Design of a water supply for Calvin Gardens

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Introduction

In the summer of 2016, research was done to make Hampshire Calvin Campus Garden more sustainable. The goal was to find a more sustainable solution then what is already used. To accomplish this research the amount of rainfall, topographical data, pressure drops, and volumetric flow rates were assessed.

The Calvin Campus Garden is currently watered using city water from a hose connected to the house next door. This research focused on trying to make the Calvin Campus Garden more sustainable. Utilizing rainwater, installing drip tubing, and eliminating the need for a pump accomplishes this goal.

Objectives

1. 4000 gallons of filtered rain water stored in two 2000 gallon tanks
2. 100 gallons daily to water the garden
3. Collect rainwater from the roof of the house that is south of the garden
4. Start collecting rain water by April each year
5. Both water storage tanks buried in the ground to be aesthetically pleasing
6. Would need no pumps to disperse the water
7. Would have no components that need electricity
8. Poly pipe for main piping
9. Use drip irrigation to water the garden
10. Use only gravity to disperse the water
11. Have the ability to switch back to having the water flow out of the rain gutters during winter conditions

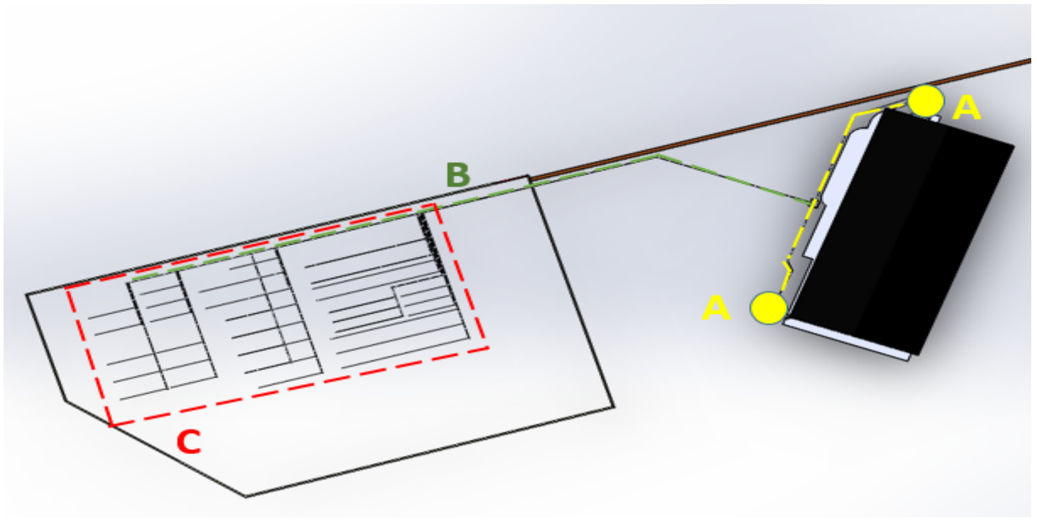
Solutions Investigated

Option 1:

Rain lands on the roof (dark rectangle) and flows into 2000 gallon rain barrels (A). Water then flows down a 2-inch main piping (B). From the main pipe, 12 secondary pipes with drip lines distribute the water (C). All of these secondary lines have ball valves that can be turned on or off so that one section of the garden is watered at a time. This system was designed with conservation of pressure and volumetric flow rate in mind because this system is a low-pressure irrigation setup and is gravity fed. Using this design, the minimum amount of pressure needed is 4 psi. This is achieved when there is at least 600 galleons in each tank. Option 1 would cost around $4,500

Option 2:

Rain lands on the roof (dark rectangle) and flows into 2000 gallon rain barrels (A). Water then flows down a 1-1/2-inch main piping (B). From the main pipe, 12 secondary pipes with drip lines distribute the water (C). All of these secondary lines have ball valves that can be turned on or off so that one section of the garden is watered at a time. This system was designed with conservation of pressure and volumetric flow rate in mind because this system is a low-pressure irrigation setup and is gravity fed. Using this design, the minimum amount of pressure needed is 4 psi. This is achieved when there is at least 600 galleons in each tank. Option 2 would cost around $4,000



Overview of option 1 and option 2

Option 3:

This is an option that is available but uses a pump, which fails a big objective. Option 3, which was proposed by Physical Plant, works by having a pipe split off of the baseball well house to the garden where it would use a sprinkler head to water the garden. Option 3 would cost around $1,500.

Location of the Garden on Calvin's Campus
Picture provided through Google

Conclusions

After looking at all of the options that are available it is very clear that option 1 is the best option, of the options that were researched. When calculated, option 1 produced a higher volumetric flow rate and pressure then option 2 and still not accomplished many of the objectives set forth by the leaders of the Calvin Campus Gardens unlike option 3. Even though it is more expensive then all of the other options it is not a huge difference in pricing compared to option 2 which would be the second best option.

Furthermore, because of the larger diameter of the pipe the watering system could have more than one secondary pipe on at the same time because of the increase in volumetric flow rate and pressure, but this was not calculated but a conjecture. Also because of the larger diameter of the pipe and all that entails, the watering system could potentially be expanded if the need arises to expand the garden, but this was not calculated but a conjecture.