

Laundry 2 Landscape

Building Breakdown



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Origin

This project was inspired by San Francisco's "Laundry to Landscape" program, which allows certain homeowners to modify their washing machine to divert graywater from a wash cycle to an irrigation system in their garden.¹ Our Eco Home doesn't qualify for the program because our washing machine is below the lowest point of our garden, but the concept was relatively simple to implement, so we decided to build our own system.

NOTE: This record is for informational purposes only. To legally and safely build a graywater system for your own property, please read over the SFPUC's "Graywater Design Manual," found here:

<https://bit.ly/3BMaiN2>



Planning

Our main challenge was determining the best method to get the water up the slope to the garden. Washing machines have a pump that removes the water from the basin, and we figured that we could use that pump to move the water up to a certain point above the washing machine. Then gravity could take over and send the water into the irrigation system. We just wanted to ensure that we didn't overexert the pump.

¹ For more information, visit <https://sfpu.org/learning/conserves-water/save-water-outdoors>

Our second challenge was determining how much land to cover with our system. In our initial diagram (Fig. 1), one pipe ran parallel to the raised planter beds on the left side of the garden. Later, we expanded to two branching channels that run below the planter beds (Fig. 2). Theoretically, we can expand our system even further in the future, as long as the water can flow easily without creating vacuums in the piping.

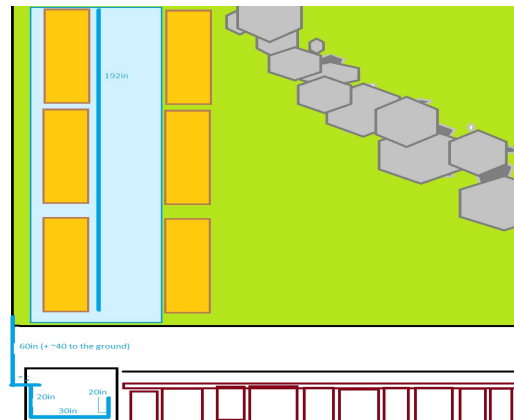


Fig. 1: Initial idea for water coverage

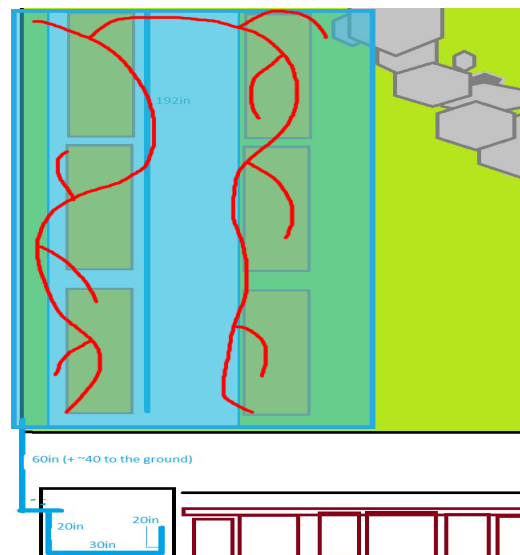


Fig. 2: Second idea for water coverage, with tubes in red

We also had to consider the blackberry bush that ran along the left-side fence. While aesthetically pleasing, it made construction difficult, so we cut it back.

Materials & Tools

Our Initial Materials:

- 2 PVC pipes measuring 1" x 10'
- 4 PVC elbow joints measuring 1"
- 1 roll of irrigation tubing measuring ½"
- 12 (3 bags of 4) irrigation T-joints measuring ½"
- 1 PVC reducing threaded male adapter measuring 1" x ¾"
- 1 irrigation adapter for converting from ¾" FPT to ½"
- 8 irrigation couplings with end caps
- 1 bag of 2-gallon-per-hour drip valves
- 2 bags of ½-gallon-per-hour drip valves
- 2 bags of mulch
- PVC cement

Three-Way Valve:

- 4 PVC threaded male adapters measuring 1"
- 1 PVC reducer measuring 1" x ¾"
- 1 PVC T-joint measuring 1 ¾"
- 2 PVC ball valves measuring 1"
- 2 irrigation elbows measuring ½"
- 1 PVC reducer measuring 1" x ½"
- 1 barbed irrigation adapter measuring ½"

Our Tools:

- Shovels
- Rake
- Wheelbarrow
- Hole saw measuring 1"
- Razor
- Hair dryer
- Zip ties

Preparation for Installation

Our first task was to place the long PVC piping along the fence. After cutting back the blackberry bush, we drilled long screws into the fence posts at an angle to keep the pipe in place (Fig. 3). We leveled the pipe during installation so that no water could backflow or pool in it.



