

# Standard Operating Procedure for field sampling with the Pump-Filter System

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## I. Materials

1. Per replicate (control and sample)
  - a. 6 - 64 oz. mason jars labeled with white electrical tape
  - b. 1 - 64 oz. mason jars filled with pure water
  - c. 6 - 32 oz. Gatorade squeeze bottles filled with pure water
  - d. 6 - Spaghetti jars each containing their respective filters (280  $\mu\text{m}$ , 100  $\mu\text{m}$ , 10  $\mu\text{m}$ )
  - e. 1 – 32 oz mason jar (wide mouth) with 100 ml pure water in it to serve as an air control
2. Flathead screwdriver for prying open the filter housing
3. 5.5 qt metal bucket for catching spill when removing filter cartridge
4. 2 squeeze bottles filled with pure water (one with small tip and another with a cut tip)
5. 1 funnel for priming gas pump
6. At least 2 of the 1  $\mu\text{m}$  filter cartridge (polypropylene string wound, 10" x 2.5", [from Amazon](#))
7. Filter pump system
8. 4 accompanying hoses:
  - a. Intake hose (reinforced hose with 1 wide attachment end and 1 threaded end)
  - b. Backwash filter hose (short reinforced hose)
  - c. Filter to pump hose (longer reinforced hose)
  - d. Outflow hose (normal gauge, non-reinforced hose)
9. WD-40
10. University truck
11. 1 HaulMaster 2-in-1 hand cart
12. 1 guerilla cart
13. 2 gas pumps
14. 1 boat hook to attaching to intake hose end so it can be held outwards in the water
15. 1 white buoy attached to wire to keep hose from sinking too far below the surface
16. 1 pair of waders
17. Orange cotton jumpsuits for all personnel
18. Waterproof paper + writing utensils
19. First Aid Kit

This filtration device was designed to eliminate sample contamination from outside microplastics either due to airborne particles or from usage-related wear of the materials (Lenz & Labrenz, 2018). The pump-filter system consists of a closed filter design and non-plastic materials in order to achieve this.

The pump filter system utilizes suction to pull water in and through the filter apparatus first before going to a gas pump. This ensures none of the sample gets ground up by the gas pump. A green intake hose, with one quick-release fitting and an open-end, is connected to the intake valve, from here water is flushed through the system to the outflow valve. The intake hose has a 4 mm metal strainer attachment fitted to the open end in order to prevent clogging and intake of large debris. Another green hose, fitted with quick-release fittings on both ends, connects the outflow of the filter apparatus to the intake of the gas pump. Suction from this pump is what ultimately draws water into the system and through the filter cartridges. Water then exits the system through a third green hose connected to the outflow pipe at the top of the gas pump and is returned to the environment.

## II. Gathering Materials

1. Use the hand cart to load all the materials from into the back of the truck, this includes all the jars, squeeze bottles, bottles, waders, 5.5 Qt bucket and tools. Remember to place 2 Gatorade squeeze bottle in each grey, plastic box of 6 jars to keep the jars from clanking against each other during transport as seen in figure 1.
2. At the loading dock of the Center for Biotechnology and Life Sciences, get the intake hose (if it was left on pump) and gas pump from outside cage (key is on top of metal shelves just inside building). Take the gas can as well. Load both gas pumps and the gas can onto the back of the truck.
3. At the Furtado warehouse on Bay Campus, load the pump filter system onto the guerilla cart and load both onto the back of the truck. Remember to also take the boat hook (long metal pole) and white buoy from Furtado.



**Figure 1.** The picture at the left is of the HaulMaster 2 in 1 handcart in the vertical configuration. If needed, it can be switched to the horizontal configuration by removing the silver loops inserted in the outside of the mid portion of the cart so the handle can be moved to the other set of holes. The picture on the right shows where to insert the 2 Gatorade squeeze bottles into each box of 64 oz jars so that all jars become tightly packed. The same layout can be used with spaghetti jars.

### III. Setting Up the System at the Site

1. Put on the orange jumpsuits.
2. Remove all grey boxes with jars to be used at the site, the toolbox, and the guerilla cart from the back of the truck.
3. Load the pump frame onto the guerilla cart and pull it to the water's edge. Take the filter system frame off the cart. Keep all grey boxes with required jars nearby.
4. Attach hoses as seen in figure 2. Make sure the hose going to the 1  $\mu$ m filter is part of the flow loop so all water gets filtered first as it goes into system.
5. Attach the boat hook end and buoy to the end of the intake hose as seen in left picture of figure 7 if this has not already been done.

