

Appendix C: Troubleshooting Manual

The troubleshooting manual is organized by location, and then by observation, possible cause and solution.

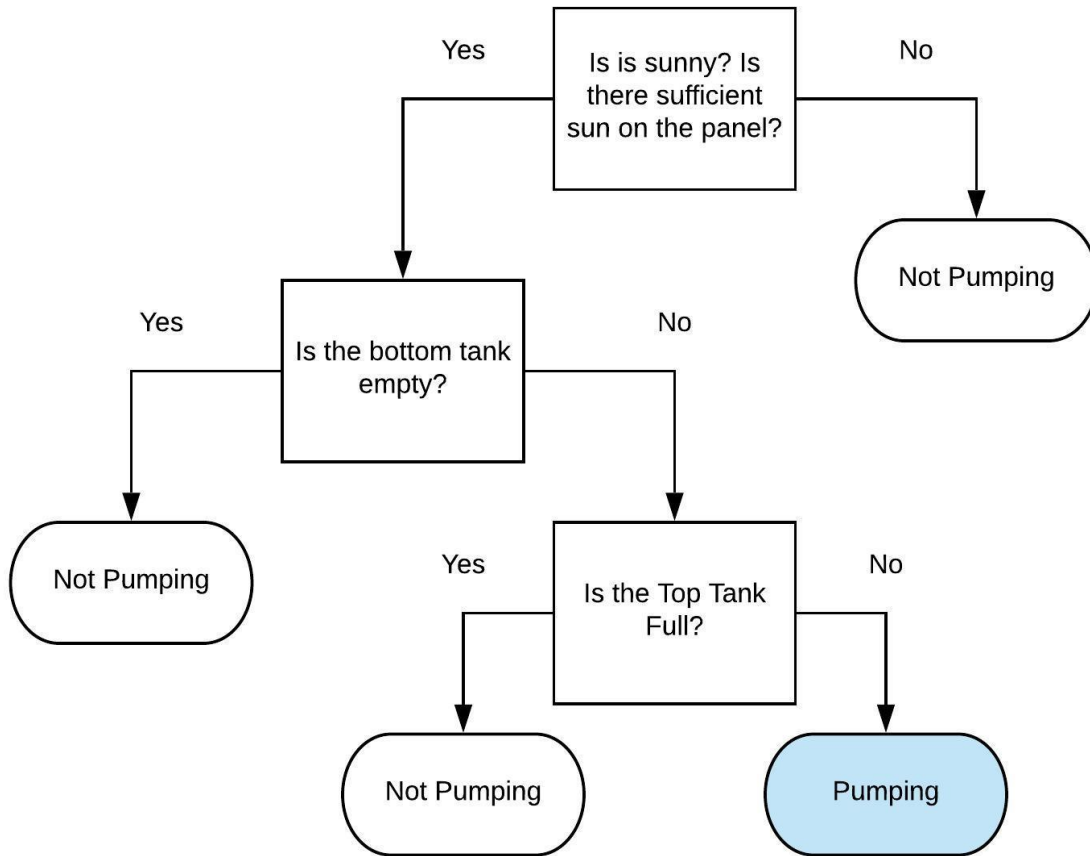


Figure C-1: Should it pump? (tree diagram)

General

- ! Attempts to fix leaks or breaks in the system should be performed when the pump is not pumping. The pump could be shut-off by covering the solar panel with a towel.

- 1) Holes or breaks in any point in the system
 - a) Locate the hole or break and replace the component. See Appendix D for reference when you get a new part.
- 2) Water spraying or dripping out of any point in the system
 - a) Locate and asses the leak.

- i) The leak could be patched TEMPORARILY with Teflon tape, SUGRU, Duct Tape, or other temporary measures. But a new component should be installed as soon as possible. Component parts are listed in Appendix D.
- 3) Ground is unusually wet
 - a) Check the exposed pipe surrounding the area
 - i) Apply temporary leak fix with Teflon tape and replace the pipe as mentioned above
 - b) Check the buried pipe
 - i) Apply temporary leak fix with Teflon tape and replace the pipe as mentioned above

Screen

- 1) Water is overflowing – the pipes underneath the screen are full of water.
 - a) Check the water level of the bottom tanks.
 - i) If the tanks are not full, then there is a blockage or leak in the pipes before the tanks. If there is no leak, you must remove the blockage, detaching the pipes if necessary. If there is a leak, see General
 - b) Check to see if the overflow pipe is functioning – is there water coming out of the bottom of the overflow pipe?
 - i) If water is not coming out of the bottom of the overflow pipe, detach the pipe and flush it out.
 - c) Check to see if there is blockage in the pipe underneath the screen
 - i) Detach the pipe first before cleaning with rags, pressurized water and biodegradable soap to prevent the blockage going into the tank



Figure C-1. Screen can be easily taken off to check the pipe underneath

First Flush

- 1) More water coming out of the first flush than normal (i.e., dripping).
 - a) Check integrity of first flush system. Is the end cap present and properly sealed?
 - i) If the cap is not properly attached, re-attach the end cap and reseal with pipe joint compound.
 - ii) If the cap is properly attached but too much water is coming out, you might need to replace the cap. Seek advice from an expert to properly size the drainage hole.
- 2) No water dripping out of first flush in the first few hours after a rain event
 - a) Check if can you push a skinny skewer through the hole in the bottom cap
 - i) If water continues to flow, the issue may be fixed temporary but there is probably a blockage.



