it weigh?
People are often surprised by how much space is needed to store a lot of rainwater and also surprised at how much water itself weighs.

--One gallon of fresh water weighs approximately 8.344 lbs. That means 100 gallons of water weighs 834 lbs and 1000 gallons of water weighs 8,344 lbs.

--7.48 gallons can fit in 1 cubic foot of storage area. So one would need 100 cubic feet (10 feet x 10 feet x 1 foot, or 5 feet x 5 feet x 4 feet) to store 748 gallons of water.

How do I calculate how much water actually falls on my roof, and how much water I could catch in any given month?

A simple calculation is to assume that for each 1 inch rain event you can capture something like 550 gallons of water per 1000 square foot of roof area.

Please note that if you only are directing rainwater from one side of your house into a rain catchment system than you just use that amount of roof area to calculate how much rain you can capture.

Average monthly rainfalls for Piedmont North Carolina vary from a low of 3.43 inches per month in November to over 4 inches of rain per month for July and August. That said, rainfall is highly variable year to year, and we can have a drought month any month of the year. A drought month is one that produces less than 1 inch of rainfall per month. We also can have extreme rain events producing 5 inches or more in one rain event or in several rain events near each other. Also rain in the winter and spring often is in longer, slower rain events, where rainfall in the summer and sometimes in the fall tends to be in shorter, more intense rain events (such as thunderstorms or hurricanes).

Average yearly rainfall for Asheboro, NC is 45.04 inches. We are fortunate in that the rainfall is fairly evenly spread over the whole year, being 3.5 to 4.2 inches each month of the year.

Where is the best location for my cistern or water catchment system?

Two main items go into choosing where to place your water catchment storage tank:
1) Choose a place that can be reached by the gutters from the house (downslope of the gutters) that is in a location that works best for this use. Because tanks take space they need to be located in a place where such space is available. Sometimes aesthetics dictate the best location, or space that is not needed for a higher priority use motivates the choice of location.
2) Choose an acceptable place that is located as highly elevated on your site as possible. All things being equal, the higher in the system you can locate the storage system, the more places the water can reach using gravity.

Is it better to have above ground storage or below ground storage?

Both above ground and below ground storage systems are good choices, each having pros and cons.

Above ground usually costs less, can feed some areas by gravity without the need for a pump, is easy to access and maintain, and is easy to gauge how full the tank is at any

given time. The negatives are that it takes up room, may be a visual impairment in certain locations, and can have algae growth if water is exposed to sunlight over time.

Below ground is more hidden and usually takes less space. Sunlight does not have access to the water, so usually there is no algae growth. Some tanks need extra reinforcement for underground use. Also, most underground systems require pumping in order for someone to make use of the water. Also maintenance of underground tanks often requires more effort because tanks and piping are buried and harder to access.

Generally freezing in the winter is seldom an issue in above ground tanks in our climate except in very small tanks, and is not an issue at all in underground tanks. Small diameter piping connected to above ground tanks may freeze and needs special protection if those pipes have water in them at all times.

Does it matter what kind of roof I have?

Most roofs can be used to capture rainwater. Metal roofs usually work best. Tile roofs work well. Shingle roofs also work, but there may be a need to filter stone granules that get released off the roof over time, and some shingles also leach other items into the rainwater in small amounts. This usually is not an issue for using rainwater for irrigation or washing, but can be a bigger issue if the water is wanted for a use that requires a higher level of purity. Flat roofs generally do not work well for rainwater harvesting.

Do I need to pump my Rainwater in order to be able to use it?

Rainwater, and water in general, will flow from a higher point to a lower point, but it will not flow at much pressure (with much force) unless the difference between the two elevations is significant.

What is important for water pressure calculations is the height of the water not the quantity of water. One foot of water height creates 0.434 pounds per square inch (psi) of pressure. It takes 2.31 feet of water height to create 1 psi of pressure.

Most houses with indoor plumbing, for example, have water lines pressurized to at least 30 psi. To run micro- sprinklers in a garden usually requires something like 8 psi. Unless elevations are significant, some uses of rainwater will require a small pump or other device to increase the available pressure to the level needed for that use.

Can I drink my Rainwater?

In many parts of the world, rainwater is the cleanest water available and is used extensively for drinking. In the United States if we plan on using rainwater for drinking we should do the following items:

1) Make sure we store the rainwater in a container that does not leach contaminants or allow contaminants a point of entry.
2) Filter or treat the water before drinking to an approved drinking water standard.

How can I meet the requirement to "have a system for using the water within the house or outside the house so the cistern always has capacity for the next storm event?"

If the goal was simply to store water, a system (or plan) for regularly using the water so that there is some capacity for the next rain event would not be so critical. Because the goal at Living Well Community is also to minimize impacts of development and manage stormwater well, being able to capture some rainwater with each new rain event is important. To do so we need a way that stored rainwater is used regularly allowing available storage capacity for the next rain event.

One could make this possible in many different ways. A person could make a commitment to physically make use of the rainwater throughout the year through irrigation, washing, or slow discharge over time after a rain event. Or another system would be to put a small weep hole about a third of the way from the top of the tank (often with a small discharge pipe that takes the water a short distance away from the house) so that after a rain event the tank will slowly discharge up to 1/3 of the tank capacity slowly back into the ground over time and thus free up capacity for the next rain event. Another option would be to connect the tank to a source that regularly uses water, such as to a flush toilet, so that water is used regularly from the tank creating capacity to capture storm water from the next rain event.