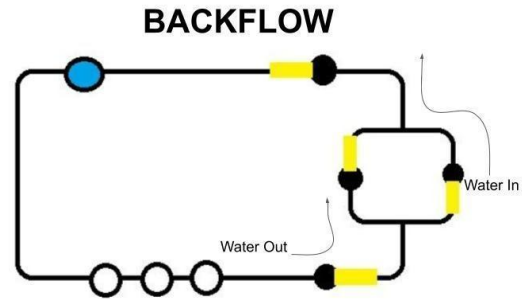


**Figure 2.** Hose set-up for backflow and forward control pump (goes through 1  $\mu$ m filter). Note that the only difference between backflow and forward control pump configurations is the way the valves are turned, hose configuration remains the same. Valves are set to backflow configuration on the left picture and the valves are set to forward control pump configuration in the right picture. The intake hose connects to the right-hand side of the 1  $\mu$ m filter cartridge and the hose on the left-hand side of the 1  $\mu$ m filter cartridge then connects to the opening at the north of the steel frame. The water then travels through the frame and steel filters and comes out the hose attached pointing south (towards inside of steel frame). That hose then leads to the pump which then moves the water out another hose attached to the pump. Field location in right picture is Spink Neck beach and the person holding the boat hook in the water is Morgan McCutcheon.

#### IV. Backflow

1. Change valves to the positions seen in figure 3.
2. Prime the gas pump with water from the metal tub using on the 5.5 qt buckets. Water will go in the top of the gas pump, unscrew the opening to access.
3. Take note of where flowmeter starts.
4. Have one person put the waders on and walk out into the water to about waist height (3-4 foot water depth) with the boat hook in hand with the buoy and intake hose attached. Hold hook 1.5-2 feet below water surface but well above the sediment at the bottom. Record depth of water and hose position (post collection), state of tide and estimate distance from shore (think about a relatable part of the shore to account for variable tides).
5. Start the gas pump and set it to 100% full throttle (as shown in figure 4).
6. Allow pumping to continue for 15 gallons, flowmeter will count down so stop flow 15 gallons from the starting reading.
7. Turn the 2 side valves off at the same time and then turn the center valve.

8. Turn off the gas pump.



**Figure 3.** Backflow valve positions. Diagram credit: Jacqueline Roush.

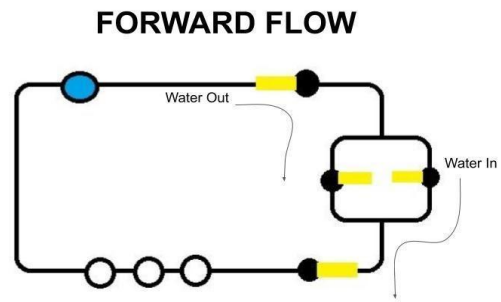


**Figure 4.** Throttle (longest metal lever) of gas pump set to 100% power for use with backflow pumping.



## V. Control Forward Pump

1. Load the control cartridge filters
2. Make sure boat hook end and buoy are attached to the end of the intake hose as seen in left picture of figure 7.
3. Take note of where flowmeter starts.
4. If they are not already out there, have one person put the waders on and walk out into the water to about waist height (3-4 foot water depth) with the boat hook in hand with the buoy and intake hose attached. Hold hook 1.5-2 feet below water surface but well above the sediment at the bottom. Record depth of water and hose position (post collection), state of tide and estimate distance from shore.
5. Switch the valves to forward flow as seen in figure 5.
6. Switch gas pump to 75% throttle as seen in figure 6.
7. Turn the gas pump on and allow it to run for 50 gallons.
8. Turn both side valves off then turn the middle valve.
9. Turn off the gas pump.
10. Place the 5.5 qt bucket under the 280  $\mu\text{m}$  cartridge filter canister.
11. Remove the 280  $\mu\text{m}$  filter cartridge by unscrewing the canister ring at the top and wedging the screwdriver in the opening as seen on the right-hand side of figure 7. Turn the screwdriver slowly to pry the suction seal open.
12. Place the filter cartridge in the appropriately labeled spaghetti jar
13. Pour the canister water in the appropriately labeled 64 oz mason jar.
14. Rinse the sides of the canister with a 32 oz (946 ml) Gatorade squeeze bottle until the water level is just below the top of the metal spring at the bottom of the canister. Swirl this water and pour out the side of the canister with the label on it. Repeat this 4 times and start pouring water into the spaghetti jar when the mason jar fills up.
15. Hold the canister upside down over the spaghetti jar and use 250 mL from sniped tip squeeze bottle to rinse contents from bottom of canister into spaghetti jar.
16. Rinse the O-ring and area canister was attached to using the sniped tip squeeze bottle into the bucket below. Then rinse the bucket contents into the spaghetti jar using the sniped tip squeeze bottle.
17. Load the 280  $\mu\text{m}$  filter cartridge for the forward pump into the canister and load the canister back into the metal frame. This is best done with one person pushing the frame down while the other pushes the canister up.
18. Repeat steps 10 through 17 for the 100  $\mu\text{m}$  and 10  $\mu\text{m}$  filter cartridges.