Fig. 3: PVC pipe resting on fence

Because the washing machine was inside an enclosed closet, the PVC piping inside needed to be positioned precisely. We made a dry fit of the overall setup (Fig. 4), then we carefully measured and cut the hole for the pipe to attach to the pipe along the fence. Once we found the right position (we needed to make a slight modification to the interior pipes to allow for more gravity potential), we sealed and glued everything with PVC cement (Fig. 5).



Fig. 4: Dry fit inside the washing machine closet



Fig. 5: Sealed and installed piping. Notice downslope for water movement

After installing the PVC pipe, we moved the raised planter beds to the opposite side of the garden. We dug two parallel trenches in the approximate location of the planter beds (Fig. 6). We planned to replace most of this dirt with mulch, so we brought most of it to a local waste management center (Fig. 7). We kept a lot of usable soil and old mulch to mix into the new mulch.



Fig. 6: Planter beds moved (before & after)



Fig. 7: Excess dirt taken to waste management

Irrigation Installation

One of our greatest challenges was working with the drip irrigation tubing. Because it's very stiff, we had to heat it to bend it into the appropriate shape. We used a hairdryer to straighten out sections of tubing as much as possible, then we spot-heated it to coax it into the trench. Fortunately, it wasn't necessary to straighten the branching pieces significantly. We then capped the main tube with an irrigation coupling.

After laying out the main "trunk" of the leftmost trench tubing, we sectioned the tube using barbed T-joints, trying to space it evenly to promote consistent water coverage (Fig. 8). When we were confident the main tubing would suffice, we measured and cut the "branch" tubes and inserted drip valves at even intervals along the tube (Fig. 9). We capped the ends of the branch tubes with couplings, then attached them to the main "trunk" (Fig. 10).



Fig. 8: Main "trunk" tube with T-joints



Fig. 9: Branch tube with drip valves



Fig. 10: Branch tubes attached and capped

Once the left side was finished, we laid out the right side similarly, then we connected both sides via a barbed T-joint. To attach the tubing to the PVC pipe, we used a combination of a 1" to $\frac{3}{4}$ " male PVC threaded reducer, a $\frac{3}{4}$ " FPT to $\frac{1}{2}$ " irrigation adapter, and a coupling (Fig. 11).



Fig. 11: PVC to irrigation connection

While we were covering the tubing with mulch, we discovered that it was too easy for the tubing to get pushed up to the surface. To mitigate this problem, we bought garden staples to hold the tubing close to the ground and to reduce its flexibility. We also placed stones at T-joints to weigh it down. After securing the tubing, we layered the old and new mulch on top (Fig. 12).



Fig. 12: New mulch added on top of tubing

Constructing the Three-Way Valve

Our initial plan was to purchase a three-way ball valve to control the irrigation, but despite hours of searching, we couldn't find a valve that fit our needs. Instead, we created our own valve system, which needed to close off both the normal sewer outflow and the irrigation system outflow. It also needed to connect to the washing machine's original $\frac{3}{4}$ " outflow tube. To do that, we used two ball valves on either side of a T-joint, which served the same function as a three-way valve and allowed all outflows to be both opened and closed, rather than one or the other (Fig. 13). This involved using a couple PVC adapters and reducers. Before gluing the parts together with PVC cement, we did a dry fit to ensure that it would work correctly and fit in our closet.

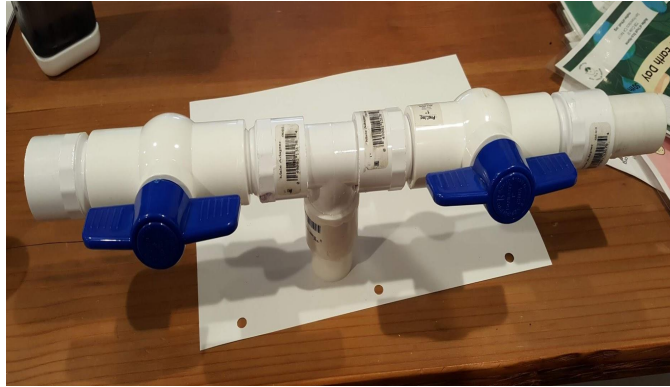


Fig. 13: PVC valve system

When installing our valve system, our main challenge was directing the sewer outflow valve into the sewer pipe. We wanted to use some of our leftover irrigation tubing to direct the outflow to the pipe, but the irrigation tubing was too stiff for our system. Instead, we opted for a series of L-joints to make the tubing turn enough to fit into the pipe, then we connected it to the valve system with a barbed adapter (Fig. 14).



Fig. 14: Irrigation tubing with L-joints to maneuver into the sewer pipe

Once we dry-fitted everything to ensure a good fit, we glued the pieces together with PVC cement and let it dry for two days, checking on the first day for cracks or problem areas in the non-standard fittings (e.g., the connection between the washing machine hose and the PVC pipe) (Fig. 15).



Fig. 15: Completed T-valve system

Final Testing and Completion

After the glue was sufficiently cured, we tested the system to check for leaks or other issues. Almost immediately, we discovered a problem with water flow and volume. Our pump was pulling too much water out of the washing machine for our small irrigation system, especially given that our drip valves only released half a gallon per hour. While this wasn't a catastrophic failure, if left unattended, the pressure would have damaged the washing machine and the PVC connections. To solve the problem, we added more drip valves, and we swapped them for two-gallons-per-hour valves.

When we tested the system again, it still backed up, but not as much as before. So in addition to the drip valves, we also installed a few sprinkler heads to ensure that no pressure was building up in the system.

After a third test, we discovered that the irrigation worked well. It handled the water load, and our Laundry to Landscape system was complete, ready for use by our Eco Home tenants (Fig. 16)! Until...

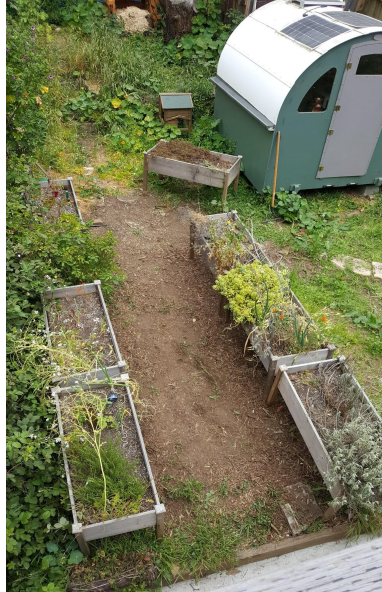


Fig. 16: Completed Laundry to Landscape system

Issues and Reworking

Within the first year of operation, our system developed a few issues. Many of the problems were caused by an incorrect installation of certain systems, but other problems were related to the system as a whole. The main issue we encountered was clogging and the uneven distribution of water from the drip valves. Because the valves were partially buried, the water broke down dirt and other debris into finer particles and pulled it into the tubes through adsorption. During rainstorms, this effect was compounded since the ground was compacted, potentially sealing off the valves entirely.

This backup also caused pressure problems, and the water didn't move through the pipes properly, straining the washing machine's pump. Because the water had fewer places to go and didn't clear out completely before the next wash cycle, the pump had to push against a near-constant level of water in the tubes. Gravity did less work than we initially thought.

To address these issues, we temporarily diverted water to the original sewer pipe. Then we reevaluated the layout of the system. We ended up reworking one of our original ideas: setting up a single outflow into a smaller area in the lower left corner of the garden (Fig. 17).



Fig. 17: New graywater outflow into garden

With professional help to design and manage the irrigation system, we completed it much quicker than the initial design. In this area we planted a variety of soap-friendly plants that could weather the effects of the graywater. During this renovation, we also reworked the rest of the garden. We moved the raised beds to either the lower edges of the garden or next to the tiny home, and we placed a footpath through the beds (Fig. 18).



Fig. 18: New footpath with raised beds by garden (left) and tiny home (right)

We set up these areas to have scheduled drip irrigation from the normal water intake (Fig. 19) rather than graywater, and we used a combination of flexible irrigation tubing and copper pipes (Fig. 20).



Fig. 19: New drip irrigation for garden, using tap water (black tubing)



Fig. 20: Laundry to Landscape tubing (white), along with the new irrigation system (copper pipes)