Figure C-2. Check the integrity of the cap shown in red

- ii) In the case of a blockage, detaching and cleaning the system from inside is best. Detach the first flush system and clean it with pressurized water or a scrub brush.
- iii) If the problem persists after cleaning, seek expert advice such as Lonny Grafman

Bottom Tanks:

- 1) No water entering the bottom storage tanks
 - a) Refer to the **Figure C-1: Should it pump? (tree diagram)** to see if water should be pumping. All of the water might have been pumped to the top tank.
 - b) Check the conveyance for holes or misalignments
 - i) If there are holes or misalignments, fix them so that rainwater has an unobstructed path to the storage tanks again.
 - c) Check the first flush to see if it is leaking more than normal.
 - i) If the first flush is leaking more than normal, see First Flush section
 - d) Check the tanks for leaks
 - i) If there are leaks, see General section
- 2) Dirty water is entering the storage tanks / Sediment in bottom storage tanks
 - a) Check first flush system to see if it is not draining properly
 - i) If there is no water coming out of the first flush after a rainstorm, see First Flush section
 - b) Check the screen to make sure it is catching debris properly
 - i) If the screen between the gutter and the pipes is no present, put it back or attach a new screen.

Pump

- 1) Leaks and water dripping below the pump
 - a) Check if the fittings between the pipes and the pump inlet and outlet are tight
 - i) If the fittings are loose, tighten up the hose clamps
 - ii) Try to apply the SUGRU if tightening of the hose clamps is not sufficient
 - b) Check if the pump inlet pipe arches up higher than the pump location and the water level.
 - i) If it does, **CAREFULLY** reconfigure the inlet pipe so the entire pipe remains as low as possible and the highest arch is not above the pump's elevation.

! Excessive bending and twisting of the HDPE pipe can result in permanent deformation and even cracking.

- 2) The pump is making a low humming noise—instead of normal operating sound—when it is sunny
 - a) Check the various water levels and consult **Figure C-1: Should it pump? (tree diagram)** to see if water should be pumped at these levels
 - b) Check if the pump inlet pipe arches up higher than the pump location and the water level.
 - i) Air could enter the pipe and the pump is not able to draw water over the arch. Apply same pipe reconfiguration fix as above.
 - c) Check the pipes coming out of the storage tanks for debris.

- i) Remove the blockage using pressurized water or a scrub brush.
 - ii) If the tank is full of sediment, you might have to evacuate and scrub the tank.
 - 3) Pump never makes any noise, even when it is sunny
 - a) Check the various water levels and consult **Figure C-1: Should it pump? (tree diagram)** to see if water should be pumped at the current water levels.
 - i) If the system is not pumping when it is supposed to, check to see if the pump is drawing water from the lower tanks, see 2)b)i, 2)c)i, and 2)c)ii
 - b) Check the Solar Panel section to make sure the panel is providing the pump with power.
 - c) Check for any exposed or disconnected wires
 - i) If exposed or disconnected wires are found, reconnect the wires by referencing the wiring diagram (Figure C-3). Make sure the wires are properly connected (e.g., using twist-on wire connectors) and insulated (e.g., with electric tap).

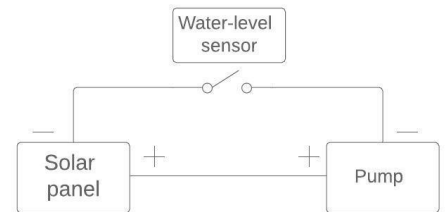


Figure C-3. Connection between the panel and the pump

Solar Panel

- 1) Solar panel is shaded all day
 - a) Check for any causes of shading and remove it if you can.
 - i) Relocate the panel in the area with more sun exposures (i.e., no or less shading) and if this accommodation does not degrade the system performance.
- 2) Solar panel appears to not provide power to the pump.
 - a) Check the various water levels and consult **Figure C-1: Should it pump? (tree diagram)** to see if water level should be pumped.
 - b) Check the voltage and the current of the pump and solar panel connection during hours where the solar panel is exposed to the sunlight. This will require exposing the wires.
 - i) With the original system solar panel and pump, the voltage should be approximately 17 or 18 volts and the current should be approximately 5 amp
 - ii) If voltage is higher than 18 voltage and current is much lower than 5 amp, but not zero, the solar panel **is** providing power to the pump. Check the Pump and Top Tank sections if water is not flowing when it should be.
- 3) Panel is cracked or damaged
 - a) Replace the panel with a new one with maximum power point voltage near the pump's nominal input voltage and recommend installing a linear current booster. Either look at the Schatz Energy Research Center and Solar Roger (CCAT's friend and solar expert) if you can get more connections from them or can get the panel for free or buy it.

Top Tank

- 1) No water coming out from the inlet pipe into the top tank
 - a) Check the water levels and consult the **Figure C-1: Should it pump? (tree diagram)** to see if water should be flowing.
 - b) Check to see if the pump is operating when there is sun on the panel.
 - i) If there is sun, but the pump is not operating, see Pump section.

- c) Check for leaks in the pipe connecting the pump and the upper tank by flushing it with water
 - i) If water goes in one end of the pipe and does not come out the other end, try to find the leak looking for water coming out of the visible part of the pipe, or puddles forming where the pipe is buried underground. If you cannot find the leak visually, dig up the pipe and inspect more carefully, then patch the leak with SUGRU. This is a temporary solution; please replace the pipe based on the specs in Appendix D.
- 2) Upper tank water level does not rise even when its sunny (and the tank is not already full)
 - a) Check the steps above for no water coming out from the inlet pipe
 - b) Check to see if the tank is leaking
 - i) If the tank is leaking at its exit valve, see General.
 - ii) If the body of the tank is leaking, apply a temporary patch and buy a new tank.
- 3) Water enters top tank even when it is already full, or, top tank is overflowing
 - a) Check the float valve (attached to the inlet pipe in the upper tank) to see if it is attached and operating properly
 - i) If the float valve is not attached, reattach it
 - ii) If the float valve is missing, consult an expert such as Lonny Grafman to put in a new float valve (the current one is from a toilet tank).
- 4) Top tank is always empty
 - a) Check if the pump is pumping.
 - i) If not, see Pump section.
 - b) Check for any blockages in the pipes.
 - i) Flush the pipes if you suspect a blockage.
 - c) Look into pipe leakage as described in the General section.
 - d) Check if the panel is functioning appropriately.
 - i) See the Solar Panel section.



Figure C-4. Tank at full capacity 1000-liter (264 gallons)

Connection Points

- 1) No water flow out when you open the valve at top connection point
 - a) Check the top tank to see if it is empty.
 - i) If it is empty, there is no water available. If it is not empty, see Top Tank section to troubleshoot from there
 - ii) Open the tank red valve more to let the water flow out more
 - iii) Close the valve and open the connection to see if there is blockage and remove.
 - iv) If there is no observable blockage, open the red valve to let the water flow naturally out of the tank to flush out the blockage inside the tank. Close the valve as soon as the blockage is flushed out.
- 2) No water when you open the valve at bottom connection point (assuming there is water in the top tank. If there is no water but there should be, see Top Tank)
 - a) Check the top connection point
 - i) See above.

- b) Check the pipes coming down
 - i) See if there is leak and fix with SUGRU. This is temporary fix, please buy a replacement component based on Appendix D.

Appendix D: Component Specifications for Replacement Parts

The specifications of the system's components are listed below in order to match new purchases with the system's requirements. Currently, there is a mismatch between the solar panel and pump voltage. If a new replacement is needed, it is recommended that the voltage of the new component should match the solar panel or pump (whichever is retained).

- Solar panel
 - Open-circuit voltage (Voc): 22.3 V
 - Short-circuit current (Isc): 8.18 A
 - Maximum power voltage: 18V
 - Maximum power current: 7.5 A

- Pump
 - 24V direct current (DC)
 - Open flow: 3.10 -5.15 gallons per minute (gpm)
 - ¾-inches float valve (upper tank)
 - Electrical sensor (lower tank) SumpAlarm
 - 2359 Float Switch
 - ½ HP @ 120V or 220V AC
 - DC pump load 12A @12V
 - Instruction can for sensor connection can be found here at [Float Switch Package Instruction](#)

- Water tanks
 - Lower IBC (white) tank: 1,000 Liters (264 gallons)
 - Lower pickle barrel tanks (red): 2 x 100 gallons (379 liters)
 - Upper IBC tank (hillside): 1,000 Liters (264 gallons)

- Piping
 - ¾-inches high-density polyethylene (HDPE) pipe
 - CenFlo HDPE ASTM D2239 ¾" 100 PSI
 - 160 feet
 - ¾-inches polyvinyl chloride (PVC) pipe
 -
 - 1 ¼-inches upper IBC tank main drain pipe
 - 1 ½-inches lower IBC tank main drain pipe



Figure D-1. Sensor Sump Alarm