**Figure 5.** Forward pump valve positions. Diagram credit: Jacqueline Roush.



**Figure 6.** Throttle (longest metal lever) of gas pump set to 75% power for use with all forward flow pump runs.

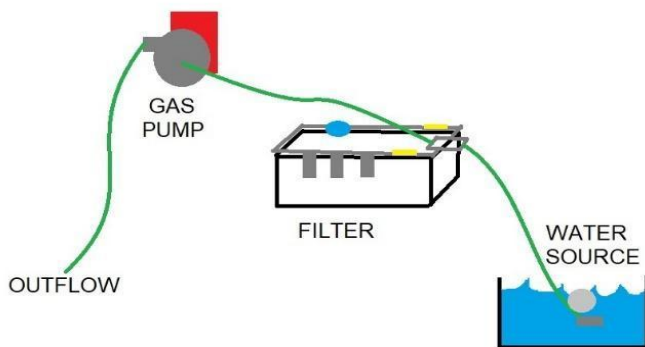


**Figure 7.** Picture on the left shows the boat hook and buoy attached to the intake end of the hose. Picture on the right shows where to wedge the flathead screwdriver above the canister holding the filter cartridge so suction pressure can be gently released.

#### VI. Environmental Forward Pump

1. Switch hoses so water no longer goes through the 1  $\mu$ m filter loaded on the frame as seen in figure 8.
2. Turn on the gas pump with throttle still at 75%.
3. Take note of where flowmeter starts and wait until flow meter starts moving.
4. Make sure the person standing in the water with intake hose is still holding the hose above the sediment.
5. Have the other person start the gas pump once the intake hose is being held constant in place by the person out in the water.
6. Allow pumping to continue for 50 gallons.
7. Turn both side valves off and then turn the center valve.
8. Turn off the gas switch on the gas pump and allow it to run until it burns leftover gas in the main compartment out.
9. Repeat steps 10 through 16 from the above “Control Forward Pump” section for each of the 3 canisters to collect sample.





**Figure 8.** Pump filter set-up with hose connections made to direct water from the environment, through the metal frame with the steel filters, through the gas pump, and then out the outflow hose. The 1  $\mu\text{m}$  filter is left out of this flow loop as the hose attached to one end of it just goes to the other end of the filter. Diagram credit: Jacqueline Roush.

## VII. Clean Up

1. Disconnect all hoses.
2. Tip the system forward and open valves to drain water out.
3. Open drain at bottom of gas pump and tilt it forward to drain it.
4. Lift the pump frame onto the guerilla cart.
5. Load all materials onto the back of the truck and travel to next site or URI Bay Campus when done for the day.
6. If done for the day, use the fresh water hose near Furtado to rinse out the inside and outside of the pump filter system frame. Rinse out inside of the gas pump only (do not spray outside).
7. Coil and tie all green hoses place all of them except the intake hose between the pump frame.
8. Spray gas pump with WD-40
9. Put the green intake hose and the gas pump back in the metal cage.

## References

Lenz, R., Labrenz, M. Small Microplastic Sampling in Water: Development of an Encapsulated Filtration Device. *Water*. **2018**, *10*: 1-8.

### Site Data Sheet

Site Name/Number	
Collector(s) Name:	
Date/Time	Date: Time:
GPS Location	Long: Lat:
Tide Height	
General Weather Conditions	
Substrate Type	
Wind Speed/Direction	Speed: Direction:
Water Temperature	
Salinity	
Flow Meter Reading	Start of Backflushing: End of Backflushing: End of Forward Flush (CON.): End of Forward Flush (ENV.):
Total Amount of Water Sampled (gallons)	
Current Speed/Direction	Speed: Direction: