

SYNTHESIS

Solar Panels + Rainwater Harvesting Takeaways:

Solar energy is a renewable source of power helping to reduce greenhouse gas emissions and mitigating climate change, which is critical to protecting humans, wildlife, and ecosystems. Solar energy also improves air quality and reduces water use from energy production.

Rainwater harvesting is the most traditional and sustainable method for saving water. It can be easily used for potable and nonpotable purposes both in residential and commercial buildings. This can reduce the pressure on processed supply water which enhances green living.

Through implementing rainwater harvesting and solar energy in the renovation of Centro Hispano, our goal is to create a more sustainable and economical environment. Using energy from the sun to power the building and harvesting rainwater for plumbing and other uses encourages sustainable living throughout Knoxville's community.

Harvesting rainwater and solar panel energy also allows for the implementation of a green roof. Green roofs act as insulation for buildings, reducing the energy needed for heating and cooling, which reduces cost. During the dry season, the harvested rainwater can irrigate the plants on the roof. Green roofs are also easy to be maintained and solar panels can still be installed. Solar panels can increase the diversity of a green roof by creating shade underneath the panels and water runoff at the bottom of the panels. This allows different types of plants to flourish that would not grow without the solar panels.



SUSTAINABILITY HARVESTING RAINWATER + SOLAR PANELS

SITE PLAN

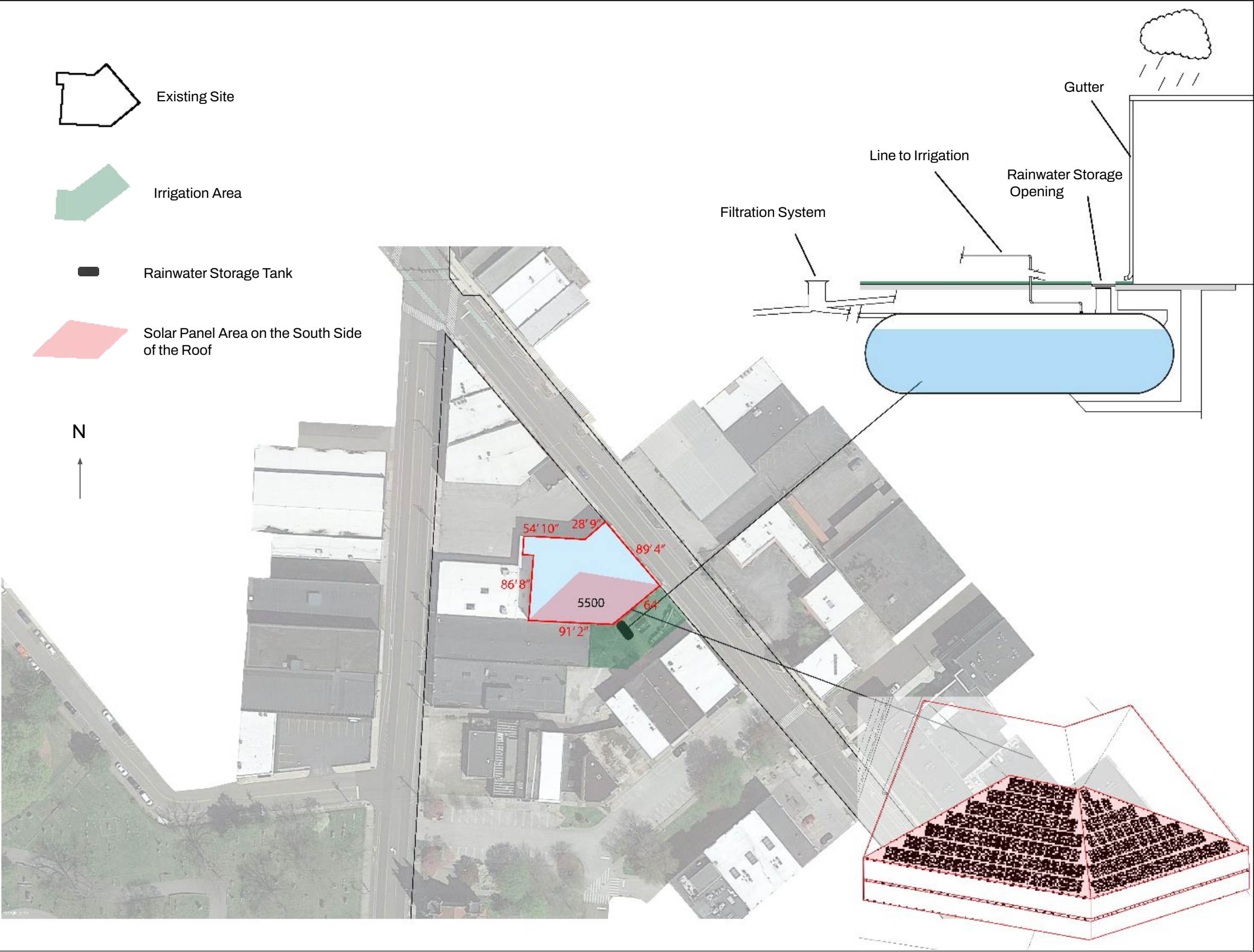
How does this exactly work ?

Harvesting Rainwater

The rainwater will be collected from the roof with the gutter system that will collect the water and transfer it down through the drain pipes into the underground water storage tank. The storage tank will filter the water so the potable water can be used inside the building, leaving the non-potable water for irrigation. The leftover contaminated water will be sent to the city to be filtered. When the potable water is low during dry season, we will pull from the city's water system to supply water until more rainwater becomes available.

Solar Energy

1. Photovoltaic cells absorb the sun's energy and convert it to direct current electricity
2. Solar inverters convert DC electricity from your solar modules to alternating current electricity, which is used by most appliances
3. Electricity flows through the building, powering electronic devices
4. Excess electricity produced by solar panels is fed to the electric grid



SUSTAINABILITY HARVESTING RAINWATER + SOLAR PANELS

INFORMATION

Harvesting Rainwater

Pros:

- Rainwater has the same pH level needed for plants to grow to their best
- Less water going to waste for bathing, cleaning, and laundry
- Rainwater does NOT contain harmful substances
- Rainwater is also considered a soft water, so less detergent is needed when cleaning
- Water bills will significantly decrease

Cons:

- Rain cannot be predicted and consistent
- The installation process can be expensive
- Upkeep and inspections of the gutters and the water tank will be necessary to ensure the quality of the water

Solar Panel Power

Pros:


- Will receive an excellent financial return on your investment
- Can use solar panels for business tax credits
- It's an affordable, reliable, dependable, and efficient energy option and electrical system
- Monthly power bills will drop after converting to solar power and it cuts overhead business costs, which will increase long-term savings
- It has future longevity
- It creates energy independence
- It's a renewable energy source that reduces carbon emissions
- It has low maintenance costs
- It can generate electricity in any climate
- It benefits the community and environment
- Technology is improving and prices are dropping

Cons:

- Initial costs of buying and installing
- Temporary decline in energy production during bad weather
 - Days with low solar energy, however, are having less of an effect due to advances in technology
- Environmental impact of manufacturing
- Difficulty with relocation
- Disposal and recycling options may be limited

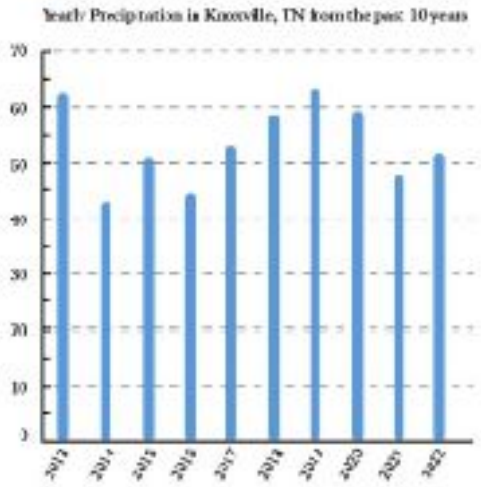
HARVESTING RAINWATER


RISK FACTORS TO CONSIDER



53.4 In

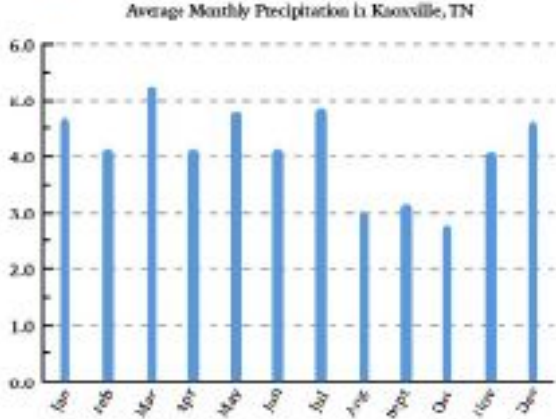
Average Annual Rainfall






45.4 In

Average Monthly Rainfall




How much rain does Knoxville receive each year?
Knoxville receives around 127 days per year of precipitation including rain, snow, sleet, and hail.




Pollution of the Water

Calculating your rainfall levels and choosing the size of your water tank is very important to ensure no water sits for too long in the tank. If the water sits for longer than a week, there is the possibility for the water to become contaminated (unless filtration system is applied).




Cost of the Filtration

Using a filtration system in order for the water to be drinkable can become expensive, especially depending on the size of the water tank



Maintenance of the Roof

Upkeep of the gutters is important when it comes to keeping the water clean from debris and contaminations.

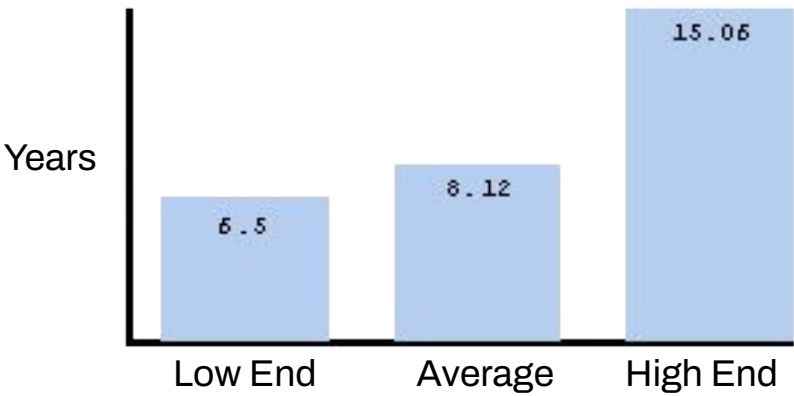


Materiality of the Roof

Choosing a roof that contains low concentrations of chemicals and a sleek surface is ideal for harvesting rainwater. Some of the best options include enameled roofing, tile, solar paneling, and slate.

SWITCHING TO SOLAR FACTORS TO CONSIDER

Solar Payback

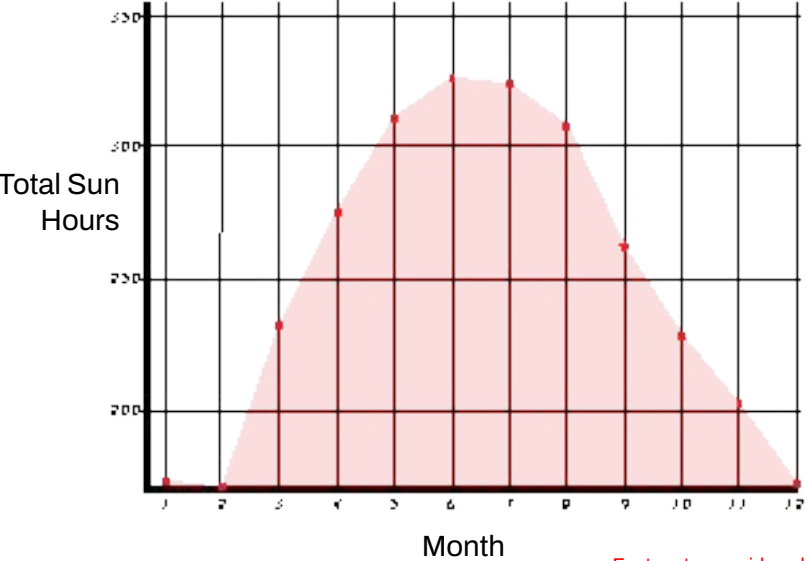


Years

Low End Average High End

How long will it take until I can payback my costs from switching to solar panels?
The payback period for solar panels is the amount of time it takes for the energy savings to exceed the cost of going solar. A typical payback period for going solar is 7-10 years.

Total Sun Hours Per Month In Knoxville



Total Sun Hours

Month

How much sun does Knoxville receive each year?
On average, there are 204 sunny days per year in Knoxville.

Do solar panels need to be maintained?
The only thing they need is an annual inspection and periodic cleaning of debris.

Does the material of the roof matter when installing solar panels?
The roof type that is most compatible with solar panels is a standing metal roof and asphalt shingles. Roofing materials that are not ideal for solar include wood and slate roofs.

Factors to consider when choosing solar panel power:

- How much electricity do you need to generate?
- How much sun do you get?
- Location of the building and inclination of the roof.
- Budget and warranties.
- Where will water runoff go?
- Calculating Panel Size:
 - Electricity consumption
 - Solar hours per day
 - Bill offset percentage
 - Environmental factor
 - Roof area

SUSTAINABILITY

HARVESTING RAINWATER + SOLAR PANELS

DIAGRAMS

The diagram to the right portrays the process of filtrating rain and waste water from the existing building.

The bottom diagram depicts the existing building with the inclusion of solar panels and area of the water tank. On the existing sloped roof system, the south side covers 5500 square feet. 174 panels of the 72 cell solar panels fit on the south side distributing between 60,900 and 78,300 watts of solar power. This diagram also shows the square footage of the entire building which is about 20,000 square feet. 49,951.44 gallons of water can be collected per month.

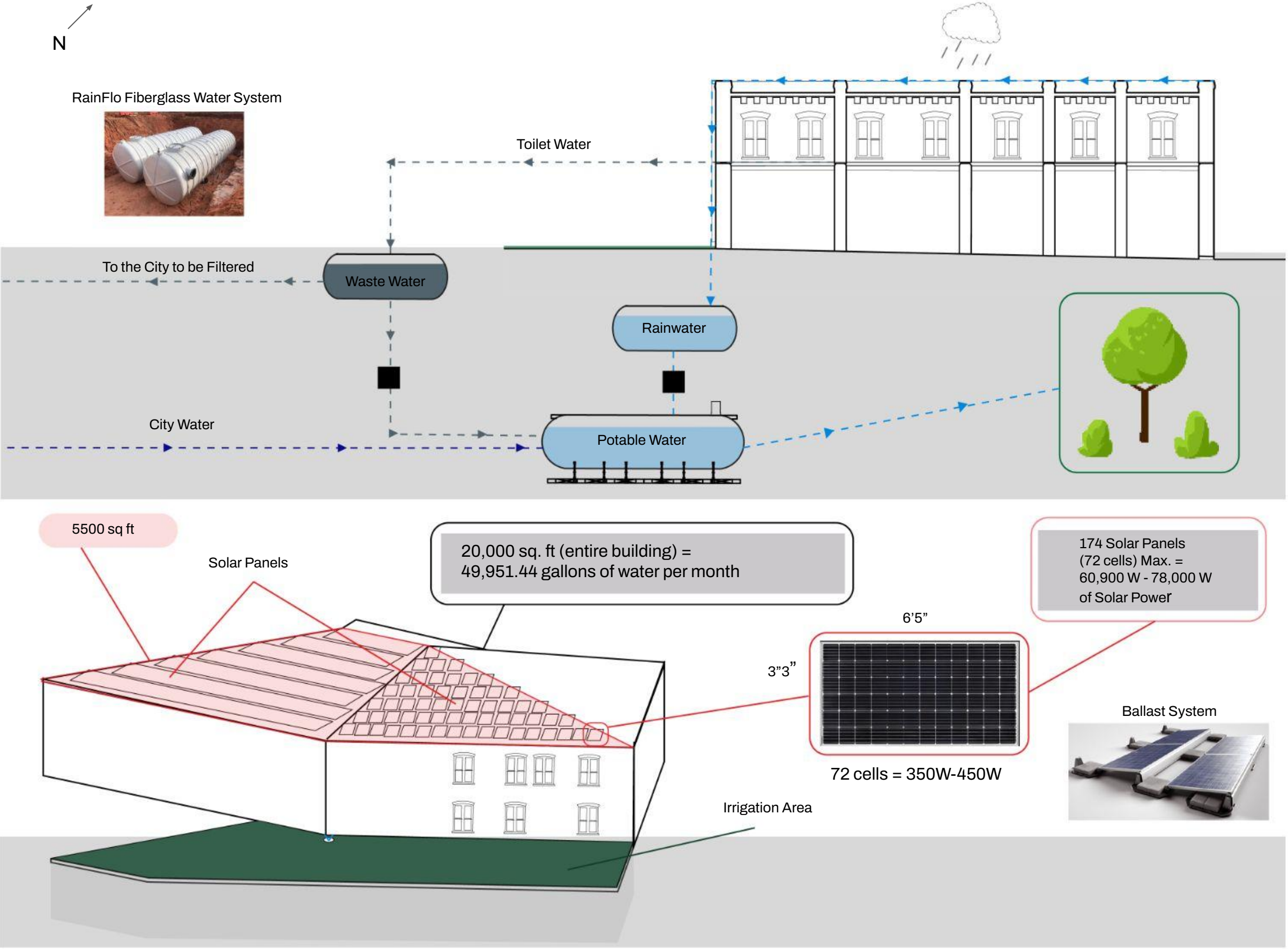
How much rainwater can the underground Rainflo water tank collect?
The Rainflo Fiberglass Rainwater System can hold up to 15,000 gallons of water. As mentioned above, with a roof square footage of 20,000, the estimated amount of water collected per month would be 49,951.44 gallons including the 10% runoff coefficient.

How much water would Centro Hispano be using each day?
Estimating each person will use around 14-20 gallons per day. With 50 people, there will be around 1000 gallons of water need per day.

How much energy does Centro Hispano need per day?
According to the Department of Energy, the average number of kilowatt hours per square foot for a commercial building is approximately 22.5. Knoxville's average solar hours per day is around 5.12 kWh/m^2.

What is the cost? (Solar Panels)
The average price of a 72 cell solar panels is between \$215 and \$260 for each panel. (174 solar panels = \$37,410 to \$45,240). Solar panel warranties can cover some of the maintenance costs with performance guarantees, but to have a professional service your panels, it can cost between \$140 to \$180 annually. An annual inspection and cleaning can cost about \$150 each.

Can solar panels be installed on flat roofs?
Short answer, yes!
Although the diagrams and models show the existing sloped roof, solar panels can also be installed on flat roof systems. Flat roofs attract plenty of sunlight, and the panels can be mounted at a 30 or 40 degree angle to avoid water pooling and leakage causing damage to the roof by using a weighted ballast system. This system uses gravity to sit atop the roof without the need for drilling holes.



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