

2022 Second Spatial Study (SSS) Protocol

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Deployment Protocol

Summary of deployment activities in order

1. Deploy the baroTROLL if appropriate
2. Take grain size pictures
3. Deploy cotton strips
4. Deploy miniDOT and HOBO sensors
5. Deploy the signs
6. Take site photos
7. Upload photos and digitize metadata (in the car, office, hotel, etc.)

BaroTROLL Deployment

Overview: BaroTROLLs have been pre-programmed and scheduled to start logging the day before deployment. The sensor records barometric pressure (mbar) and temperature (°C) data with a log interval of 1 min. All you need to do is deploy the sensor as described below.

1. Upon arrival at each sampling location, check the hard copy schedule sheet in the provided binder to see whether the site needs a baroTROLL (based on the hard copy sheet with coordinates, etc. for all sites). If it is a site that includes a baroTROLL deployment, go to step 2. If not, go to the next section.
2. Hang the baroTROLL from a tree or bush in the shade that is out of sight (i.e., that's going to be hard for a general person to see/find). If you can't find a location where it won't be visible if hung from a tree or bush, zip tie the baroTROLL to the backside of a tree branch or bush so it will be out of the direct line of site. Also place it as high above the ground as you can to ensure that the sensor is not affected by reflected heat from the ground or exposed riverbed. **Take a photograph of baroTROLL location and a teammate pointing to it. It is important to know exactly where the baroTROLL is located so sampling and retrieval teams can find the sensor next time they visit the sites.**

3. Record the start time of deployment (**PST**) and baroTROLL serial number on the metadata sheet. *Reminder that your cell phone will be reporting times in PDT in July/August, so you cannot just write that time. We must have PST on the metadata sheets. Use the field watches, which are always set to PST.*
4. Leave the sensor in place, it will be retrieved during the ‘retrieval’ week.

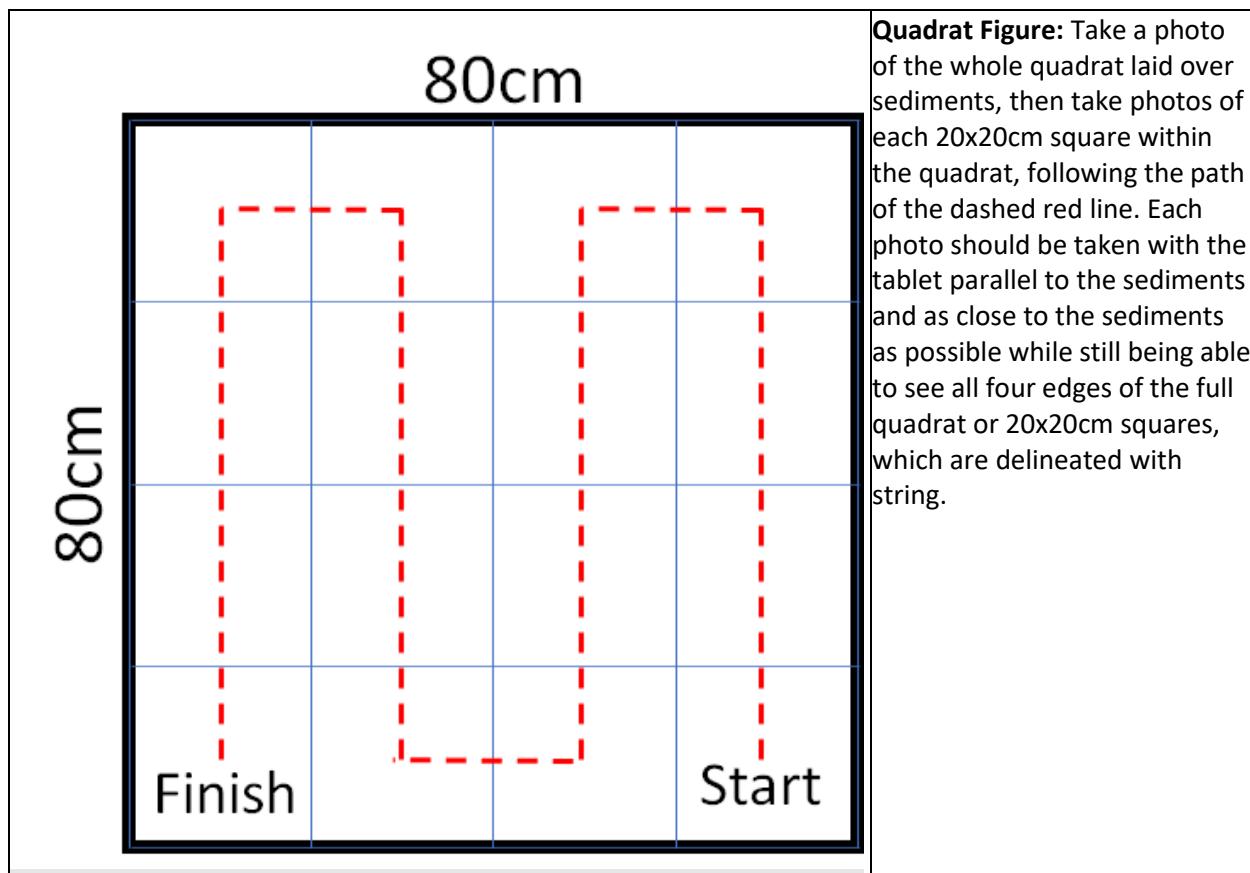
Grain Size (photos of exposed riverbed sediment)

Overview: The goal of these photos is to estimate grain size of the surficial sediments at each spatial study site. This protocol needs to be done once at each site. If there is a return visit to a given site, this protocol does not need to be repeated. The assumption is that grain size won’t change much between trips. **Take the photos using the SFA tablet. For all photos, the tablet should be parallel with the riverbed being imaged.** This is important to avoid distortion in the images, which is needed to generate robust estimates of grain size. For each photo use the PVC quadrat for scale. If the quadrat can’t be used for any reason, use a tape measure with 30cm of ‘tape’ showing. If any other method is used for scale, record details in the metadata notes. Do your best to avoid creating a shadow with your body as you take the photos. Complete the following steps.

1. Visually survey the riverbed sediments that are **above/out of the water** and below the upper scour line. **We are focused on photographing materials that are obviously riverbed sediments (i.e., those that would normally be underwater during normal/seasonally high water, not the shoreline soils that would be underwater during a large flood).** The sediments should be between the water’s edge and the upper “scour line.” The scour line can be a little subjective, but there are obvious soils above it and little to no soil below it. Below the scour line you’ll see sediments exposed due to water removing (i.e., scouring) soil.
2. Select a location that is representative of the site’s exposed sediments and that is relatively **flat/even**.
3. Place the quadrat on the sediments. If there is a narrow area between the scour line and the water, put the quadrat partially in the water and take photos as best you can. If you have a steep cut bank, try to place the quadrat vertically and take photos while standing in the water (if safe).
4. Clearly write the site name (e.g., S02) and date (e.g., 30 Aug 2021) on the white board. **If the riverbed is angled or vertical, also draw an arrow pointing up on the whiteboard** so that later it is clear the quadrat was not on a flat/horizontal location. Place the white board just outside the lower left corner of the picture frame, but not on the quadrat, **so it is visible in the photo**.
5. Take a photo of the quadrat with tablet as close to parallel as possible and as close to the quadrat as possible while still being able to see all inner edges of the quadrat and the white board. It is important to be as close as possible so sediment grains can be resolved in the image, but don’t cutoff any edges of the quadrat. Also be careful to include the pieces of colored tape placed in the corners when photographing inner quadrats. **Be sure to take the photo at the same angle as the grid (i.e., parallel to the quadrat orientation).** To check this, ensure the horizontal length is similar to the vertical length in the photo.
6. After taking the photo, **confirm that it was taken/saved in the tablet and that the image quality is good, the whiteboard is visible, the writing can be read, and no edges are cut off.**
7. Without moving the quadrat, take photos of each 20x20cm square defined by the strings within the quadrat as follows:
 - a. For all these photos keep the tablet in the same orientation that was used for the photo of the whole quadrat (stand in the same place, don’t rotate or angle the tablet). That

way it is easier to know where each photo is located. Make sure to follow the path indicated in the quadrat figure below to make it even easier to know where each photo is located within the quadrat.

- b. Starting in the **lower right** corner, move the tablet as close as possible to the sediments while being able to see all edges of the lower right 20x20cm square. Here, ‘lower right’ is in reference to the orientation of the photo taken of the whole quadrat. You should have string on two sides and PVC on two sides, and at least the inner edge of all should be visible in the image. Keep the tablet parallel to the sediments and take a photo.
 - c. Then move ‘up’ the quadrat along the right-hand edge. Take a photo of the 20x20cm square. You should have string on three sides and PVC on one side.
 - d. Keep moving up until you have reached the top right corner, then move to the left and take photos moving ‘down’ the quadrat until at the bottom and move left and then take photos going up the quadrat, etc. (see the quadrat figure).
 - e. You should end at the lower left corner and you should have taken 16 photos of the individual squares.
 - f. After taking the photos of the 16 individual squares, **double check that all photos were taken/saved, the image quality is good, and no edges are cut off. Delete any duplicate photos.**
8. As time permits, repeat steps 1-7 at **two** additional representative locations with exposed bed sediment along the shoreline of the field site.
 9. And then, at **two** more locations take a photo of the entire quadrat as done in step 5, but do not take photos of the individual 20x20cm squares (i.e., **only take the photo of the whole quadrat**). This is to provide additional grain size information without adding much time to field effort.
 10. When you finish taking photos, make a note in the metadata sheet about the total number of locations you photographed. For example, “Photos of 3 whole quadrat + individual squares; 2 whole quadrat without individual squares” if you take all of the photos described.



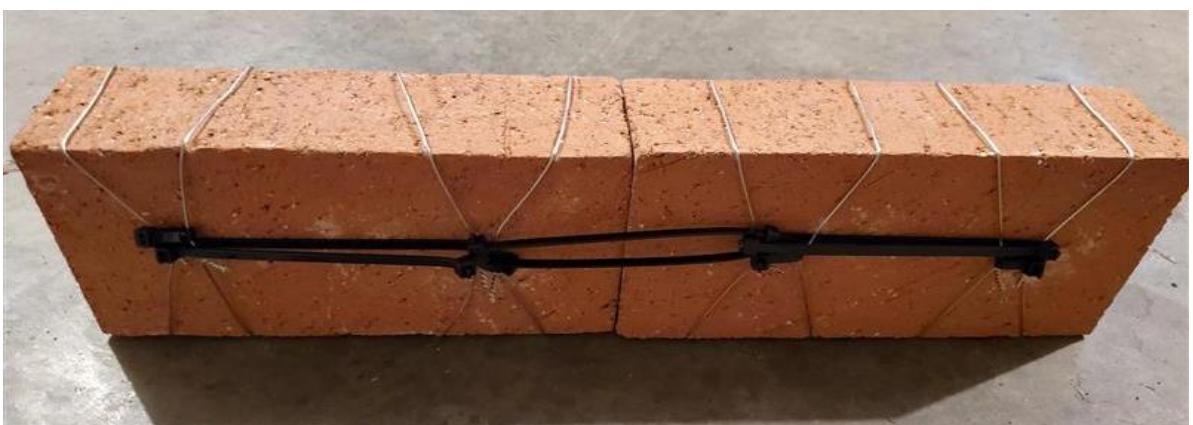
Cotton Strips

Overview: The purpose is to deploy cotton strips as proxies of decomposition. To the right is an image of the tea infusers being used to protect the cotton strips. It opens like a clam shell and is just the right size to lay a cotton strip down flat.

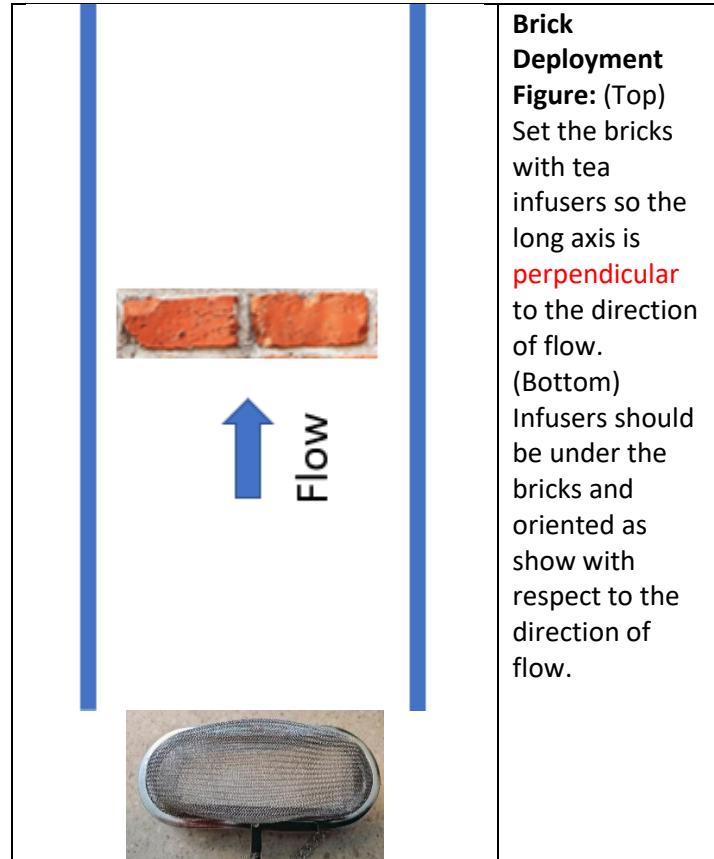


Deployment

Every site should have 4 tea infusers, each with one cotton strip inside. The infusers will already be attached to the bricks when you receive them, but the two brick assemblies will need to be attached together before deployment, as shown in the images immediately below (see the black zip ties on the bottom and top of the bricks). The upper photo shows the tea infusers which will be facing down nestled into the sediment. **Note the black zip tie in the middle of the photo connecting the two bricks.** The lower photo shows the reverse side that will be facing up out of the sediment. Follow the steps below.



- 1) Attach two brick assemblies together end to end using zip ties as shown in the pictures above.
- 2) Deploy the brick assemblies **upstream** of where the miniDOT DO sensor will be placed. This is so the infusers are not impacted by people walking in the river to maintain the DO sensor during the sampling week.
- 3) Find a location that is representative of the stream reach in terms of sediment texture and flow. **Do not** deploy in a pool/backwater/eddy with no/little/backwards flow. The location should allow for putting 2 bricks that have the 4 infusers next to each other. Also, **make sure** it's far enough into the stream channel (i.e., deep enough) that the location will still have water even if the stream depth decreases by ~6 inches during the 35 days of incubation.
 You will set the bricks with infusers in the sediment and so the long axis is **perpendicular** to the direction of flow. See figure on the right.
- 4) As best you can, nestle each brick/infuser assembly into the sediment (regardless of sediment texture) so that the 'rim' of each infuser is ~1cm below the average riverbed surface. If unable to see the tea infusers, try to use your finger to run along the edge of the rim to check if it is sitting within the sediment. This will be difficult to judge in gravel-bedded streams as the surface is rough and the bricks will block some of the view. Just do your best to get the infusers nestled in deep enough that the infusers are within the riverbed.
- 5) If needed, put another rock on top of the brick/infuser assembly to keep it from moving. Only do this if truly necessary, and most cases won't be necessary. **Please be aware that you don't want to squish the infusers so much that the top side impacts the cotton strip. If the infusers are squished all the way, it will make the cotton strips useless.**
- 6) Check the box on the metadata form indicating that the cotton strips were deployed.
- 7) Before leaving, say 'goodbye little buddies, you're about to get eaten by microbes and then ripped in half, but don't worry, it's for a good cause.'



MiniDOT and HOBO Deployment

Overview: The purpose is to collect continuous dissolved oxygen (DO) and water depth data from the open channel of the stream/river. This is done by deploying a miniDOT DO logger and a HOBO water level logger attached to two bricks in the open channel. This section combines the miniDOT deployment with the HOBO water level logger, because the sensor deployment method involves attaching both sensors to the same two bricks. Some miniDOTs that will be deployed in bigger and slower rivers have a miniWIPER assembly attached to them, which takes up additional space on the bricks. Therefore, deployment configurations will vary by site. **Check the hard copy sheet that has coordinates, etc. to determine whether a given site will have a wiper assembly.**

NOTE: The log intervals for all sensors and wipers needed for this deployment have been pre-programmed and logging/wipers have been turned on. All you need is to determine the best sensor/brick configuration for each site (see photos of potential configurations), zip tie everything together, and deploy the unit in stream as outlined below.

Deployment

- Upon arrival at the site, record the date, time, GPS location, and miniDOT serial number on the hard copy metadata sheet. If there is not a field for the miniWIPER serial number, record it in the notes section of the metadata sheet.
- Assess the stream channel suitability for deployment, including discharge, depth, and channel substrate. Channel depth and substrate will determine how you orient the bricks and attach the sensors. For example, the bricks can be 1) placed side-by-side with sensors attached to the sides of the bricks for the shallowest depths (Figure 2) or 2) side-by-side with the sensors on top of the bricks for deeper waters (Figure 1). **Connect the two bricks together independent of the sensors** with two zip ties as shown Figure 2 (top photo) and Figure 1. **This is critical so the HOBOs can be removed for data downloads—but the bricks remain in place—and redeployed in the exact same location and depth.** Attach the HOBO to one of the bricks using two zip ties: 1) run one zip tie through the HOBO hangar cap (the end with a single hole) and through one of the zip ties holding the bricks together and 2) run the second zip tie around the body of the HOBO and through the second zip tie holding the bricks together. Securing the hangar cap separate from the sensor body allows the sampling teams to unscrew the HOBO from the cap to download data **while leaving the cap in place**, zip-tied to the brick in the exact same location and depth as it was initially deployed. Zip tie the miniDOT similarly so it can be removed by the sampling teams to download data and remove and clean the copper kits without disturbing the bricks. **Make sure the sensors will stay underwater if the stream depth decreases by 6-12 inches *and* the wiper assembly can rotate freely.**
- Regardless of depth, place the sensor/brick configuration in the stream such that 1) both the miniDOT and HOBO are as far under water as possible AND are in the **main flowing part** of the stream (don't deploy in a backwater, pool, eddy, etc.); 2) **both sensors face upstream** (i.e., the black end of the miniDOT and the pointed-with-holes-end of the HOBO are pointed upstream), and 3) the bricks are oriented to **keep the miniDOT sensor window out of direct sun**. The brick may be oriented however best allows this to happen. For example, it can be set on its side if the water is very shallow.



Figure 2. Low profile sensor configuration for shallow water. Top: miniDOT without a miniWIPER and a HOBO water level logger. Bottom: miniDOT/miniWIPER assembly and HOBO water level logger.



Figure 1. Configuration for deeper water. Top: miniDOT without a miniWIPER and a HOBO water level logger. Bottom: miniDOT/miniWIPER assembly and HOBO water level logger.

- The miniDOT sensor window should be out of direct sunlight, either by being in the shade, or facing north, if at all possible. If necessary and flows permit, add a sun-shade by cutting a short piece of plastic—enough so that the plastic wraps only part-way around the sensor and extends a couple inches beyond the sensor face (much like an “awning” rather than all the way around it) and secure it with zip ties. Wherever possible, the sun-shade should also be oriented to keep the sensor window out of direct sun but **make sure it is still facing upstream**.
- Additionally, the miniDOT should be out of easy view from the public, if possible.

Pictures of the Site

Take the following photos (note these will be uploaded along with metadata). Hold the tablet in a **horizontal** orientation such that the picture should be wider than it is tall (i.e., landscape not portrait orientation). For pictures B, C, and D place a **measuring tape to 30cm** as a reference for scale and make sure it can be seen in the photos.

1. Whiteboard with the site ID and date
2. Looking across the river to give a sense of how broad the river is
3. Looking upstream, showing the river surface, shoreline sediments, and vegetation
4. Looking downstream, showing the river surface, shoreline sediments, and vegetation
5. Then take a 10 second video panning from upstream to downstream. Have your field partner stand very near the location of the cotton strips and DO/Hobo sensors. This will help the sampling team find the gear when they return.
6. Team photo – At one site, take a selfie in the field!

Place Signage

Overview: This is the sign to let people know there is equipment and to ask that they not disturb it.

1. On the shoreline in a clearly visible (e.g., on the exposed sediments) place and near where the DO sensor and cotton strips are deployed place a 2 gallon bucket in a flat spot in which it is stable.
2. Put the sign on the wood post in the middle of the bucket, and position it so the wood is seated on the bottom of the bucket.
3. Fill the bucket with rocks and/or sand (and probably some water) so it is stable.

Ending (in the field)

- Please confirm that all fields on the paper metadata sheet are filled out prior to leaving the field
- Take a picture of the filled out metadata sheet using the tablet.

Photo upload (out of the field)

Each day upload your photos into the RC2 **SharePoint** folder for the correct date and catchment. *If you have difficulty access the SharePoint site, at a minimum, download the photos to your laptop.* The top-level folder is found here: <https://tinyurl.com/SSS-Field-Photos>. Photos should be categorized into the following folders:

1. Environmental_Context_Photos: 1 photo looking across, 1 photo up-river, and 1 photo down-river, and the video.
2. Grain_Size_Grid_Photos: 1 quadrat photo and 16 sub-grid photos for each 'replicate' location you photographed for sediment texture of exposed riverbed sediments
3. Metadata_sheet_Photos: Photos of the metadata sheets from deployment, sampling, receive, transect depth, and kayak depth
4. People_Working_Photos: Any additional pictures of people working

Inside each of these folders, navigate to the date and alphanumeric site folder corresponding to your images and copy them over. **If you do not see the correct folder, create a date folder using the format of the other folders. Inside of each date folders, create a folder named with the alphanumeric site ID.** Place your photos into the subfolders you created. Archive any duplicated, blurry, or unwanted images.

Digitizing Metadata (out of the field)

Each day, digitize the metadata using this google form: <https://tinyurl.com/SSS-Deployment>. **Make sure to hit the submit button.**

Note: When you are typing up your free text notes from the open box on the metadata sheet, keep in mind that these will be reviewed for readability by other people and eventually published with the data, so please write clearly, and avoid shorthand.

Sampling Protocol

Before Going to the Field

Before the field: Water column respiration (manual chamber)

Manual Chamber: Prior to the field day

1. Charge 10 NiMH AA boat motor batteries so you have 3 batteries per site.
 2. Freeze the ice packs or purchase a bag of ice.
- Manual Chamber: Leaving the lab/hotel on measurement day

3. Record the three miniDOT serial numbers on the metadata sheet. Only record serial numbers for the three miniDOTs used in the chambers (not the two spares). **USE YOUR FIELD WATCHES TO ENSURE YOU ARE RECORDING ALL TIMES IN PACIFIC STANDARD TIME (PST).** Your phone will be displaying Pacific Daylight Time in August. Do not record in Pacific Daylight time.
4. Open the boat motor by unscrewing the front of the housing. There may be a white plastic screw that prevents the housing from coming unscrewed if it abuts the plastic flange extending outward on the lip of the back half. If so, remove the screw. If a screwdriver is unavailable, it is usually possible to simply continue unscrewing the housing until the screw rolls over the flange. This flange/screw combination acts as a “stop” for turning the motor on/off.
5. Place a battery into the front half of the boat motor, with the negative end going in first.
6. Screw the front of the motor onto the back half until it is snug. Note, when fully screwed on, the propeller will start spinning. The white screw should be snug against the small plastic flange to the left extending upwards on the lip of the back half. Turn the propeller off by unscrewing the back half $\frac{1}{4}$ -turn until the white screw is snug against the plastic flange to the right that extends outwards on the lip of the back half. **MAKE SURE THE PROPELLER IS NOT SPINNING BEFORE PROCEEDING TO THE NEXT STEP.**
7. Place miniDOTs, chambers (pre-filled with water from the lab), and toy boat motors in the cooler with the ice packs. Keep the spare miniDOTs separate from the three that will be used in the manual chambers. We want to use the same miniDOTs from day to day whenever possible. The spare sensors are in case you lose one in the river, drop and break one, etc.

Ultrameter: Leaving the hotel on measurement day

1. The ultrameter must be calibrated at the start of each day in the hotel. Follow the calibration steps on the back of the ultrameter. Calibrate with 500 us/cm for conductivity, 7 and 10 pH standards.

Step 4:



Step 5:



Step 6:



Step 7:



Figure 1

In the Field

Note: It is vital to start the tasks in the sequence described below (i.e., manual chambers, Manta, water sampling, sediment sampling, miniDOT download/clean/redeploy, and then wading transects).

Water column respiration (manual chamber)

Manual Chamber Equilibration Overview: When you arrive at a site, **immediately** start the manual chamber temperature equilibration. While you wait for equilibration, move on to deploying the Manta and starting water sampling. **Be sure to keep track of the equilibration time, so you do not miss the scheduled start time.** If you do, it could make the incubation unusable due to not having enough data.

Manual Chamber: Arriving at site

1. Take ice packs or ice out of the cooler with the miniDOTs, chambers, etc., and place them in the other cooler with ice (i.e., the cooler used to store the physical water samples). Leave the miniDOTs and all the equipment in the cooler. Carry the cooler to the monitoring location.
2. Immediately place the miniDOTs into the river so they are submerged in a location with flowing water. Hold them down with a brick or rock. On the metadata sheet, **record the time the miniDOTs go into the river**; this is the start of the **20 minute equilibration period**.
3. Pour out the water from the 2L bottles along the shore downstream of where you will take water samples but not in the river itself (to avoid transporting sediment, etc. into your sampling zone, and to avoid moving organisms around different field sites).
4. Rinse each 2L bottle three times with water from the stream by submerging it to fill and then pour that rinse water downstream of where you are working.
5. Fill each 2L bottle a fourth time and put in the toy boat motor (turned off). It is essential to remove air bubbles. They can get trapped in the corners of the bottle. To do this,
 - Use the pitcher to fill the bottle completely and cap.
 - With the bottle upright and closed, tap the bottle to knock bubbles loose, and then rock it around so the cap moves in a circle to encourage bubbles to rise to the top.
 - Remove the cap and use the pitcher to generate a convex surface above the neck opening, then re-cap.
6. Repeat the bottle rinsing and filling process with the other two 2L bottles.
7. Place the three filled 2L bottles into the stream so they are submerged. You may need to put a rock or brick on them to keep them in place. If the stream is too shallow to submerge them, place them as deep as possible and in the shade so the water does not heat up.
8. **When the 20-minute miniDOT equilibration time is over, record the equilibration end time on the metadata sheet.** **Note:** Aim for as close to 20 minutes as possible. Equilibrating for more or less time is bad.
9. Dump the water from each 2L bottle, remove the boat motor, and refill with fresh river water.
10. Place the miniDOT inside the chamber, with the sensor window UP (as shown). It is a close fit but should drop in without being pushed hard. The miniDOT will forcefully displace a fair amount of water so aim away from yourself.



Figure 2

11. Turn the boat motor propellor on and drop the boat motor into the chamber, with the propeller end up (as shown). The position of the rudder is not important. **NOTE: MAKE SURE THE PROPELLER IS SPINNING BEFORE PROCEEDING TO THE NEXT STEP.**



Figure 3

12. Follow the procedure above to remove air bubbles. **Leaving air bubbles inside the chamber can result in bad data, so try hard to eliminate them.**
13. After capping each 2L bottle, submerge it in the river and hold down with a brick or rock.
14. Repeat for the other chambers. The incubation period start is when all three are submerged. **Record this time on the metadata sheet.**
15. The incubation should last for **75 minutes**. While the incubation occurs, you can proceed with the other steps in the protocol. If you finish the protocol before 75 minutes, you will need to wait until the 75 minutes has elapsed to continue with this piece of the protocol.
16. When 75 minutes has elapsed, pull the chambers out of the river, **and record the incubation end time**. You do not need to pull the sensor or boat motors out of the bottles. When leaving the site, put the chambers and sensors back in the cooler with ice.
17. At the next site, dump the water as instructed above, but use the pitcher to catch the boat motor and miniDOT. Turn the boat motor off to save battery. Then repeat all the steps.



Figure 4

18. If you are done for the day, after the incubation period, extract the boat motor and miniDOT and refill the 2L bottles with river water following the procedure above to remove bubbles. **The 2L bottles must be stored full of water** to avoid air diffusion/capture.
19. Dry the miniDOT and do not turn it off. You do not need to **record the miniDOT end time until the last site of the week, when you will finally turn the miniDOTs off (open the miniDOT and flip the switch to "halt")**.

Manta deployment

Manta Overview: Deploy the Manta **after starting the manual chamber equilibration**. Make sure to deploy it **upstream** of where you will be doing manual chambers, water sampling, and sediment sampling. This is so the Manta is measuring undisturbed water. Once you start doing depth transects, the Manta **should be removed** from the water to avoid generating bad data (due to material kicked up into the water column while walking). Your Manta Multiprobe comes pre-programmed to log data at 1-min intervals and save the data to a pre-existing log file that has been created and stored in memory. Logging has already been “enabled” for you and is ready to be deployed (see section below on “Data logging and data downloading”). All you need to do is switch the battery pack on, place the Manta in the river, retrieve it when you are done at each site, and turn it off at the end of the day. **Each night you will bring the Manta back to the hotel and download the data.**

Manta: Upon arrival at the first site of the day

1. When you arrive at the first site of the day, remove the Manta storage cup, dump the water, and replace it with the weighted sensor guard.
2. **Record the serial number on the metadata sheet.**
3. Turn the Manta battery switch to “ON”. Remember to look for the red LED to blink five times to confirm that Logging is activated, and the green LED blink briefly to confirm that the Manta is receiving adequate voltage to start Logging.
4. Gently slip the Manta into the pipe kit. The Manta is tough but should be handled with care.
5. Close and secure the lid using the carabiner.
6. **Record the “Time turned on (start of day)” on the metadata sheet.**

Manta: Sensor deployment and retrieval

7. Find a representative section of the river to deploy the sensor, and gently lay the pipe kit/Manta on the riverbed as close to the thalweg (middle flowing part of the river) as you feel comfortable wading. Wherever possible, do not deploy the Manta in or immediately below a riffle or in a deep pool, unless a pool is the only section of river that can accommodate the probe.

- a) If needed, secure the pipe kit rope to either a large rock or a tree, if flow is high/fast.
 - b) If the river is too shallow to accommodate the sensor AND the pipe kit, you can remove the Manta and simply lay the Manta on the riverbed.
8. [Record the “Time in water \(at site\)”](#)
 9. Once all the physical samples are collected, and just before doing any work in the stream that is upstream of the Manta (e.g., retrieving sensors, depth transects), retrieve the Manta from the river. Due to the extreme heat—and the fact that two of the Mantas have pH sensors that must be kept moist—remove the weighted sensor guard and replace it with the storage cup. No more than $\frac{1}{4}$ " of water is needed, or you can just make sure there is some moisture in the cup. **DO NOT TOUCH THE BATTERY SWITCH UNTIL THE END OF THE DAY (see next section).**

Manta: At the last site of the day

10. Retrieve the Manta at the last site of the day and [record the “Time out of water \(at site\)”](#)
11. Pull the Manta out of the pipe kit and use a rag to dry the top of the Manta, around the battery plug to prevent water from seeping into the batteries.
12. Loosen the steel eye bolt on the battery plug until you can swing the battery switch back and forth and switch the notch to “OFF” making sure it is seated directly beneath then tighten. If not seated correctly it could snap.
13. Place the storage cup on and sure there’s a little water in the cup before you close it up. No more than $\frac{1}{4}$ " is needed, or you can just make sure there is some moisture in the cup.
14. [Record the time the battery switch is turned to “OFF”](#)

Ultrameter

Ultrameter Overview: If your team does NOT have a Manta with a pH probe, please take measurements using the ultrameter. If your team DOES have a Manta with a pH probe you can skip over the Ultrameter portion and [cross out that portion in the metadata sheet](#).

1. Equilibrate the ultrameter by dipping into the water and holding it under for 30 seconds.
2. [Record the start time on the metadata sheet.](#)
3. To take a sample, dip the ultrameter into the water again and toggle between the COND, pH, and TDS buttons to get readings. [Record on the metadata sheet.](#) (**Note:** the readings are not stagnant, and the screen switches off after about 10 seconds. This is normal so you need to take a reading before it disappears).
 - a. There is no button for temperature, but it should appear at the bottom of the screen whenever you toggle between COND, pH, and TDS.
4. After recording all the values, dump the water, dip the ultrameter again, and repeat the measurements. Take 3 measurements in total for each of analytes and [record](#).

Water Sampling

NOTE ABOUT FILTERED WATER SAMPLE COLLECTION: We have provided multiple Sterivex filters, one labeled and several unlabeled. **Use the labeled filter first and replace it only if it clogs.** When you finish collecting water or when the filter clogs (whichever happens first), preserve the labeled filter following that portion of the protocol below. Then you can continue filtering water with the unlabeled filters. Do not preserve unlabeled filters if they were used. **Preserve only the labeled filter.**

NOTES ABOUT STERILE TECHNIQUE IN THE FIELD: We collect samples in a sterile way due to the analyses we plan to perform on the samples. Contamination of the samples from the environment or from the sampler can lead to data that are unusable. Keep the following in mind as you sample,

- Be mindful of wind. Debris can fall into your sample.
- If you drop any of the materials on the ground after they have been opened or exposed (filter, syringe, etc) there are plenty of extras to replace those materials.
- When opening vials, DO NOT place the caps on the ground ever! Hold the edge of the cap in your hand instead. Do not put your fingers inside the cap.
- Do not touch the outlet of the syringes or the inlets/outlets of the filters.
- When filtering into the vials/tubes, do not touch the inside of the vial with the filters or syringe. Instead hover over the opening of the vial as you expel liquid from the filters/syringe.
- Avoid touching your gloved hands to the rims of vials. Instead, hold the body of the vial.
- When sampling sediment, avoid touching the sediment with your hands. Instead, use the metal tools provided. These were prepared specifically for this use and wrapped in foil to protect from contamination. If needed, use a second spatula.
- Do not place metal tools on the ground. Instead, they can be placed on the inside of the clean foil they were wrapped in. Do not place them on the outside of the foil that has been exposed to handling. That side is contaminated.
- Do not touch personal objects (i.e., cell phone, food, clothing, hair) with gloved hands. Remove gloves and put on a new pair if needed.

Water Sampling Overview: Follow the instructions below to collect your water samples downstream of the DO sensor and cotton strips bricks that were deployed during the deployment week and also downstream of where the manual chamber vials will be. Collect all the water samples before beginning sediment collection. After collection, vials, tubes, bottles, and the filter should go into a cooler with ice.

Prepare for Water Samples

1. Put on nitrile gloves.
2. Locate all the water sampling materials (vials, tubes, filter), which should all be together (sediment materials are packed separately).

Collect Filtered Water Samples

ICR SAMPLES

FILTERED WATER - Three pre-acidified 60mL AMBER GLASS vials (Wear safety glasses) ***These vials are for FTICR-MS. The label suffix after the kit ID is "ICR" and a replicate number (-1, -2, -3)***

3. Locate the labeled filter and the three 60mL amber vials labeled as "ICR". These contain a very small volume of phosphoric acid (safety glasses recommended). **Do not unscrew the vial lids.**
4. Open the filter package and attach a needle and leave the needle/filter assembly in the package
5. Open the 60 mL syringe package and remove the syringe.
6. While sampling, please **stand downstream of the sampling location and point the opening of the syringe upstream**. This is important to collect a representative sample and to avoid getting disturbed sediment into the water sample. Also sample from a location with flowing water.
7. Fill the syringe with river water, collecting water from 50% of the water column depth. Expel the syringe contents into the river (downstream of the sampling location) and repeat this two more times. You only need to flush the syringe as described when you first open the syringe package. You do not need to flush repeatedly when collecting additional syringe volumes.
8. After flushing the syringe 3 times, fill the syringe again from 50% of the water column depth; this is the sample water to be collected.
9. Screw the syringe onto the filter that has a needle connected to it. Remove the plastic cover that is protecting the needle while the needle is still in the filter package.

10. Push and discard 5 mL of water through the filter/needle assembly to prime the filter.
11. Without touching the vial septum, pierce the septum of the vial with the needle and expel water using the syringe plunger. Fill one of the acidified **amber** glass vials **to the pre-marked line**.
12. Shake the vial gently to incorporate the acid into the sample. Store vial on ice.
13. Prior to collecting the second replicate, remove the filter from the syringe, and push out all the water, then refill the syringe and push at least 5ml of water through the filter (this is to push new sample into the filter housing).
14. Collect the second replicate as described above into the second vial, then refill the syringe, flush the filter, and collect the third replicate into the third vial. Store vials on ice. *See the note above this section if your filter clogs. If your filter clogs, skip down to the filter preservation section before continuing on with a new filter here. When ready to continue here, one of the extra, unlabeled filters has a luer-lok connection to attach a needle. Find that extra filter if needed. The others do not have the luer-lok connection on the outlet.*
15. **Remove the needle before moving on. This is to avoid any acid cross-contamination.**

OCN SAMPLES

FILTERED WATER - Three 40mL AMBER GLASS vials. ***These vials are for DOC and total N. The label suffix after the kit ID is "OCN" and a replicate number (-1, -2, -3)***

16. Locate the 40mL amber vials labeled as "OCN".
17. Collect water into the syringe as described above and flush 5 ml through the filter.
18. Open one 40mL glass vial and fill up to the pre-marked line (~ $\frac{3}{4}$ full)) by holding the filter outlet above the vial opening. Then re-cap the vial.
19. Refill the syringe as described above, flush 5 ml through the filter and collect the second replicate in the second vial. Repeat for the third replicate in the third vial. Store vials on ice.

WIN SAMPLES

FILTERED WATER - Three 15mL WHITE CAP PLASTIC TUBES. ***These tubes are for ions. The label suffix after the kit ID is "WIN" and a replicate number (-1, -2, -3)***

20. Locate the plastic 15mL tubes labeled with "WIN".
21. Collect water into the syringe as described above and flush 5mL through the filter.
22. Open one 15mL tube and fill to 10mL by holding the filter outlet above the tube opening.
23. Refill the syringe as described above, flush 5mL through the filter and collect the second replicate, and repeat for the third replicate. Store tubes on ice.

FILTER PRESERVATION

USED, LABELED FILTER (Wear safety glasses) *for microbial sequencing*

24. For the **labeled filter only**, continue to push 14 syringe fulls of water (to complete 1 L of water through the filter) or until it clogs before moving forward with preservation. This water will not be collected.
25. To preserve the microbes, detach the 60mL syringe from the **labeled** filter, expel remaining water from the syringe, and **fill the syringe with air**.
26. Attach the air-filled syringe to the filter and push the air through the filter. The goal is to expel as much water from the filter as possible. Repeat 2 or 3 times if needed.
27. Take the used labeled filter off the 60mL syringe.

28. Take the “female” luer lock cap, dip it into the stream to rinse it and then **attach it to the open (discharge) end of the filter**. Note that the filter has a “male” side and a “female” side and therefore there are two types of caps provided.
29. From the provided supplies, take out a small plastic epi tube filled with RNALater. This is the preservative for the filter. Also take out a 3mL syringe and a new needle.
30. Connect the new needle to the 3mL syringe, carefully open the small epi tube, and fill the syringe with all the RNALater by simply putting the needle down into the liquid.
31. Invert the filled syringe so that the needle is facing up. Safely discard the needle.
32. Attach the 3mL syringe to the filter and rotate so that the syringe is facing down and the filter is below it. Push the plunger to slowly fill the filter with RNALater. Fill until you feel some resistance or until you have used all the RNALater.
33. Detach the syringe and place it back into the syringe wrapper. Locate the remaining luer lock cap, dip it into the stream to rinse it, and then attach to the filter. Gently shake the sealed filter to distribute the RNALater.
34. Put the capped filter into a small whirlpak bag, tie up to seal, and place in the cooler. Please ensure no water enters the whirlpak bag.

Collect Unfiltered Water Samples

BWT SAMPLES

UNFILTERED WATER - One 500mL OPAQUE BROWN PLASTIC BOTTLE. **This bottle is for bulk unfiltered water and is labeled with “BWT”.**

35. Locate the opaque brown plastic bottle labeled with “BWT.”
36. Face upstream and simply fill the bottle from ~50% of the water column depth and cap it.
37. Store on ice.

TSS SAMPLES

UNFILTERED WATER - One 2L OPAQUE BROWN PLASTIC BOTTLE. **This bottle is for total suspended solids, and is labeled with “TSS” and a replicate number (-1)**

38. Repeat the same steps listed in the BWT section above but use the 2L bottle labeled “TSS.”

Vials	Storage Richland
TSS 2 L amber rectangle amber bottle filled with unfiltered water (-1)	4°C Cold Room F (2F) 2nd from top shelf
OCN 40ml amber glass vials (filled ¾ way with water) (-1, -2, -3)	Half will be kept and sent to Sequim. Doesn't matter which half as long as all of one sites reps are together. The rest will go to 4°C Cold Room F (2F) 2nd from top shelf.
WIN 15 mL white capped proteomic friendly tubes (filled to 10mL with water) (-1, -2, -3)	-20°C Freezer (2245)
ICR 60ml amber glass vials. Acidified and filled ½ way with water.	-20°C Freezer (2245)
Sterivex Filter with luer lock (Filled with RNAlater, and capped, in whilrpak)	-80°C Freezer Media Prep Room (2237)

Sediment Sampling

Identify Sampling Location

After completing the water sampling, identify a wadeable (i.e., **in water**) sampling location for sediment collection in a **depositional zone near the water sampling location** (Fig. 5). Sampling should focus on fine grained material that is <2 mm in diameter (a sieve will be used to help with this).

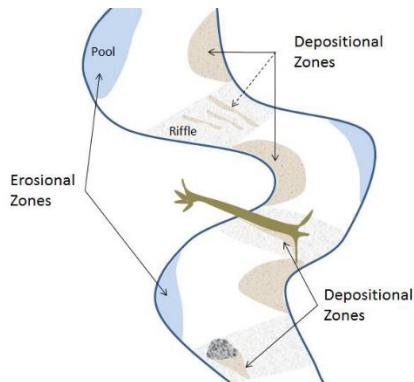


Figure 5. Examples of depositional zones, as defined in the NEON protocol (NEON.DOC.001193; Jensen, 2019): “the area within a river where the energy regime is low and typically are found at the inside bend of a stream, riffle, pool lip, downstream from obstacles or simply shallow waters near the shore (USGS, 1994)”. As in the NEON protocol (NEON.DOC.001193; Jensen, 2019), “The sample strategy for sediment analysis focuses on fine-grained surficial sediments from natural depositional zones... (USGS, 1994). Surface sediment is considered to range from 1 to 3 cm in depth (Golterman et al., 1983; Keith, 1991).” **Collect sediments from a depositional zone and avoid erosional zones, to the degree it is possible.** Image from NEON protocol (NEON.DOC.001193; Jensen 2019). **Sediment should be collected under water.**

1. Record the latitude and longitude of the **sediment collection** location in decimal degrees.
2. Measure the water depth where sediments will be collected and **record it on the metadata sheet** in centimeters.

Collect Sediment

3. Locate the foil-wrapped 30mL scoop and scoopula.
4. Put on a new pair of nitrile gloves to be used for sediment collection.
5. Unwrap the scoop and scoopula and ensure you only touch the handles and not the spoons. Wash the scoop and scoopula by dipping them in the stream. If you need to set down the scoop or scoopula, place them on the clean side of the foil to minimize contamination.
6. Before sampling, rinse the sieve and sieve pan in the stream water. Try to clear all sediment and other material from the sieve and sieve pan. Do not use fingers, etc. to clean (even if fingers/hands have nitrile gloves on). If needed, use the scoop and scoopula to help clean.
7. Use the scoop to collect **underwater** surface sediments (**1-3 cm depth**, ideally, but can go a little deeper if needed) from the streambed. Decant any bulk water (e.g., hold the scoopula against the scoop to retain sediments as you tip the scoop to drain water). Avoid plant material.
8. Scoop sediment onto the sieve and push it through using the provided metal tools.
9. To get enough material, it is okay to move around and collect sediments from across the depositional zone and even to move to additional nearby depositional zones with a similar physical setting and similar sediments.
10. Once you have enough sediment, tip the pan to drain excess water (but be careful not to lose fine-grained sediment) and use the metal tools to stir the sediments to homogenize them.
11. Once the sediments are homogenized, move onto parsing sediments into the vials as indicated below. All vials, tubes, etc. should have a pre-marked line to fill sediments to. For all vials/tubes besides the vials with RNAlater, it is okay to remove some sediment using the scoopula, if too much sediment is added. However, take great care if doing this with vials that have optode dots as we don't want to damage the dots.

Step	Vials	Instructions	Storage Richland
11a	Three 15 mL proteomic friendly vials labeled with “SCN” and a replicate number (-1, -2, -3): These are for bulk C/N analyses.	Scoop 1 ml into each SCN vial.	-20°C (2245)
11b	Three 50 mL proteomic friendly vials labeled with “SIN” and a replicate number (-1, -2, -3): These are for water extractable ion analyses.	Scoop 10 ml into each SIN vial.	-20°C (2245)
11c	Three 50 mL proteomic friendly vials labeled with “SED” and a replicate number (-1, -2, -3): These are for water extractable organic matter analyses.	Scoop 10 ml into each SED vial.	Flash freeze immediately, then -80°C (2215)
11d	Three 40 mL glass vials with optode dots and labeled with “INC” and a replicate number (-1, -2, -3): These are for aerobic respiration rate measurement.	Scoop 10 ml into each INC vial. The vials will be wrapped in foil because the optode is sensitive to light and must be covered. Only unwrap when you are about to sample and fill to the pre-marked line. Once done, immediately wrap in the foil again. Super critical to do this.	Store in the 4°C upon arrival to the lab, then let sit for 1 day, then place in the 2G (21°C) chamber by the end of the day with breatheeasy membranes. Let the temperature stabilize overnight
11e	Three 5 mL epi tubes labeled with “ATP” and a replicate number (-1, -2, -3): These are for ATP analyses as proxy of active microbial biomass.	Scoop 1 ml into each ATP vial.	Store in the 4°C upon arrival to the lab, then let sit for 1 day, then place in the 2G (21°C) chamber by the end of the day with breatheeasy membranes. Let the temperature stabilize overnight
11f	One 50 mL proteomic friendly vial labeled with “GRN”: This is for grain size analysis.	Scoop 50 ml into the GRN vial.	4°C Cold Room F (2F) 2nd from top shelf
11g	Three 2 mL epi tubes labeled with “XRD” and a replicate number (-1, -2, -3): These are for mineralogy analyses.	Scoop 1 ml into each XRD vial.	4°C Cold Room F (2F) 2nd from top shelf
11h	One 50 mL proteomic friendly vial labeled with “HK”: This is for heat kill analysis.	Scoop 40 ml into the HK vial.	Tap sediments onto side and freeze at -20 °C (2245)
11i	Three 50 mL proteomic friendly vials labeled with “MOI” and a replicate number (-1, -2, -3): These are for moisture analyses.	Scoop 10 ml into each MOI vial.	Transfer to MOI Tins and place in oven at 105°C, once dry transfer to PF tube and store in dark place.

11j	One 50 mL proteomic friendly vial labeled with “ST”: This is for long-term storage.	Scoop 30 ml into the ST vial.	Flash freeze then -80 °C (2215)
11k	Two 50 mL proteomic friendly vials with RNAlater labeled with “MIC”: This is for microbial sequencing.  <p>Figure 6. 50 mL tube before sediment has been added (left) and after sediment has been added (right). Note that after sediment has been added, the total volume in the tube is at the pre-marked line.</p>	Scoop 7.5 ml into the MIC vial, or until the **liquid** reaches the pre-marked line (Fig. 2). If you accidentally go past the line, do not try to remove material as it will likely contaminate the sample and/or lose RNAlater. Be careful to not splash RNAlater out of the tube. Take care not to spill the RNAlater at the sampling site. After adding sediment, gently mix with the RNAlater by inverting the closed tube 5-10 times.	-80°C (2215)

Table 1

- Following collection, place all vials, tubes, etc. onto ice in a cooler.

miniDOT download, clean, redeploy

MiniDOT Overview: After collecting samples you will need to download, clean, and redeploy the miniDOT sensor that was placed in the stream channel during the Deployment Week. This is not the same as the miniDOT inside the manual chamber bottles. **NOTE:** This is an opportunity to split tasks across the team. The miniDOT/brick deployment will also have a HOBO water level sensor attached that will also need to be downloaded (see section on the HOBO depth sensor). Another option is to have one person clean the copper kit and miniWIPER (if miniWIPER is present) while the other downloads the miniDOT data. You can also consider having one person start doing wading transects while the other handles the miniDOT. **Multi-tasking across the team is important to stay on schedule.**

If the MiniDOT is not at the site location (i.e., it was stolen or lost). You can sacrifice one of the manual chamber miniDOTs and deploy one of those into the stream instead. The instream DO is more important than the manual chambers. To redeploy, please find a new spot that will make it harder for the public to disturb it. We can sacrifice up to 2 miniDOTs if needed because replicates are not as necessary for manual chambers. If you need to sacrifice the third miniDOT, call James to discuss the situation first.

MiniDOT Retrieval and Cleaning

- Retrieve the miniDOT/brick assembly from the river. At some sites (typically larger streams with little shade), the miniDOT will be paired with a miniWIPER connected to the miniDOT with a bracket assembly (aka “miniDOT/WIPER”). A HOBO water level sensor is also zip tied to the bricks (see the section “HOBO download, clean, and redeploy”).

2. Record the time the sensor is taken out of the water.
3. Set up a flat workspace away from the water's edge and make sure that you are dry enough that no water drips off your hair or clothing onto the electronic components while working.
4. You will need to cut zip ties to access the sensor. However, to simplify sensor maintenance and downloads in the field, bricks were zip tied together separately from the sensors and do not need to be disassembled. To avoid making extra work for yourself, **make sure you only cut the zip ties holding the miniDOT or miniDOT/WIPER assembly**. Several different configurations of bricks (2-4 bricks) + sensors (miniDOTs and HOBOs) were used in the field depending on the depth and flow of the river at the time of deployment.
 - a. Shallow, slower-moving streams usually deployed with a single miniDOT and HOBO in a very low-profile configuration consisting of two bricks laid side-by-side and a miniDOT and HOBO sensor zip tied on either side of the bricks as shown in the figure below. These miniDOTs are equipped an anti-fouling copper plate and a copper mesh plus a nylon spacer mounted to the sensor face (collectively known as a “copper kit”).



Figure 7

- b. Deeper, faster moving streams were typically deployed a higher profile configuration consisting of two bricks (or four bricks in certain cases where the current was very strong) laid side-by-side and either a) a miniDOT or b) a miniDOT with a miniWIPER (aka “miniDOT/WIPER”) attached to the miniDOT with a bracket assembly, and c) a HOBO sensor zip tied to the top of the bricks as shown in the figure below. In shallower rivers that receive a lot of sunlight, the miniDOT/WIPER may be zip tied to the side of the bricks at an angle (no photo available). MiniDOT/WIPER assemblies are equipped with an anti-fouling copper plate screwed to the sensor head.



Figure 8

5. Disassemble the miniDOT from the brick assembly (cut zip ties)
 - a. MiniDOTs configured with miniWIPER assemblies: Cut the zip ties connecting the miniDOT/WIPER assembly to the zip ties connecting the bricks. Try not to cut the zip ties holding the bricks together (if you do, simply use new zip ties to reconnect the bricks). On the bracket that holds the miniDOT and wiper, loosen all 6 bolts with an Allen key. Carefully slide the miniDOT backward and remove it from the bracket. Note that the miniDOT fits very tightly in the bracket, so you may need to loosen the bolts further. If it slides out, you can leave the wiper in place, but it may be necessary to remove the center bolts entirely, which will remove the bracket pieces from the baseplate. It may be necessary to remove all 6 bolts, which will disassemble the bracket.
 - b. MiniDOTs only: Cut the zip ties connecting the miniDOT to the zip ties connecting the bricks. Try not to cut the zip ties holding the bricks together. If you do, simply use new zip ties to reconnect the bricks.
6. Record the condition of the sensor window on the metadata sheet (e.g., it is clean, covered in mud or algae, something else?)
7. Wipe the exterior of the miniDOT dry with a cloth
8. Remove the copper kit from the single miniDOT (unscrew the 3 screws and take it off) and place the copper plate, copper mesh, and nylon spacer in a cup along with some vinegar and allow them to soak while you are downloading data. You may not need to soak them in vinegar if they are not very dirty. (NOTE: the copper plate on the miniDOT/WIPER does not need to be removed since the sensor window is accessible through the opening on the plate.) Set the screws aside in a zip loc bag so they do not get lost.
9. Carefully but thoroughly clean the sensing window (the black, inset window in the center of sensor face shown in the photo below with a wet Q-tip. The window has a soft rubber coating

that you do not want to damage, but you do want to remove any algae, mud, or other foreign matter on the window. Rinsing and GENTLE rubbing with a wet Qtip are generally sufficient.

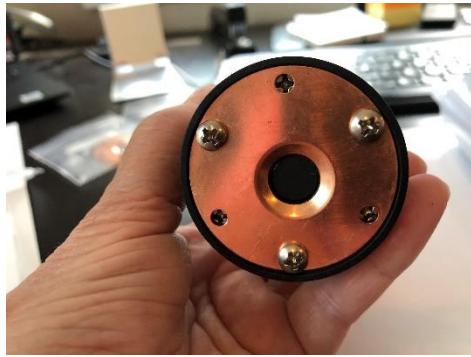


Figure 9

10. If necessary, gently scrub the copper plates, copper mesh, and nylon ring with a toothbrush after they have soaked in vinegar for a while.
11. Re-install the copper kit. Note that the sensor is slightly offset from center (see above photo), so you will need to rotate the copper plate to fit properly. If the sensor has a copper kit, replace the copper mesh over the copper plate and then add the nylon spacer. Do not overtighten the screws when replacing a copper kit.

Downloading data from the miniDOT in the field

12. Remove the sensor housing (white plastic tube) from the sensor core (the part that consists of the sensor and circuit board) by unscrewing it from the black cap. Try not to touch the circuit board while working. **NOTE:** Only work with one miniDOT at a time so you do not accidentally separate or mix-up multiple sensor inner cores from their housings, which will mismatch serial numbers on the inner and outer parts.
13. To download the data, connect the sensor to your laptop using the supplied micro USB cable. (Upon connection, the LED immediately below the USB port should blink green.) **NOTE: DO NOT TURN SENSOR LOGGING OFF**, i.e., do not flip the toggle switch to “Record” (see “NOTE” in Step #6 for more information).
14. In Explorer, click on “Local Disk” (you can read the contents of a miniDOT just like a USB drive). You will see three Java files (.jar) and a data folder. MiniDOTs store data files (aka “log files”) as text files (.txt) in the data folder on the sensor’s hard drive (local memory). The data folder on each miniDOT is named “7450-SensorSN” where SensorSN = the unique 6-digit serial number associated with each miniDOT:

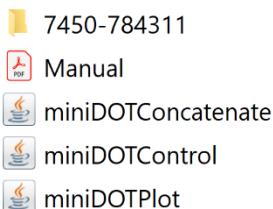


Figure 10

15. Right-click on the data folder to copy it.
16. Once you have copied the folder, paste it into the appropriate folder on your laptop. At end of the day, you will upload these data to the SharePoint. Sensor data is stored on the RC2 SharePoint by date and by site ID. The file folder structure has already been created for you, so all you need to do is locate the folder for each day. Go to this link: <https://tinyurl.com/SSS-Minidot>. Then navigate to (or create) the date folder. This date should correspond to the date that the data was **downloaded**. Inside this folder, find (or create) a folder with the site ID.
17. Quickly review the data to make sure the miniDOTs were 1) turned on and 2) recorded “good” data. Data is recorded once every minute .
18. Each log file contains five columns of data and one row or data record for every minute data was recorded.
 - a. Unix time
 - b. BV = battery voltage (V)
 - c. Water temp (°C)
 - d. DO (mg/L)
 - e. Q (sensor quality based on degree of light penetration; manufacturer-specific)
19. ***Open the text file*** and check that the data values are representative of the conditions you would expect for the stream you are working in (e.g., temperature, DO concentration).
20. ***When you’re certain that you copied the data correctly to your computer, and that the data looks reasonable***, disconnect the sensor by closing the Control window or simply unplug the USB cable. **NOTE: Do not delete the data from the sensor** (see “NOTE” in Step #6 for more information). The Explorer window will close on its own, so you will have to open a new Explorer window each time you connect a new sensor.
21. Replace the sensor housing and hand-tighten until the silicon O-ring is fully inserted below the lip of the housing. DO NOT OVERTIGHTEN or it will be very difficult to remove next time.

Redeploying the miniDOT

22. Re-attach the miniDOT (with miniWIPER if so-equipped) and the HOBO to the bricks, as it was prior to retrieval. Reattaching a miniDOT/WIPER assembly is a bit more complicated:
 - a. Insert the miniDOT back in the bracket, align the miniDOT and wiper so the brush completely contacts the sensor, tighten the bracket bolts, and check the wiper for alignment.
 - i. Examine the miniDOT sensor face. Note that the sensor is slightly offset from center. Locate the flat screw that is closest to the sensor. When installed, the miniDOT should be rotated so this screw is as close as possible to the wiper.
 - ii. Insert the miniDOT in the bracket so the protrusion on the wiper (under the center of the large wheel) is lined up directly over the screw from the last step. The miniDOT should be inserted far enough forward that the wiper protrusion just makes contact with the black miniDOT cap.
 - iii. Tighten all 6 bolts on the bracket until the locking washers are flat and the bolts are snug. There is no need to overtighten the bolts—just tighten them with moderate pressure until they stop turning.
 - iv. Move the magnet around the sides of the wiper housing until the wiper activates (the activation point is different on different wipers). Look closely at the brush as it moves and make sure it covers the entire sensor circle and makes

contact with the sensor. If it does not, readjust the wiper and/or miniDOT position in the bracket.

- b. Re-attach the bracket baseplate and the HOBO to the brick as it was prior to retrieval.
23. Place the whole assembly back in the stream as close as you can to where it was when you retrieved it. When you put it back, make sure it stays underwater and is in an area that has flow so that it integrates upstream domain. It cannot be in places like an eddy or waterfall that have no flow or too much turbulence. If it comes out of water, the data is not good. **The priority is that the sensor goes back into a spot that will give us good data despite it potentially not going back into the same spot as first deployed.**

[24. Record the time the sensor is placed back in the water.](#)

25. Here are the initial placement requirements provided to the Deployment Week Team:

- Place the miniDOT in the stream, so that is as far under water as possible. The brick may be oriented however best allows this to happen. For example, it can be set on its side if the water is very shallow. If the water is not very shallow, the brick should be under the miniDOT, so the miniDOT is **not** right up against the streambed.
- The miniDOT sensor window should be out of direct sunlight, either by being in the shade, or facing north, if at all possible.
- Additionally, the miniDOT should be out of easy view from the public, if possible.

HOBO download, clean, and redeploy

Hobo Overview: As with the miniDOTs and miniWIPERs, we will be retrieving the HOBO water level loggers, disassembling them from the miniDOT/HOBO brick assembly, cleaning the logger, downloading logger datafiles in the field, and redeploying the HOBO with the miniDOTs on the brick assembly. Data downloads in the field will be conducted using a HOBO Waterproof Shuttle (“shuttle”) and then offloaded from the shuttle each evening back in the hotel. **NOTE:** Shuttles have been preprogrammed to correctly sync and relaunch the HOBOs following downloads in the field.

HOBO retrieval and cleaning

1. Go get the HOBO/miniDOT brick assembly from the river. See the MiniDOT Retrieval and Cleaning, Step 3 for different sensor/brick configurations deployed in the field.
- [2. Record the time the HOBO was removed from the water.](#)
3. Disassemble the HOBO from the brick assembly.
 - a. Note that the HOBO is attached to the bricks using two zip ties. Cut the second zip tie that runs around the body of the HOBO:
 - i. One zip tie runs through the HOBO hangar cap (the end with a single hole) and through one of the zip ties holding the bricks together. DO NOT cut this zip tie.
 - ii. A second zip tie runs around the body of the HOBO and through the same zip tie holding the bricks together. Cut this zip tie.
 - b. Now you can simply unscrew the HOBO body from the hangar cap while leaving the cap in place. The body and shuttle connection are completely waterproof so the waterproof shuttle can be used to download the logger while it is underwater.
4. Wipe the exterior of the HOBO dry with a cloth

Downloading HOBO data in the field using the waterproof shuttle

5. Make sure the shuttle’s large cap and center cap are closed securely. Tighten the center cap until it is just flush with the large cap, or until the O-ring is no longer visible.

6. Make sure the communication end of the shuttle is clean. Attach the coupler and ensure that it is seated properly.
7. Insert the logger into the coupler by lining up the slot on the logger with the groove in the coupler.
8. *Momentarily* press and release the coupler lever (circled in red, below), pressing hard enough so the lever bends. Readout should begin immediately. The **amber LED blinks continuously** while readout and relaunch are in progress. **NOTE: Do not remove the logger when the amber LED is blinking.** After reading out the logger, the shuttle synchronizes the logger's clock to the shuttle's internal clock and relaunches the logger, using the settings that the logger was originally launched with.

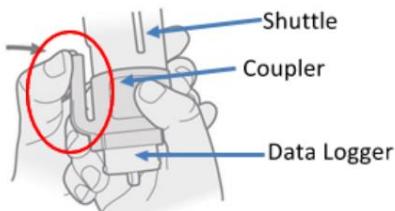


Figure 11

9. When the relaunch has completed, the **green LED blinks for 15 minutes**, or until you momentarily press the coupler lever to stop it (press hard enough so the lever bends). If the **red LED blinks instead, there was an error**, and the logger may have stopped. Refer to "Troubleshooting" in the manual for details.
10. Remove the logger from the coupler (even if the green LED is still blinking).

Redeploying the HOBO

11. After you have downloaded the HOBO, screw the HOBO body back on to the hangar cap and reattached the body to bricks, as it was prior to retrieval.
12. Place the whole assembly back in the stream as close as you can to where it was when you retrieved it.
13. Here are the initial placement requirements:
 - Place the miniDOT in the stream, so that is as far under water as possible. The brick may be oriented however best allows this to happen. For example, it can be set on its side if the water is very shallow. If the water is not very shallow, the brick should be under the miniDOT, so the miniDOT is **not** right up against the streambed.
 - The miniDOT sensor window should be out of direct sunlight, either by being in the shade, or facing north, if at all possible.
14. Additionally, the miniDOT should be out of easy view from the public, if possible.
15. Record the time the HOBO was redeployed and indicate whether it was placed in the same location on the metadata sheet.

Installing HOBOware Pro Software and setting software preferences

16. Install HOBOware Pro software by clicking on the executable file "**HOBOware_Setup**" and follow the default options. HOBOware will be installed in the following directory: C:\Program Files\Onset Computer Corporation\HOBOware.
17. Open HOBOware from your laptop *Start Menu>Onset Applications>HOBOware*. The Setup Assistant appears the first time you open HOBOware. Click Start and follow the prompts to

select device types, units, and data assistants. Enter the **License Key** (see the Appendix for all file locations). Click “No” in the pop-up window “Check for updates.”

18. Once the software is installed, set “*HOBOware Preferences*” by clicking the dropdown menu *File>Preferences...* to open the *HOBOware Preferences* dialog box as shown below.
19. Select the appropriate icon (left-hand sidebar) to set *HOBOware Preferences* for “General,” “Communications,” “Plotting,” and “Display” (shown in no particular order in steps a, b, c, and d in the figures below). These preferences define which parameters and units you want the HOBO to log, as well as how you want to view, plot, and download sensor data. For example, to set *General Preferences*, click the icon labeled “General” (circled in red in the figure above) to display all available *General Preferences* options. **Do not click the “OK” button (bottom right-hand corner) until you have set all four preferences as outlined in and saved the Preference file** (see next step).

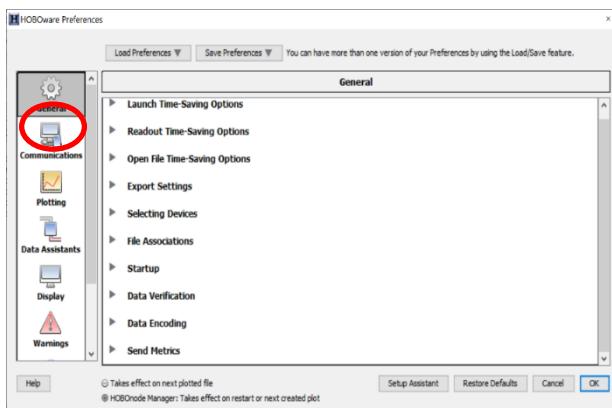


Figure 12

a. Communications Preferences

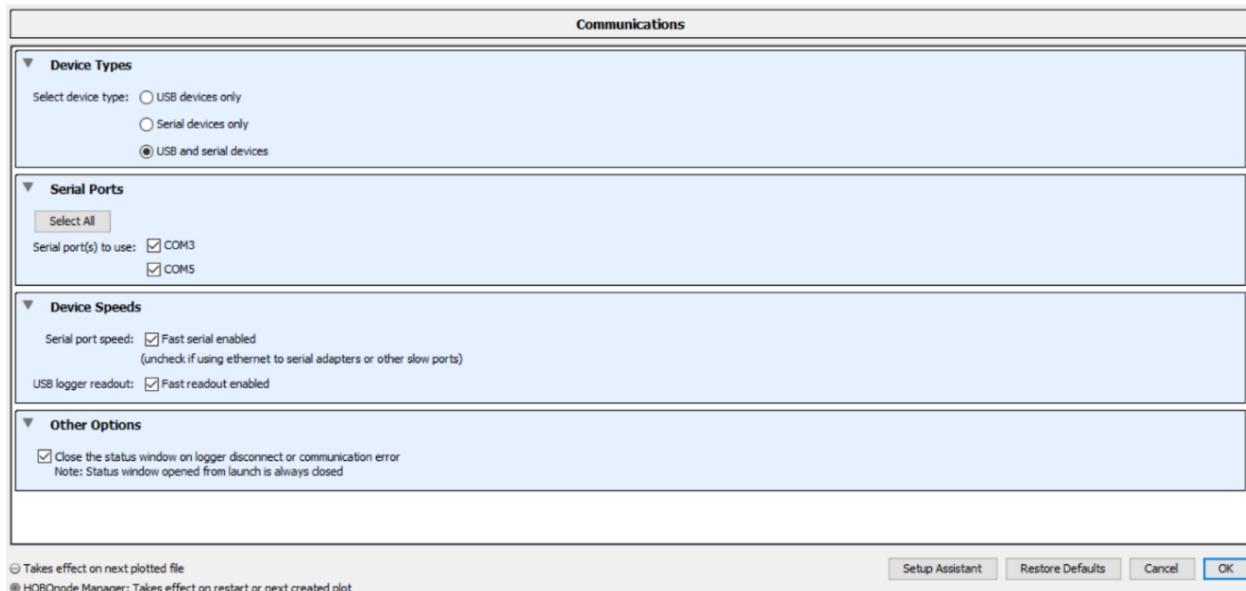


Figure 13

b. Plotting Preferences

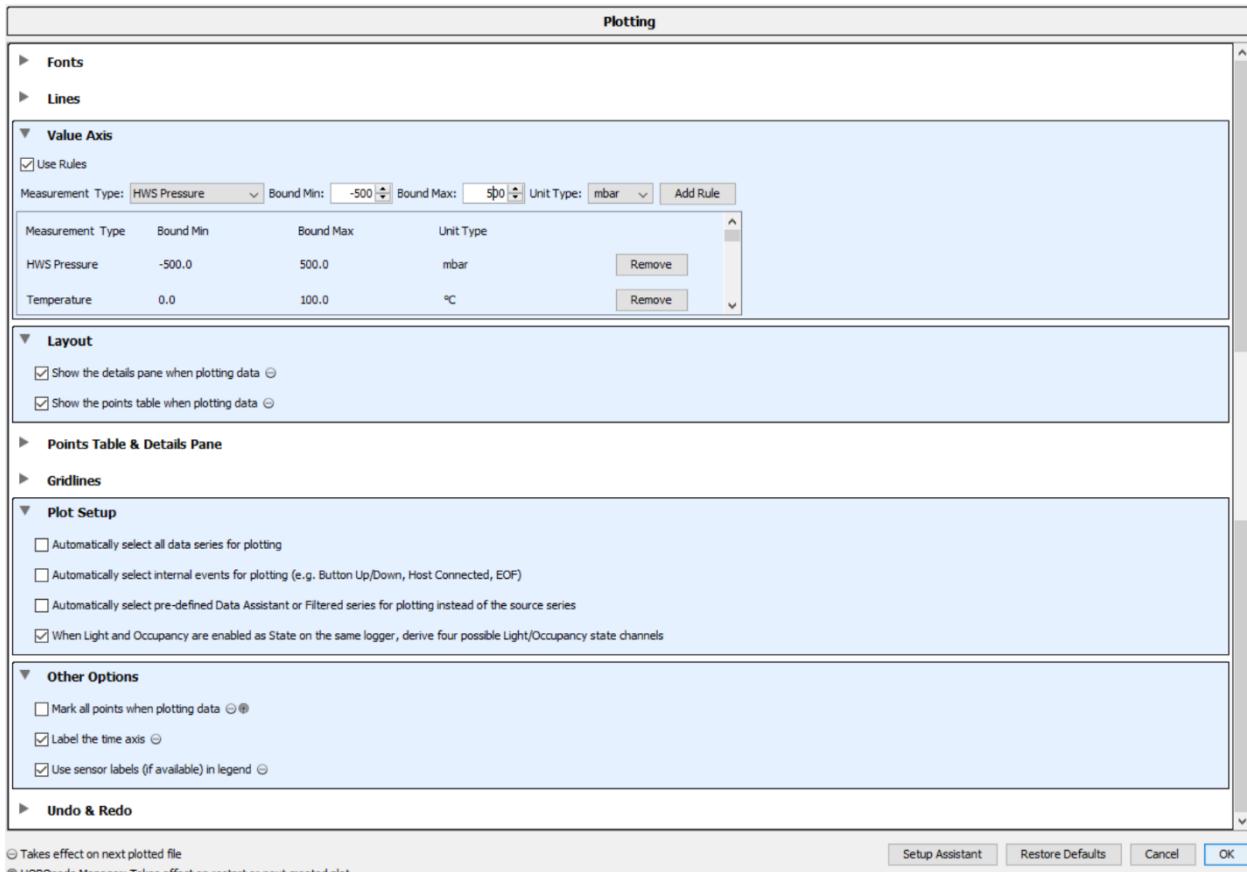


Figure 14

- Set the upper and lower bounds for each logger parameter under the *Value Axis* option. First, use the *Measurement Type* dropdown menu to select each parameter and then type the Bound Min, Bound Max, and Unit Type as shown above for pressure (i.e., HWS Pressure) and below for temperature.



Figure 15

- Display Preferences

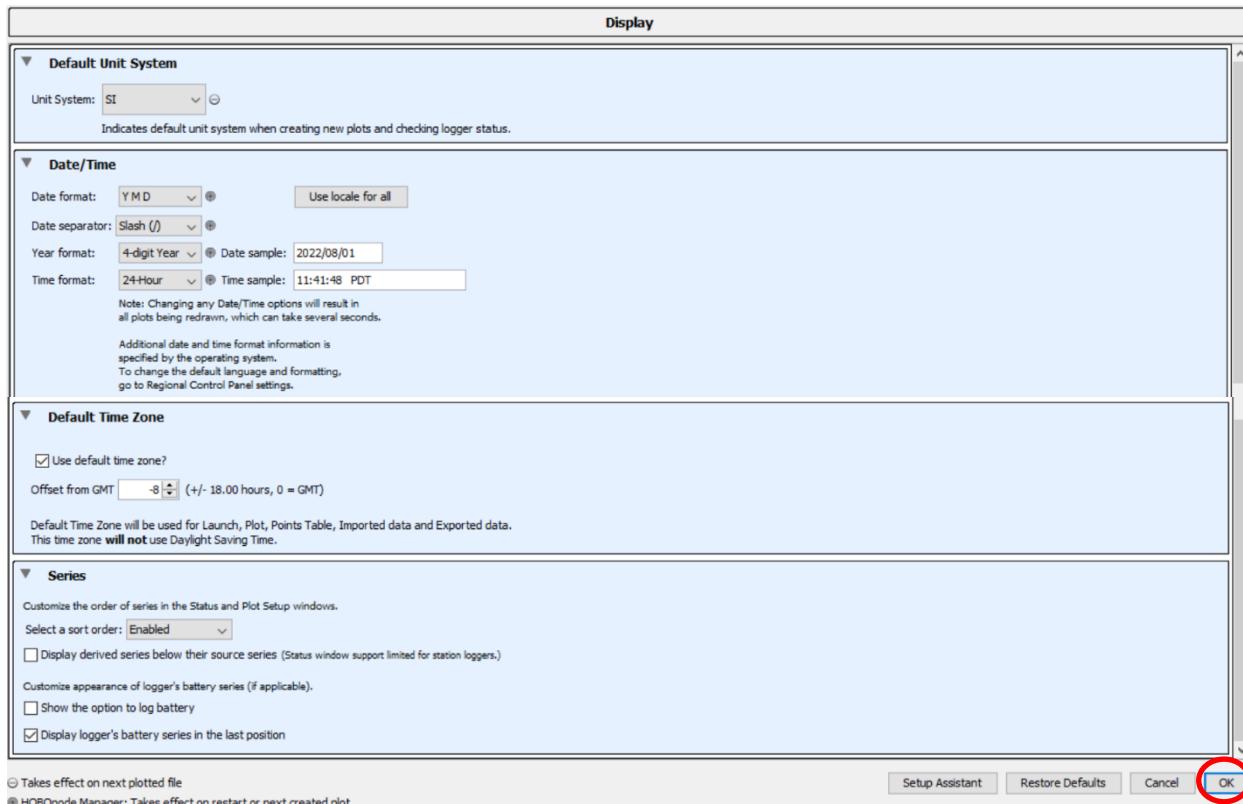


Figure 16

- General Preferences

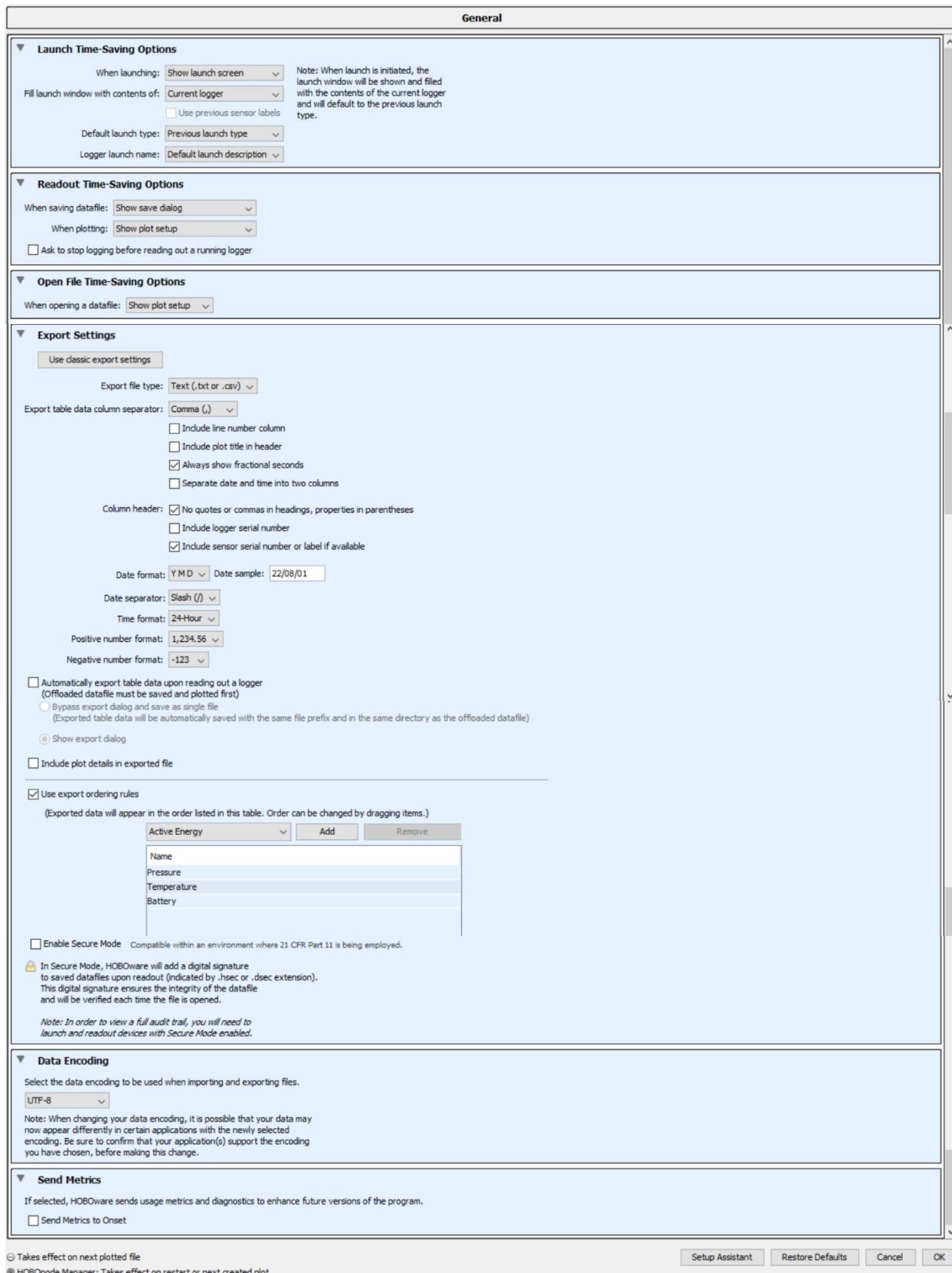


Figure 17

20. When you have finished setting Preferences as outlined , click the “Save Preferences” dropdown menu (circled in red, below), and name the Preferences “U20L”. Hit the “OK” button at the bottom of the screen (see previous step) to finish saving Preferences and exit the HOBOware Preferences window.

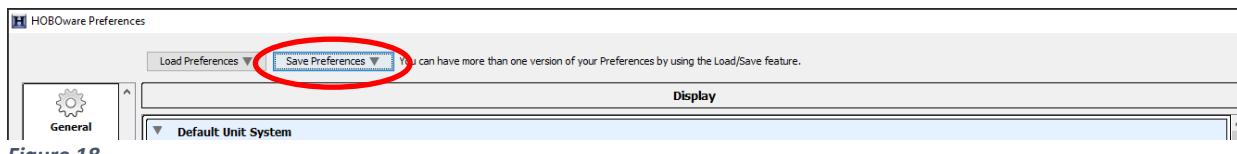


Figure 18

Offload HOBO data from the shuttle to your laptop

21. Connect the shuttle to your computer.
- Plug the large end of mini USB cable into a USB port on your computer. You can use the USB C to USB adapter if you have a Dell computer but avoid using a USB hub, if possible.
 - Unscrew the center cap on the shuttle. If the cap is too tight to loosen by hand, insert a screwdriver through the lanyard hole and rotate counterclockwise until the cap is loosened.
 - Plug the small end of the USB cable into the USB port in the shuttle. (If the shuttle has never been connected to the computer before, it may take a few seconds for the new hardware to be detected.) using the mini USB cable.
22. Readout the data stored on the shuttle
- Using the drop-down menu at the top of the window, select *Device>Readout...*
 - A *Select Device* window like the one below should appear showing your shuttle as the attached device.

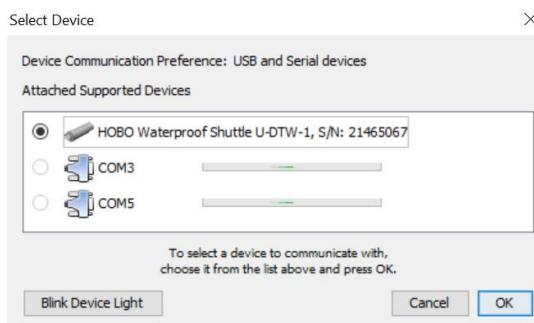


Figure 19

- Click **OK** in the lower right-hand corner of the window, which will open the *Waterproof Shuttle Management* window shown below. From the list of loggers, select those with a status of “NOT OFFLOADED”. Before you offload the data, **make sure the Delete Contents Upon Offload box in the lower right corner (circled in red) IS NOT CHECKED**. Click the *Offload Checked* button. A progress bar will indicate the data for each logger is being offloaded.

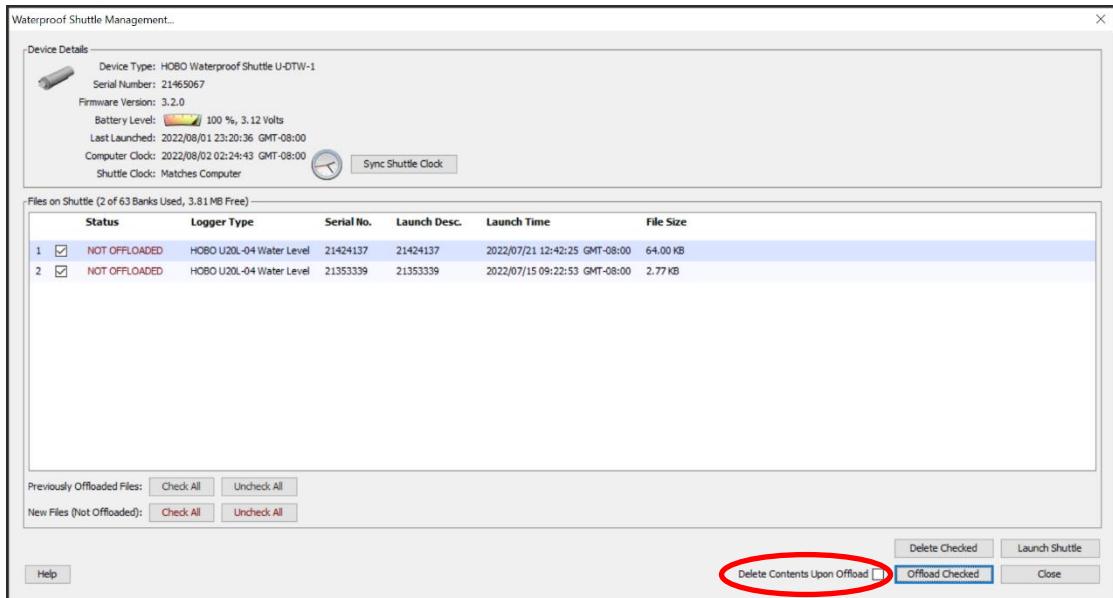


Figure 20

23. Save the .hobo datafiles to your computer (NOTE: Offloaded datafiles are identified by logger SN in the dialog box shown below, circled in blue):

- a. Rename the datafiles using the following naming convention, separating each item by an underscore:
 - Data download date (e.g., “2022-08-02_”)
 - Sensor type in all caps (i.e., “HOBO_”)
 - Primary parameter unit of interest in all caps (i.e., MBAR_)
 - Logger SN (e.g., “XXXXXXXX”, where XXXXXXXX is the 8-digit SN).
- b. Check the box *Open Folder in Windows Explorer After Save*.
- c. Click the *Save Checked* box in the lower right corner (circled in red).

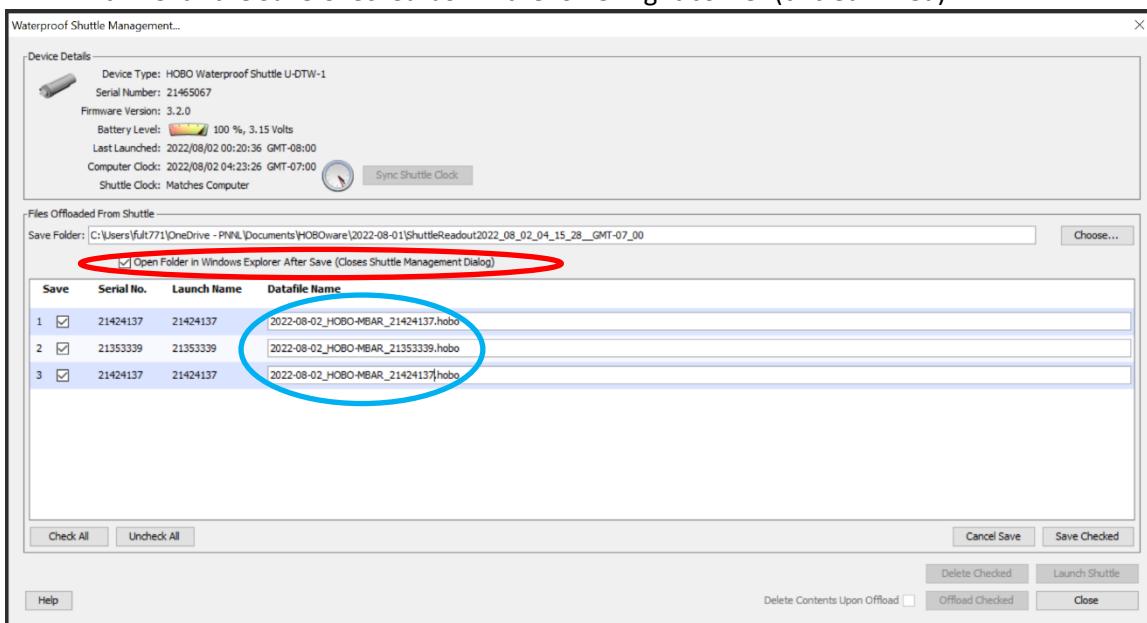


Figure 21

24. Once the datafiles have been saved, the *Shuttle Management* window will close and Windows Explorer will open to the location of the saved files (see figure below). Individual shuttle readouts will be stored separately by download date and time based on your computer clock , (e.g., \Documents\HOBOWare\2022-08-01\ShuttleReadout2022_08_02_03_51_46_GMT-07_00).
25. View the graph and data table to ensure the sensors are logging correctly (i.e no NAs in the table and the data isn't a straight line).
26. When finished, remove the logger from the coupler. The green LED stops glowing when you disconnect the logger or the USB cable.

Sensor Location Indicator

7. Take a photo or video of someone pointing to the sensor location in the stream that shows the surrounding area near the sensor to make it easier for the retrieval team to locate the sensors.

Wading-based depth transects

Note: Depth transects will mostly be done by the ‘Depth Transect Runner’ (DTR; AKA Bonus Buds) team (James, Aaron, Kelsey). But at some sites the sampling team will do this piece of the protocol. More important than getting depth data is sampling 3 sites a day. *Don’t allow depth transects to hold you back.* If you have one site within a given day that does not have depth transects (e.g., mainstem Yakima River), please do that site first. The depth transects will be recorded on a separate metadata sheet. No more than 10 transects can be measured in one day.

Wading-Based Depth Transects Overview: To calculate ecosystem or open-channel respiration on a per-unit-area bases, it is important to know the average depth of the stream or river in question, over the distance that contributes to the oxygen signal at the monitoring location. This distance is not easy to determine specifically, being a function both of oxygen residence time in the system and flow velocity. In practice, we have set the desired distance at 50 times the width of the river. We are NOT particularly concerned with achieving this distance. **Do up to 10 transects (or fewer if you can’t get to 10, but spend not more than 1 hour) and spread them as far upstream as is achievable.** The other important thing to keep in mind is that the idea here is to roughly characterize the river, not to generate super high-resolution bathymetry. Therefore, a lot of transects, each consisting of relatively low quality data, is the target. At least 2 people, at least one of whom is comfortable and capable of walking in fast-moving streams up to waist-deep is needed for this. **It is critical to avoid stepping on the cotton strips and DO sensor!**

Wading-Based Depth Transect Procedure:

1. Record the start time and transect starting point latitude and longitude (decimal degrees). Please make sure to wait long enough to write down coordinates until the accuracy is less than 20ft.
2. Your first transect should be 2m upstream of the DO sensor. Record that distance
3. Stand at the edge of the water and measure the wetted (i.e., water edge to water edge) stream width with the tape or range finder and record. Note: the range finder will not read under 5 meters.
4. Walk across the stream and measure the depth at 5 locations between the banks. **Record these measurements on the metadata sheet.** These locations should be ROUGHLY equally spaced, however the emphasis here is on SPEED, not accuracy. Do not measure the distance between measurement points.

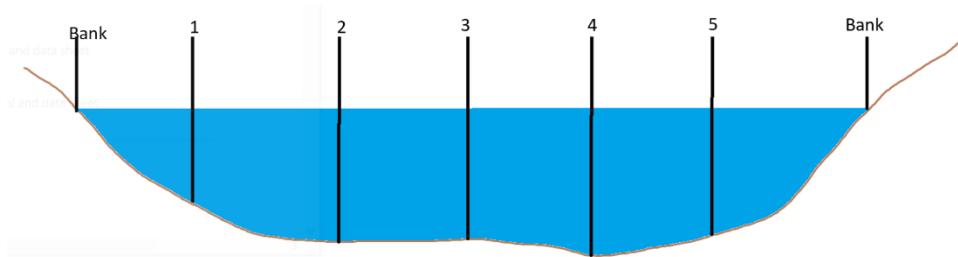


Figure 22

- Team member 1 stands on the shore.
- Team member 2 wades across the river, reporting depths at the approximate measurement locations. If the stream is wide or noisy, 2-way radios may make communication easier.
- To measure depth, place the wading rod against the bottom of the river UPSTREAM of your body and hold it as close to vertical as you can. If the water is moving fast enough to make it pile up on the upstream side of the wading rod, take the measurement on the side of the rod, where the water is following a somewhat diagonal path (Fig. 23):
- Move upstream to the next transect at least 5-10 meters upstream and put a flag in the ground to mark the location.
- Repeat until you have used up your **allotted time (1 hour)** or **have completed 10 transects**. **Do not do more than 10 transects.** To the extent possible, try to minimize any unnecessary walking on the bed in the stream.
- At the most upstream transect, record the lat/long from the tablet in decimal degrees. Also record the GPS accuracy.
- When all transects are complete, **record the end time in PST.**
- On the way back down the stream to pick up flags, have one person go one transect ahead of the data recorder and act as a target for the range finder and measure and record the distance between each pair of transects. [Use meters!]

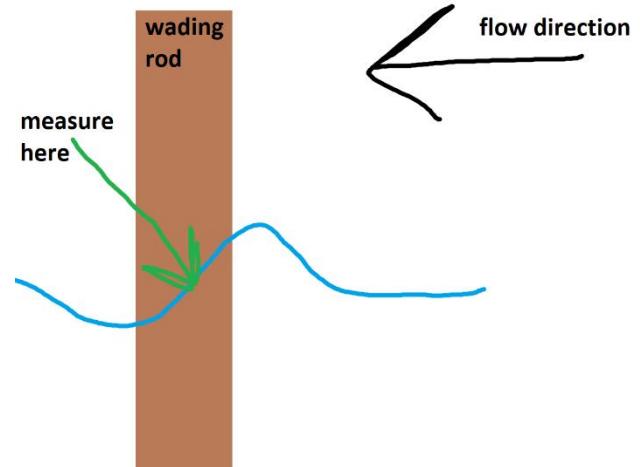


Figure 23

Wading-based transect special cases:

- River is too deep in one or more areas to safely wade:
 - If the river is too deep (past waist deep, or simply deep enough that the wading team member is not comfortable continuing across), estimate the width and max depth of the un-wadeable portion to the best of your ability and note it down. If the other bank of the river is accessible, it may be possible to take readings on both sides of the deep part, minimizing the area you have to estimate.

How to set-up and use rangefinder:

Rangefinder buttons

The RANGE button on top:



Figure 24

And the MODE button on the side:



There are 3 important settings in the rangefinder.

Rangefinder units:

The rangefinder must be set in Meters (not yards).

- When the rangefinder is set in meters, the letter M will be displayed to the right of the measurement:
- If it says Y (yards), hold down the MODE button until you enter the settings screen, then tap the MODE button until the Y is flashing, and push the RANGE button to change it to M, then push the MODE button a bunch of times until you are back at the main ranging screen.

BEST vs LAST:

- The rangefinder should be set in LAST mode. This makes the rangefinder spit out continuous data as long as you're holding the button down, and keep the last value on screen when you let go. It may be beneficial to switch to BEST in some cases, but LAST is generally what you want.
- If the rangefinder says BEST in the lower left corner, hold down the MODE button until you enter the settings screen, then tap MODE until BEST is flashing. Then tap RANGE to switch it to LAST, and tap MODE a few more times to get back to the main ranging screen.

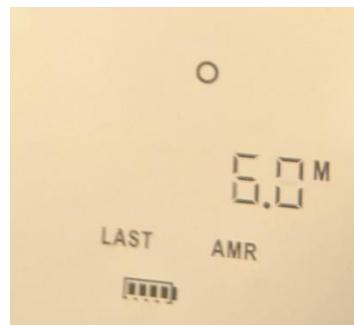


Figure 25

Distance method:

- The range finder has several “methods” for calculating range. You want the rangefinder set on **AMR or Angle-modified range**. In AMR mode, the rangefinder will use the tilt of the rangefinder to compensate for non-horizontal measurements. This means you do not have to aim at a target that is the same height as the rangefinder, which is very helpful.
- Again, if the rangefinder says something other than AMR, hold down the MODE button to enter settings, and then tap MODE until the non-AMR word is flashing. Then tap RANGE until it reads AMR and tap mode again until you are back in the main ranging screen.

Before leaving the site

1. Check over the metadata sheet to ensure all fields are complete.

End of field day

Please confirm that all fields on the paper metadata sheet are filled out prior to leaving the field and **take a picture of the front and back of the data sheet using the tablet.**

After the Field

Manta Download

1. Download and review the review log file.
2. Copy the file to the appropriate folder in this folder: <https://tinyurl.com/SSS-MantaRiver>.
3. Check the remaining battery voltage on the Manta and change the batteries if the voltage falls below 7 V.
4. Instructions for installing the software, connecting the Manta to your computer, and changing the batteries (if needed) are provided below the instructions for downloading/reviewing/uploading the data. If you need assistance, the User's Manual is available on the Manta USB drive, or on the shared drive (see #6, Installing the Eureka Manta Control Software, below).

Manta data logging and data downloading

Manta Data Overview: All Mantas include data memory and software that allows you to select which parameters you want to measure, set the logging interval (how often you want the Manta to record a measurement), and create a Log file to store sensor data. Log files have already been created for each Manta used for the spatial study. Logging intervals have been set for 1 minute, i.e., the Manta will take a measurement from each sensor once every minute and record the measurements in the pre-existing Log file. Below are instructions to enable/disable logging and download the log file every night following field data collection.

5. Since logging has already been "enabled" on your Manta, logging must be temporarily disabled before you can download the Log file. To disable logging, click the "Manta2 Logging is ON" hot button. The button should change to "Manta2 Logging is OFF" (Figure . 26). **NOTE: IT IS CRITICAL WHEN YOU ARE DONE DOWNLOADING DATA THAT YOU RE-ENABLE LOGGING (see #8, below).**

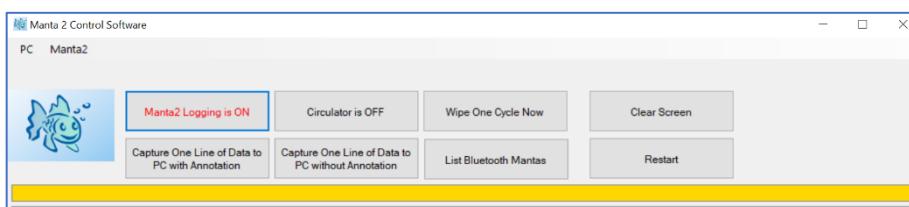


Figure 26. Manta 2 Control Software home page showing that logging has been "activated."

6. To download the Log file, first click on the **Manta2** dropdown menu, and then select **Manage Manta2 Files** (**Error! Reference source not found.** 27).

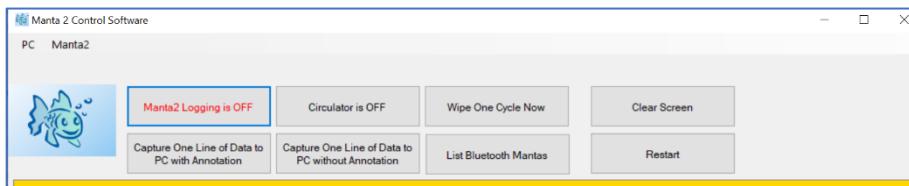


Figure 27: Manta 2 Control Software home page showing that logging has been "deactivated"

7. A pop-up screen will appear showing the name of the Log file and the date the Log file was last modified, along with several options for managing the Log file (Fig. 28). (The active Log file name is also displayed in the bottom line of the Home Page.)
8. Highlight your Log file by clicking on it, then click ***View Files***.
9. Another screen will appear with the Log file displayed in table format. Double-check that the serial number, which is recorded at the top of the file, is the same as the serial number you have been recording on the metadata sheets. Click on the Save As button at the bottom of the screen to save the Log file as a .CSV file on the RC2 shared drive (see next step).
10. Raw sensor data is stored hierarchically on the RC2 shared drive by
 - a) study name, b) sensor type, c) data type (in this case “raw data”), d) sampling date, and lastly e) site. The file folder structure has already been created for you, so all you need to do is locate the folder for each day. Navigate to this folder:
<https://tinyurl.com/SSS-MantaRiver>. Find the correct site folder with the correct date folder and put your data here.
11. Once the file is saved to the shared drive (it will look like an Excel file, but with the .csv file format extension name), open the file and look at the data to make sure the data makes sense to you (see sample Log file, Table 2; note that your file will also have a column for pH and Chlorophyll a data). Ask yourself the following questions:
 - a. Did the Manta start recording data at approximately the same time as you turned it on first thing in the morning?
 - b. Did the sensor measurements start reflecting the water quality parameter values you would expect when you placed the Manta in the river, and did the values change as you would expect when the Manta was no longer in the water?
 - c. Was data recorded throughout the day, and did the last line of data occur at approximately the time you turned the Manta off?
 - d. At the end of the file check to see that the battery voltage is reading at least 7 V. If not, change all 6 batteries with fresh batteries. DO NOT MIX DIFFERENT BRANDS OF BATTERIES.

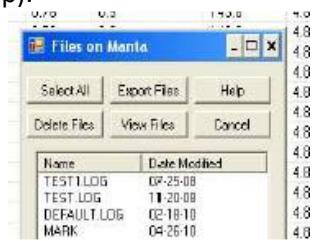


Figure 28. Manage Manta2
Files pop-up screen listing available Log files and the available options to manage those files.

2021-07-22_MANTA_4659L.LOG.csv						
DATE	TIME	Temp deg C	Depth m	SpCond uS/cm	Turb FNU	Int Batt V
Eureka_Manta_2	V7.13	3214659				
DATE	TIME	Temp_deg_C	Depth_m	SpCond_uS/cm	Turb_FNU	Int_Batt_V
7/22/2021	7:32:00	17.12	0.09	0	0	7.81
7/22/2021	7:33:00	17.52	0.09	0	-0.06	7.84
7/22/2021	7:34:00	17.93	0.09	0	0.12	7.79
7/22/2021	7:35:00	17.72	0.09	0.1	-0.09	7.63
7/22/2021	7:36:00	18	0.09	0	-0.04	7.68
7/22/2021	7:37:00	18.08	0.1	0.1	0.04	7.73
7/22/2021	7:38:00	18.14	0.09	0	0.16	7.59
7/22/2021	7:39:00	22.94	0.37	237.8	2.13	7.57
7/22/2021	7:40:00	22.95	0.37	238	0.06	7.68
7/22/2021	7:41:00	22.97	0.37	238.5	0.05	7.74
7/22/2021	7:42:00	22.97	0.36	238.2	0.02	7.78
7/22/2021	7:43:00	22.98	0.37	238.2	0.03	7.81
7/22/2021	7:44:00	22.98	0.37	237.7	0.02	7.76
7/22/2021	7:45:00	22.98	0.37	238.1	0.09	7.83
7/22/2021	7:46:00	22.98	0.37	237.9	0.09	7.84

Table 2. Sample Log File in comma separated variable (CSV) format.

12. **CRITICAL:** Once you have copied the file over to the shared drive, **RE-ENABLE LOGGING by clicking on the “Manta2 Logging is ON” hot button. Make certain that the hot button shows that logging is on before you disconnect the Manta.**
13. Disconnect the Manta from the cables and replace and hand-tighten the dumpy plug.

Installing the Eureka Manta Control Software

Try to install the Eureka software (“Manta 2 Control Software” or “CS”) on your computer before you leave town. The installation file can be downloaded here: <https://tinyurl.com/Manta-Software-Installation>

If you are unable to install the software before you leave, install it using the steps below.

14. Plug the Manta Flash Drive into one of the computer’s USB ports.
15. When the dialog box shown below opens, click *Install Manta Software* to upload the Manta 2 Control Software and the USB Driver software onto your computer. When the installation is complete, you will be returned to the same screen that you started with.
16. Click the “X” in the upper right corner of the dialog box to close the installation process.
17. If you wish, download onto your computer the Manta manual and various videos and technical documents that are also stored on the flash drive. The User’s Manual (“Manta Manual 11-30-20”) is a very useful resource for operating the Manta and contains additional information beyond that provided in this protocol.
18. If Windows did not create a Desktop shortcut to the Manta Control Software, and you would like to have one, click your laptop’s Start button, click *All Programs*, click the Eureka folder, right-click “Manta 2 Control Software”, and drag it to your desktop or taskbar.
19. The User’s Manual (Manta Manual 11-20-30.pdf) is very useful and can be found here if you need to refer to it: <https://tinyurl.com/Manta-Users-Manual>

Connecting the Manta to a Computer/Laptop

The Manta comes with a Data Cable (Fig. 29, below left) and USB Converter (Fig. 29, below right), and both are needed to connect the Manta to your laptop. The Manta Flash Drive is also shown below (Fig. 29, bottom).

20. Remove the waterproof polymer eye bolt (aka “dumpy plug”) on the top of the Manta by unscrewing it counterclockwise. This will expose the 6-pin Data Cable connection. One end of the Data Cable has a 6-pin connector (the rubber tip with holes in the same configuration as the 6-pin connector on the Manta) and the other end is a 9-pin RS-232 connector (easily recognized by the old-style computer cable connection used to connect slide projectors, monitors, etc.).
21. Connect the Data Cable 6-pin rubber tipped connector to the Manta by lining up the holes in the rubber tip with the pins on the Manta and push the connector down until the rubber tip is seated snugly over the pins. Connect the other end of the Data Cable (female 9-pin connector) to the male 9-pin connector on the USB RS-232 Converter and screw down the connection. Then, connect the USB connector on RS-232 Converter to the female connector of the USB cable, and plug the other end of the USB cable into your USB port on your computer. Note: the order in which the cables are connect does not matter.
22. Once you are connected to your computer, open the software using the Start Menu or by clicking on the Desktop or Task Bar shortcut. The software can be a little buggy, and typically will crash the first couple of times you try to open it. When the software successfully opens, the Home Page will appear (Figure 30). The status bar in the lower left-hand corner of the Home Page will initially show the message “Manta Not Connected”. It may take 30 seconds or more, but shortly you should see the message change to “Manta Initializing on COM#,” where “#” refers to the USB COM port to which the Manta is connecting. Once connected, the message should read “Connected on COMX” and the Home Page will display the Manta’s real-time data and various menu options. You can close the program by simply clicking the “X” in the upper right corner.



Figure 29. Manta Data Cable (left), RS-232 USB Converter and extension cable (right), and Manta Flash Drive (bottom).

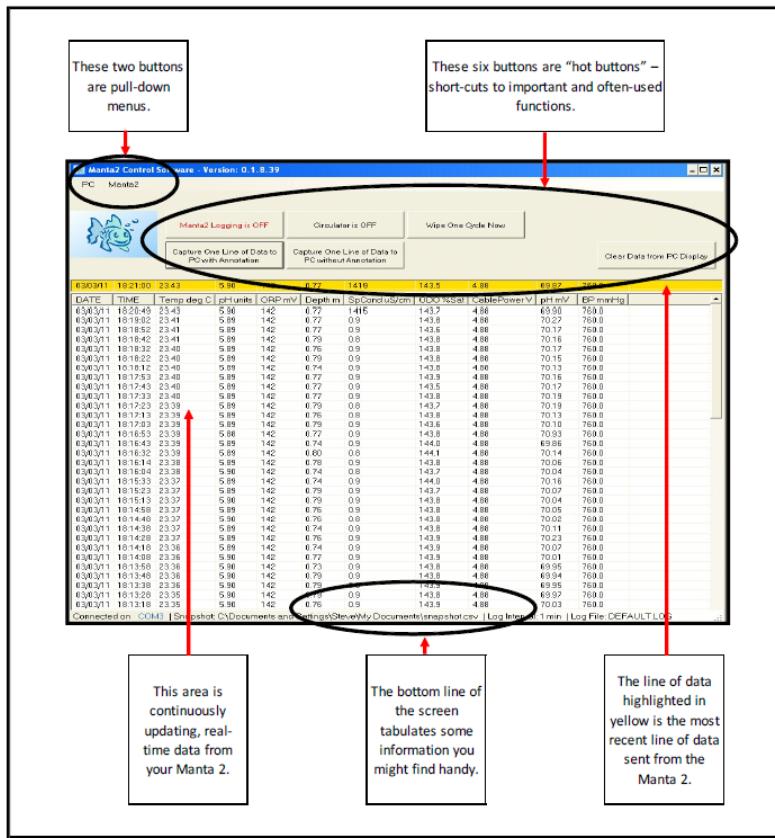


Figure 30. Manta 2 Control Software home page.

Manta Battery Replacement

The IBP holds six (6) “C” batteries supplying the Manta with 9 V. Minimum recommended voltage is 6 V, but the batteries should be replaced before total voltage supplied reaches that minimum level. To replace the batteries:

23. Unscrew the steel eye bolt until you can remove the battery plug and remove the spent batteries.
24. Clean all moisture, dirt, grit, and any other debris off the Manta because you are going to expose sealing surfaces as you change the batteries.
25. Clean all moisture, dirt, grit and any other debris off the exposed O-ring surfaces and the inside of the battery tubes. Add a small amount of silicone grease to the O-rings and to the inside of the battery tubes where the O-rings will seat.
26. Install six (6) alkaline “C” batteries carefully following the polarity diagram on the side of the Manta. Replace all six (6) batteries at the same time using the same brand of battery. NEVER COMBINE DIFFERENT BRANDS OF BATTERIES.
27. Re-attach the battery plug by turning the eye bolt. Use a screwdriver to tighten the eye bolt as much as you can without overtightening. The eye bolt must be secured tightly to ensure the battery plug is tight enough to firmly hold the batteries in place and maintain continuous power to the Manta. If the battery plug is not tightened securely enough, continuous power to the Manta can be broken when the Manta gets knocked around either in the pipe kit in your backpack or during deployment in the river. Momentary loss of power can cause the Manta to “throw” extra header files in log file, which then must be removed during data QA/QC.

Downloading miniDOT data (manual chamber)

Downloading data from the miniDOT

Bring the **manual chamber** miniDOTs with you to the hotel every night to download the day's data, quickly review it to ensure that the miniDOTs were on and recording data throughout the day, and then upload it to the RC2 share drive.

1. Remove the sensor housing (white Delrin tube) from the sensor core (the part that consists of the sensor and circuit board) by unscrewing it from the black cap.
2. To download the data, simply connect the sensor to your laptop using the supplied USB cable. (Upon connection, the LED immediately below the USB port should blink green.)
3. In Explorer, click on “Local Disk” (you can read the contents of a miniDOT just like a USB drive). You will see three Java files (.jar) and a data folder. MiniDOTs store data files (aka “log files”) as text files (.txt) in the data folder on the sensor’s hard drive (local memory). The data folder on each miniDOT is named “7450-SensorSN” where SensorSN = the unique 6-digit serial number associated with each miniDOT:

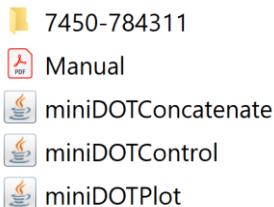


Figure 31.

4. Right-click on the data folder to copy it.
5. Once you’ve copied the folder, paste it into the appropriate folder on the RC2 shared drive. Sensor data is stored on the RC2 shared drive by date and by watershed. The file folder structure has already been created for you, so all you need to do is locate the folder for each data. Go to this folder: <https://tinyurl.com/SSS-ManualChamber>. Find the correct site folder with the correct date folder and put your data here. This date should correspond to the date that the data was **downloaded**.
6. It’s a good idea to quickly review the data to make sure the miniDOTs were 1) turned on and 2) recorded “good” data. Data is recorded once every minute (i.e., the logging interval) on the even minute once you turn the sensor on (flip switch to “Record”) and stops recording new data when you turn the sensor off (flip switch to “Halt”). A new log file is created every day starting at midnight Greenwich Mean Time (GMT; subtract 8 hours from GMT to convert to Pacific Standard Time, PST). The miniDOT keeps time in Unix time, which is the number of seconds that have passed since January 1, 1970. You can convert Unix time to PST here:
<https://www.epochconverter.com/>
7. Each log file contains five columns of data and one row or data record for every minute data was recorded.
 - a. Unix time
 - b. BV = battery voltage (V)
 - c. Water temp (°C)
 - d. DO (mg/L)

- e. Q (sensor quality based on degree of light penetration; manufacturer-specific)
- 8. ***Open the text file located on the shared drive*** and check that the data values are representative of the conditions you would expect for the streams that you sampled that day (e.g., temperature, DO concentration). You should be able to recognize two different kinds of data: a) continuous blocks of data that were recorded during each chamber metabolism test followed by b) continuous blocks of data that were recorded when the miniDOT was in the cooler during transport, etc.
- 9. ***When you're certain that you copied the data correctly to the shared drive, and that the data looks reasonable,*** delete the data folder from the miniDOT by right-clicking the folder and selecting delete.
- 10. Disconnect the sensor by closing the Control window or simply unplug the USB cable. The Explorer window will close on its own, so you will have to open a new Explorer window each time you connect a new sensor.
- 11. Replace the sensor housing and hand-tighten until the silicon O-ring is fully inserted below the lip of the housing. DO NOT OVERTIGHTEN or it will be very difficult to remove next time. NOTE: miniDOTs have the serial number (SN) recorded on the instrument both internally (located on the white circuit board just above the black cap) and externally (on the top of the housing near the cable tie-off). Be careful not to separate or mix-up multiple sensor inner cores from their housings, e.g., DO NOT replace the housing from one sensor on the sensor core of a different sensor or the serial numbers will not match, and you could record the wrong SN in the field. The data stored on the miniDOT is associated with the SN on the inner core. It's a good idea to work with them one at a time.

Downloading HOBO data

1. Download the data you collected that day from the waterproof shuttle to your computer. Before you can readout a HOBO logger, you must first install HOBOware Pro software, set HOBO "Preferences" using the steps described below.

Digitizing Metadata

11. Each afternoon, digitize the sample metadata using this google form: <https://tinyurl.com/SSS-Sample>.
12. Digitize the wading depth transect metadata using this google form: <https://tinyurl.com/SSS-WadingDepth>.
13. Double check that you have taken a photo of the completed metadata sheet.

Appendix A: Equipment Lists

Equipment: Water column respiration (manual chamber)

- 40 qt. cooler with ice packs
- Two (2) medium ice packs or a couple of bags of ice
- Three (3) chambers full of water with no headspace (2-liter amber plastic bottle with wide-bore neck. NECK MUST BE DRILLED OUT TO FIT MINIDOT)
- Three (3) miniDOT oxygen sensors
- Six (6) small, sealed toy boat motors (three for stirring; three extras in case one or more don't work)

- Twelve (12) boat motor batteries (NiMH rechargeable is required. Alkaline batteries do not last long enough)
- Water pitcher (for filling manual chambers in shallow streams)
- Bricks or Pavers

Equipment: Manta deployment

Each Manta kit comes with the following:

1. Manta+ Multiprobe
 - a. The Eureka Manta+ 35B Multiprobe is large multiparameter probe (“multiprobe”) that has the capacity to hold up to nine sensors. The Mantas you are using for this study are currently configured with five sensors to measure the following parameters:
 - i. Depth (m)
 - ii. Temperature (°C)
 - iii. Specific conductance ($\mu\text{S}/\text{cm}$)
 - iv. Turbidity (Nephelometric Turbidity Units, TNU)
 - v. pH and reference sensors (Standard Units, SU; reference sensor is required to measure pH). NOTE: Currently installed on only 2 multiprobes: SNs 4657L and 4658L.
 - vi. C-FLUOR sensor for chlorophyll a
 - b. Internal battery pack (IBP): consists of a watertight housing secured by a “battery plug” and steel eye bolt, a cassette for batteries, and a battery switch.
 - c. Storage/Calibration Cup: The Storage/Calibration (S/C) cup protects the sensors when the Manta is not in use and is also used to hold calibration solutions. When not in use, Mantas equipped with pH sensors must be stored with the S/C cap on and a few ounces of tap water to keep the membrane moist. It is good protocol to store all Mantas with the S/C cup and a few ounces of tap water when not in use. The black cap on the top of the S/C cup is a screw-top and can be removed to pour calibration solutions directly into the S/C cup.



Figure 32. Manta+ Multiprobe and associated equipment.

2. Weighted Sensor Guard: used during deployment and replaces the S/C cup to protect the sensors and to weigh down the sensor end of the Manta.

3. Manta Flash Drive: contains all software needed to connect the Manta to a computer or other Data Display, plus digital copies of the User's Manual, several instructional videos, and several technical notes.
4. Data Cable: required to communicate directly with the Manta to program log files, calibrate the sensors, and download data.
5. USB Converter: connects between the Data Cable and a USB port on a computer or other Display Device. The USB Converter can also connect an external power supply to your Manta if USB power is not adequate (particularly with long Underwater Cables or large number of sensors).
6. Maintenance Kit: contains all the tools and maintenance items needed to keep your Manta in top shape.
7. Pipe Kit
8. Carabiner
9. Rope

Equipment: miniDOT cleaning and downloading

- Computer
- micro USB cable
- Bag of zip ties
- Zip tie cutter
- Towels/paper towels
- Philips screw driver

Equipment: Safety Equipment

- Cell phone in Ziploc bag
- Satellite phone if outside cellphone coverage (if available)
- Life jackets for both team members (if water is deep)
- A throw rope
- River shoes, muck boots, waders, or other cold-protection equipment as appropriate to the situation. In general, this protocol is designed for work in the summer when air temperature is hot.
- Please see the offsite risk management plan for additional cold and heat stress information.

Equipment: Depth Transects

- Phone/tablet gps
 - a measuring tape (for <5m wide streams)
 - a laser range finder (for >5m wide streams)
 - a graduated wading rod (marked out in centimeters, at least 1m long. 1.25-1.5m is preferable)
 - 2 2-way radios (walkie talkies)
-
-

Retrieval Protocol

Before the Field

Installing HOBOware Pro Software and setting software preferences

1. Install HOBOware Pro software by clicking on the executable file "**HOBOware_Setup**" and follow the default options. HOBOware will be installed in the following directory:
C:\Program Files\Onset Computer Corporation\HOBOware.

2. Open HOBOware from your laptop *Start Menu>Onset Applications>HOBOware*. The Setup Assistant appears the first time you open HOBOware. Click Start and follow the prompts to select device types, units, and data assistants. Enter the **License Key**: (see the Appendix for all file locations). Click “No” in the pop-up window “Check for updates.”
3. Once the software is installed, set “*HOBOware Preferences*” by clicking the dropdown menu *File>Preferences...* to open the *HOBOware Preferences* dialog box as shown below.
4. Select the appropriate icon (left-hand sidebar) to set *HOBOware Preferences* for “General,” “Communications,” “Plotting,” and “Display” (shown in no particular order in steps a, b, c, and d in the figures below). These preferences define which parameters and units you want the HOBO to log, as well as how you want to view, plot, and download sensor data. For example, to set *General Preferences*, click the icon labeled “General” (circled in red in the figure above) to display all available *General Preferences* options. **Do not click the “OK” button (bottom right-hand corner) until you have set all four preferences as outlined in and saved the Preference file** (see next step).



Figure 1

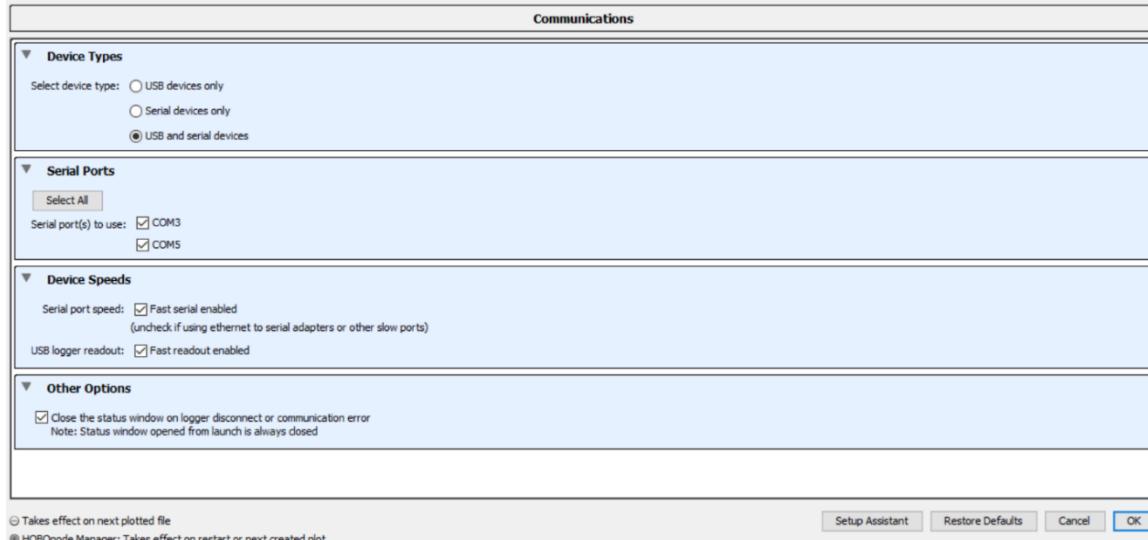


Figure 2:

Communications Preferences

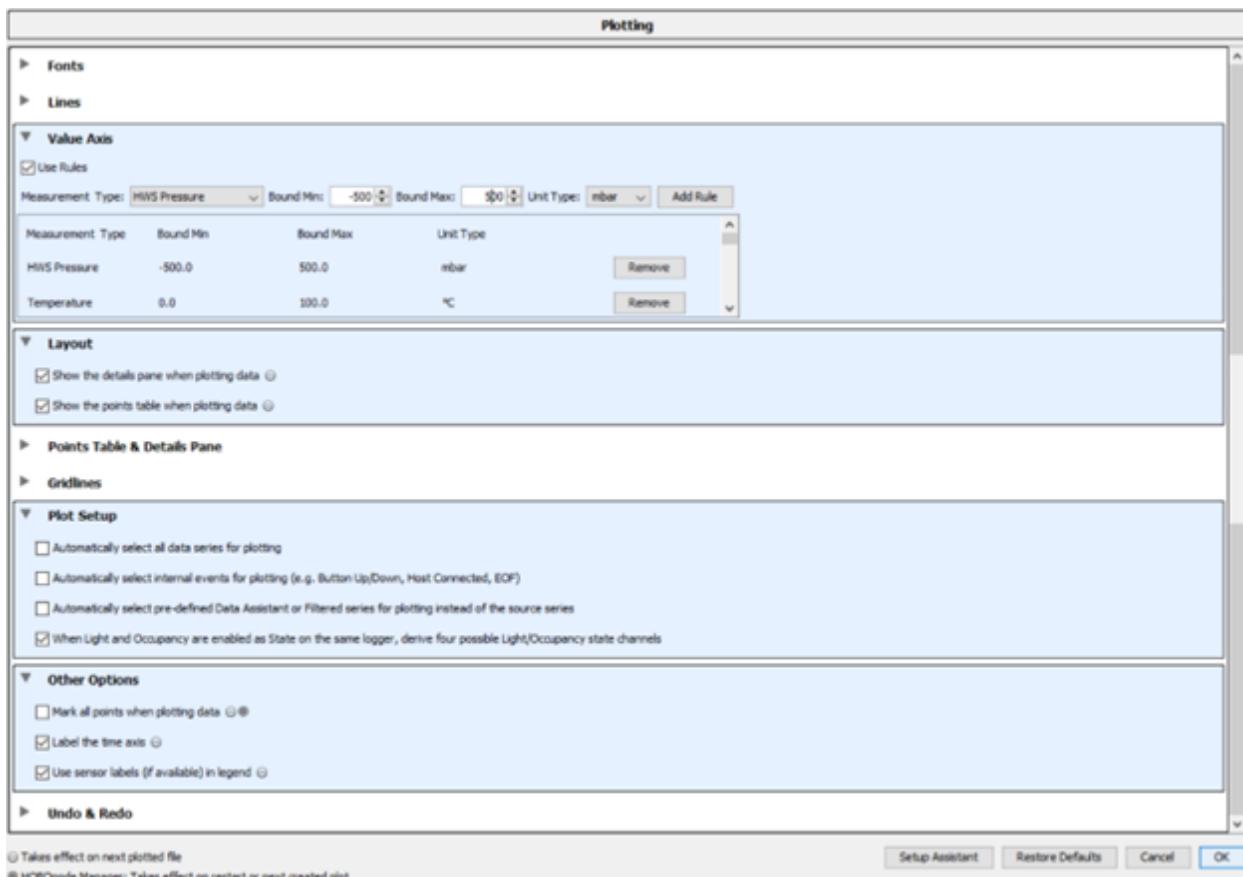


Figure 3: Plotting Preferences

- Set the upper and lower bounds for each logger parameter under the *Value Axis* option. First, use the *Measurement Type* dropdown menu to select each parameter and then type the Bound Min, Bound Max, and Unit Type as shown above for pressure (i.e., HWS Pressure) and below for temperature.



Figure 4

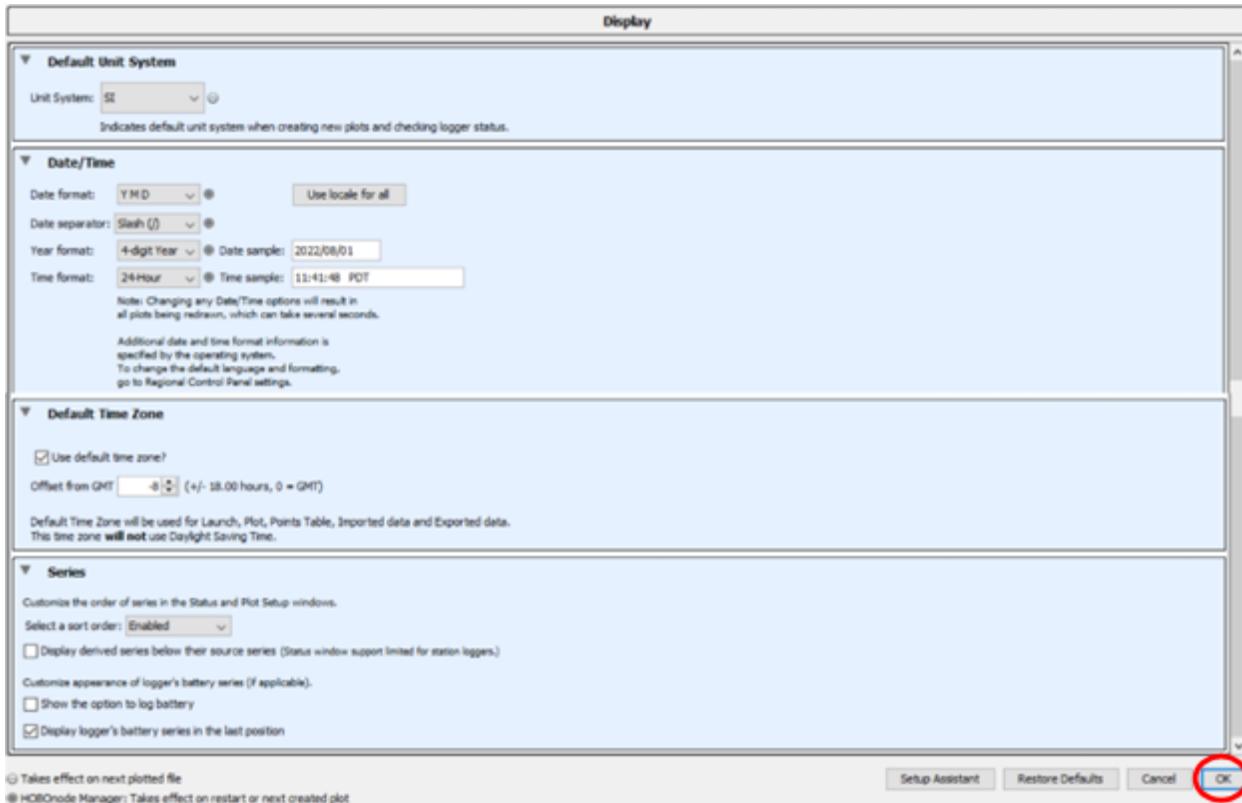


Figure 5: Display Preferences

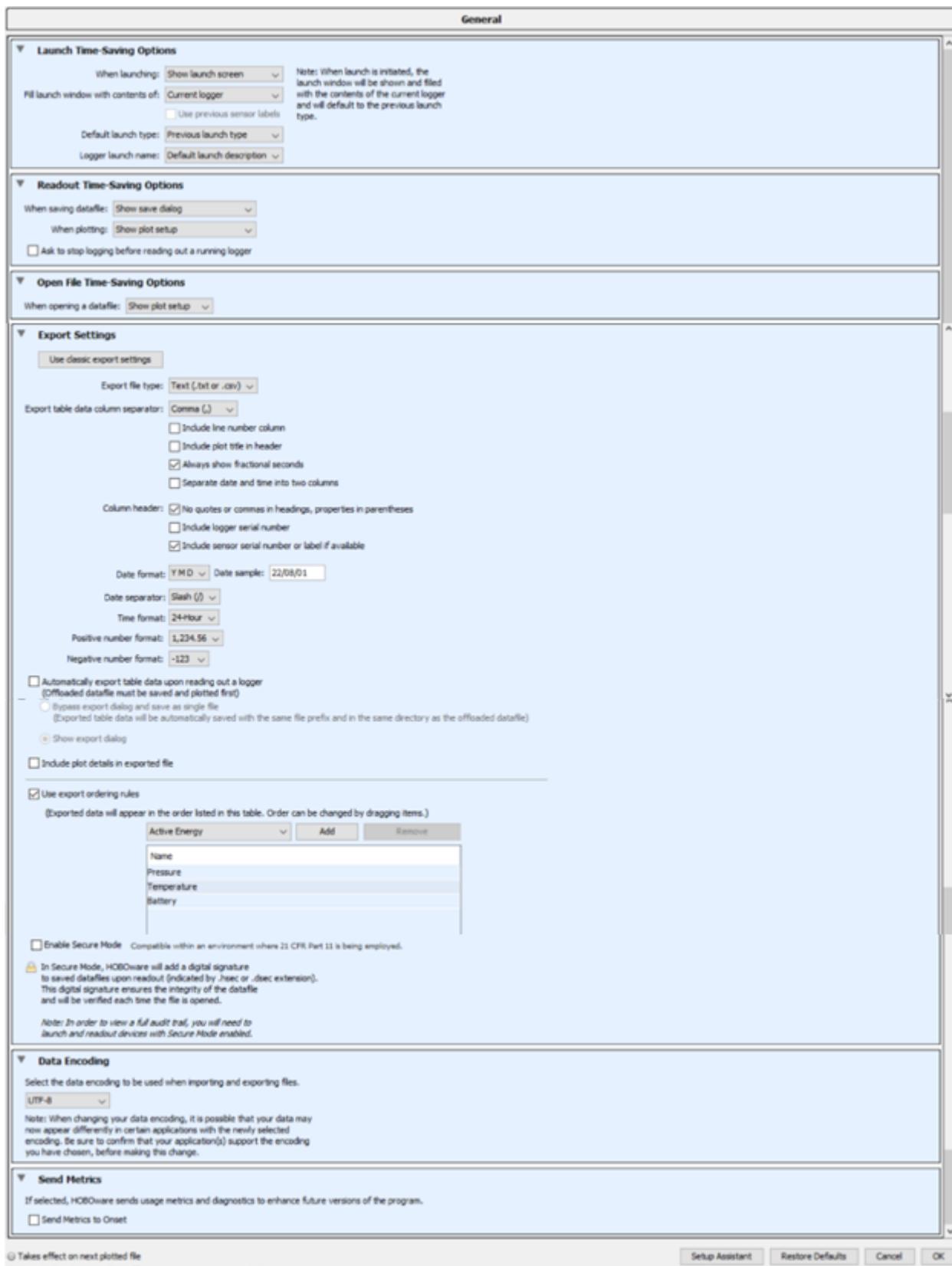


Figure 6: General Preferences

6. When you have finished setting Preferences as outlined , click the “Save Preferences” dropdown menu (circled in red, below), and name the Preferences “U20L”. Hit the “OK” button at the bottom of the screen (see previous step) to finish saving Preferences and exit the HOBOware Preferences window.

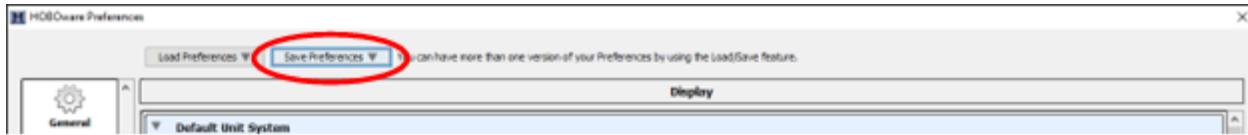


Figure 7

7. Download the Win-Situ 5 software from In Situ’s web site at <https://insitu.com/us/support/categories/software-firmware>.
- Scroll down to Software & Firmware and filter by “Software”
 - Type “Win-Situ 5” in the search window exactly as typed in quotes here (excluding the quotes). NOTE: the search window is cap-sensitive and will not find the Win-Situ 5 software unless you capitalize the “W” and “S” and include the hyphen.
 - Alternatively, filter by “Software” and scroll all the way to the end of the entries until you find “Win-Situ 5” (there are a lot of entries to scroll through).
 - Click the “Download” button and accept all prompts to install the software, including USB drivers.
8. Under the Preferences menu, select General Settings to define the sensor sensor data formatting, including *Time Format*, *Time Zone*, *Export Delimiter Character*, *Parameter Defaults*, and *Other* (see above).

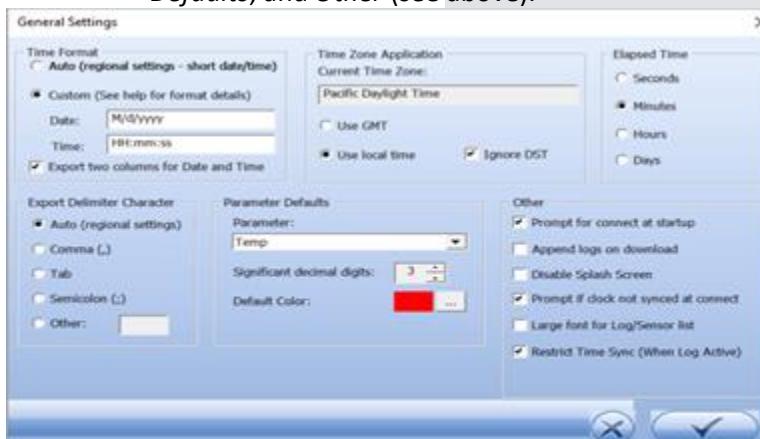


Figure 8. WinSitu General Settings window.

9. Add a Site to the Site database
- If this is the first time using the sensor, a *Site* must first be added to the site database in your *Working Directory* (left-hand side of the Data screen; see above). **NOTE:** WinSitu automatically creates a *Working Directory* during installation. The *Working Directory* path name should look something like this: \Documents\WinSitu Data\.
 - To add a new *Site* to the site database in your *Working Directory*, do the following:

- c. Click the **Data** tab, click the *Site Data* folder on the left-hand side of the screen, and using the menu at the top of the screen, select *File > New > Site*. (A new *Site* can also be added by simply left-clicking the *Site Data* folder.)
- d. Click *Save* to save the new site. The new site will appear in the *Site Data* folder, and Win-Situ will add it to the site database in the *Working Directory* on your computer.

In the Field

HOBO/MiniDOT Assembly

1. Upon arrival, take a photo of metadata sheet with site ID with underwater camera.
2. Locate the brick assembly. From ~2 feet away, take photo of the entire brick assembly with camera facing sensing element and wiper. Before moving on, check that photos are of good quality and you can see the miniDOT assembly. You may need to take a picture closer to assembly if the water is turbid. Visibly inspect miniDOT assembly and make notes on metadata sheet.
3. Before removing the brick assembly, **record a depth measurement from the tip of the HOBO to the top of the water surface**. Remove the brick assembly out of the water and **record the end time and serial numbers** of the HOBO, MiniDOT, and of the MiniDOT wiper if present.
4. Once out of the water but before cleaning, take a picture of the miniDOT sensing element from ~4 inches away. This can be with your phone.

Starting a new file and redeploying the miniDOT

1. If redeploying, make sure the switch is on “record”. Close up the miniDOT and reassemble the minidot as it was found and redeploy in the same position and **record the time back in the water**. If the water level has changed and you suspect the minidot will be out of water, move it to a different location and make **note in the metadata**.

Barotroll

1. Locate the Barotroll from the 9 sites and remove it from wherever it was attached. **Record the end time and serial number on the metadata sheet**.
2. No further downloading is needed in the field. Download once back at the lab.

Cotton Strips

1. **Note:** Each site should have 2 bricks attached together with 4 stainless steel tea infusers, each with 1 cotton strip. The tea infusers should all be under a couple large bricks.
2. Locate the cotton strip bricks and with the digital camera take a 360 underwater video that captures the interface between the brick and the sediment.
 - a. To get camera in video mode, press the “mode” button. Press the shutter to start and stop the video.
3. Take an additional picture of both bricks from upstream and downstream looking at cotton strips from ~15 inches away (2 pictures total). To get camera back in picture mode, press the “mode” button twice. Check that photos are of good quality and include both bricks before moving on. Inspect cotton strip assembly before and after removing from water. **Write notes on metadata sheet**.



Figure 9

- a. If the water is turbid, you may need to take multiple pictures closer to bricks (4 pictures total). From ~7 inches away, one brick is visible in the frame.

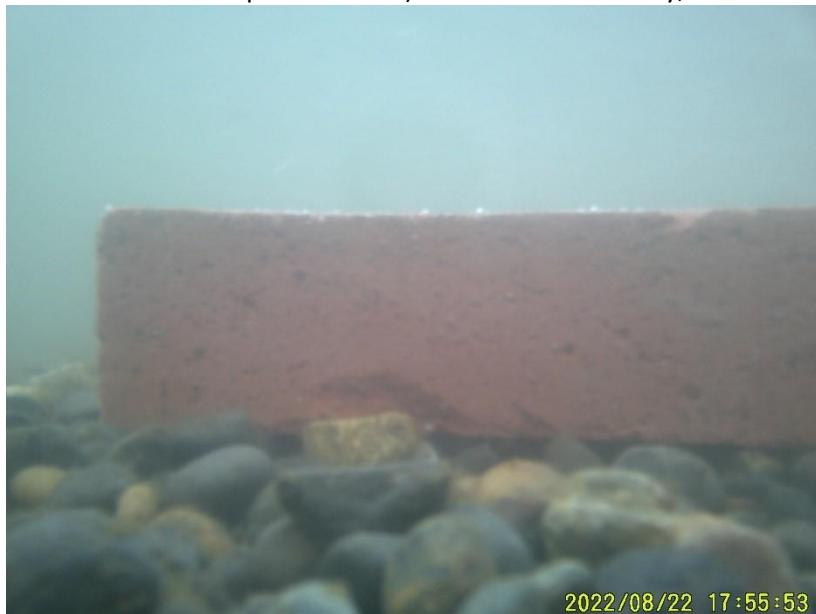


Figure 10

4. Pull out the 2 bricks with 4 tea infusers from the stream and let the water drain from the infusers. The 4 infusers and associated strips are all replicates and don't need to be kept in any order. Record the time the cotton strips were removed from the water on the metadata sheet.
5. Put on nitrile gloves.
6. Make an effort to handle the strips gently, and to hold them **ONLY** on the very ends (this part of the strip is held in the jaws of the tensiometer and does not influence tensile measurements to the same degree as other parts of the strip).
7. Using the pliers, open each infuser and using a finger, gently brush the whole strip for 10 seconds or so on each side to remove adhering sediment and biofilm in the stream water to help material wash away. Please don't be aggressive and don't try to remove everything,

just get any loose stuff off. After brushing/rinsing each strip, place it back into an infuser to hold it flat (**DON'T EVER FOLD OR CRUMBLE THE STRIPS**) and stack strips on top of each other.

8. After brushing/rinsing all 4 strips, gently slide the stack of 4 strips into the pre-labeled 50ml tube. **BE CAREFUL TO NOT FOLD OR CRUMBLE THE STRIPS.**

a. Pro tip: if there is some mild "curling" of the strip, twisting the strips in the opposite direction allowed them to straighten out and helped with the crunching up issue.

9. Fill the tube that has the 4 strips with 70% ethanol. Cap the tube and gently roll the tube for 10 rotations.

10. Pour out the ethanol into the waste container, being careful to not let the strips slide out of the tube. It's okay to block them with your gloved fingers.

11. Repeat by refilling the tube with 70% ethanol and gently rolling the tube 10 times. Leave the ethanol in the tube during transport to the lab.

12. Place the tube with strips into the cooler with blue ice. Make sure the tube is placed horizontally and that it is secured well enough so it doesn't move significantly (we don't want the strips to be damaged by bouncing around in the cooler).

13. [Record the vial ID on the metadata sheet](#)

14. Transport the strips to the lab for drying.

After the field

HOBO Download

1. Disassemble the HOBO from the brick assembly.
2. Unscrew the HOBO body from the hangar cap and wipe the exterior of the HOBO dry with a cloth
3. Make sure the shuttle's large cap and center cap are closed securely. Tighten the center cap until it is just flush with the large cap, or until the O-ring is no longer visible.
4. Make sure the communication end of the shuttle is clean. Attach the coupler and ensure that it is seated properly.
5. Insert the logger into the coupler by lining up the slot on the logger with the groove in the coupler.
6. *Momentarily* press and release the coupler lever (circled in red, below), pressing hard enough so the lever bends. Readout should begin immediately. The **amber LED blinks continuously** while readout and relaunch are in progress. **NOTE: Do not remove the logger when the amber LED is blinking.** After reading out the logger, the shuttle synchronizes the logger's clock to the shuttle's internal clock and relaunches the logger, using the settings that the logger was originally launched with.

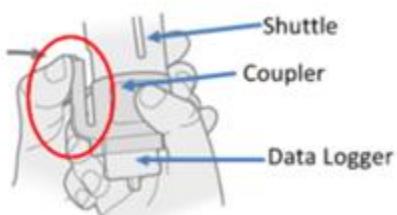


Figure 11

7. When the relaunch has completed, the **green LED blinks for 15 minutes**, or until you momentarily press the coupler lever to stop it (press hard enough so the lever bends). If the **red LED blinks instead, there was an error**, and the logger may have stopped. Refer to "Troubleshooting" in the manual for details.

8. Remove the logger from the coupler (even if the green LED is still blinking).

Offload HOBO data from the shuttle to your laptop

1. Connect the shuttle to your computer.
 - a. Plug the large end of mini USB cable into a USB port on your computer. You can use the USB C to USB adapter if you have a Dell computer but avoid using a USB hub, if possible.
 - b. Unscrew the center cap on the shuttle. If the cap is too tight to loosen by hand, insert a screwdriver through the lanyard hole and rotate counterclockwise until the cap is loosened.
 - c. Plug the small end of the USB cable into the USB port in the shuttle. (If the shuttle has never been connected to the computer before, it may take a few seconds for the new hardware to be detected.) using the mini USB cable.
2. Readout the data stored on the shuttle
 - a. Using the drop-down menu at the top of the window, select *Device>Readout...*
 - b. A *Select Device* window like the one below should appear showing your shuttle as the attached device.

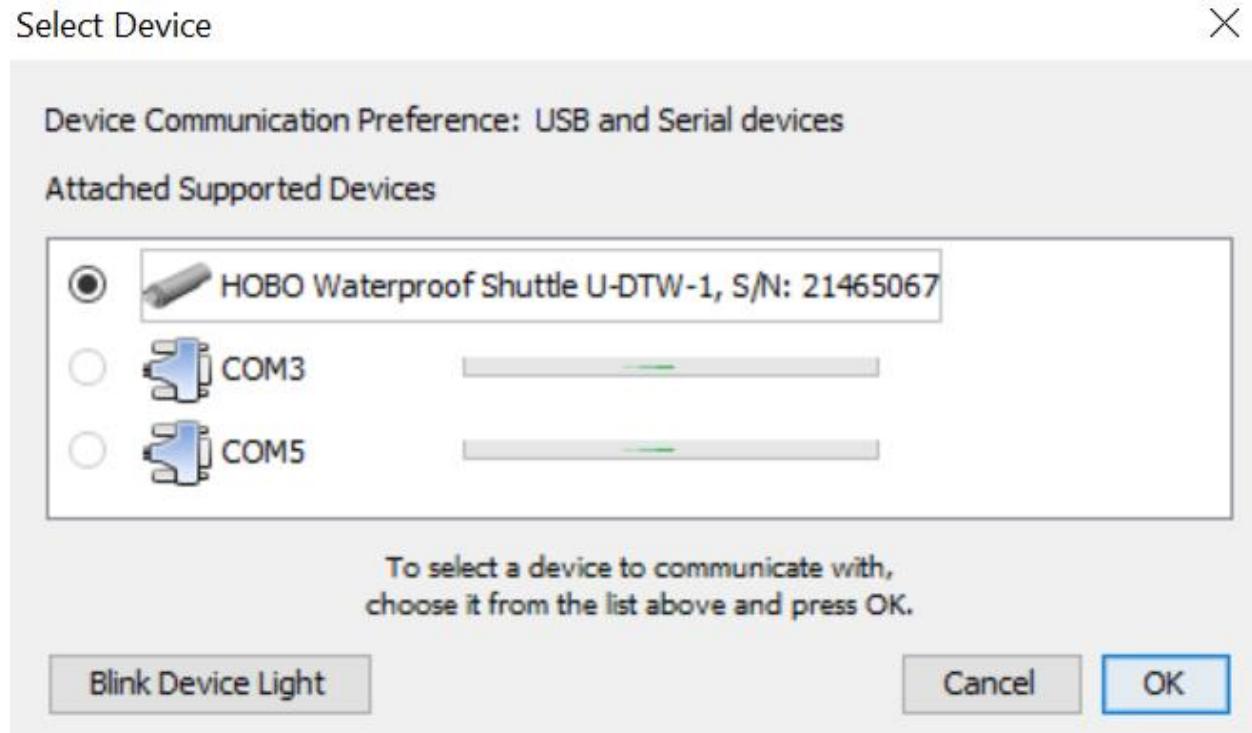


Figure 12

- c. Click *OK* in the lower right-hand corner of the window, which will open the *Waterproof Shuttle Management* window shown below. From the list of loggers, select those with a status of "NOT OFFLOADED". Before you offload the data, **make sure the *Delete Contents Upon Offload* box in the lower right corner (circled in red) IS NOT CHECKED**. Click the *Offload Checked* button. A progress bar will indicate the data for each logger is being offloaded.

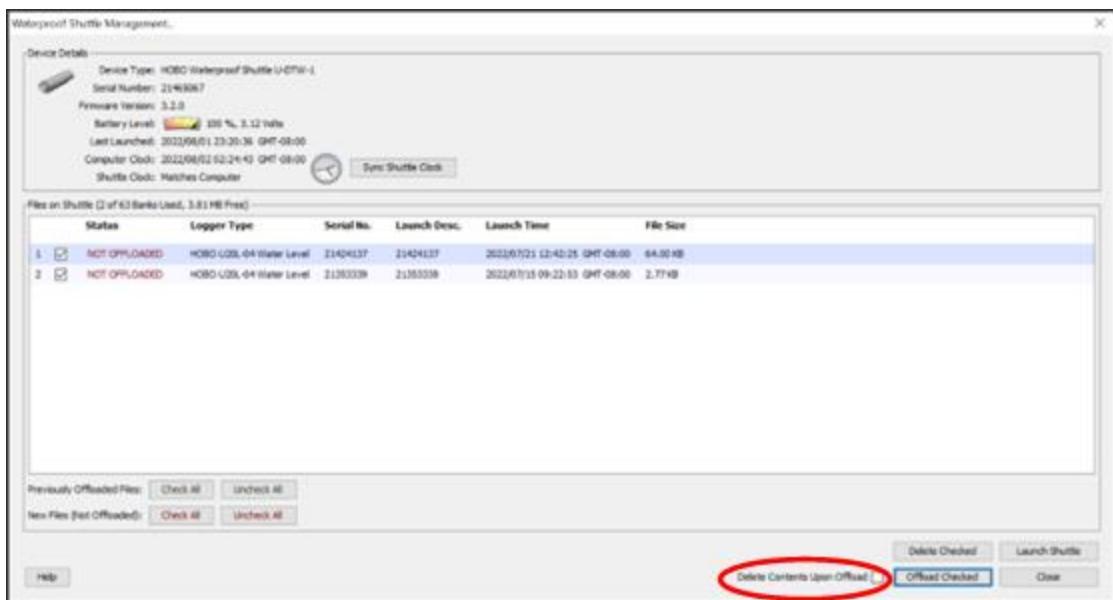
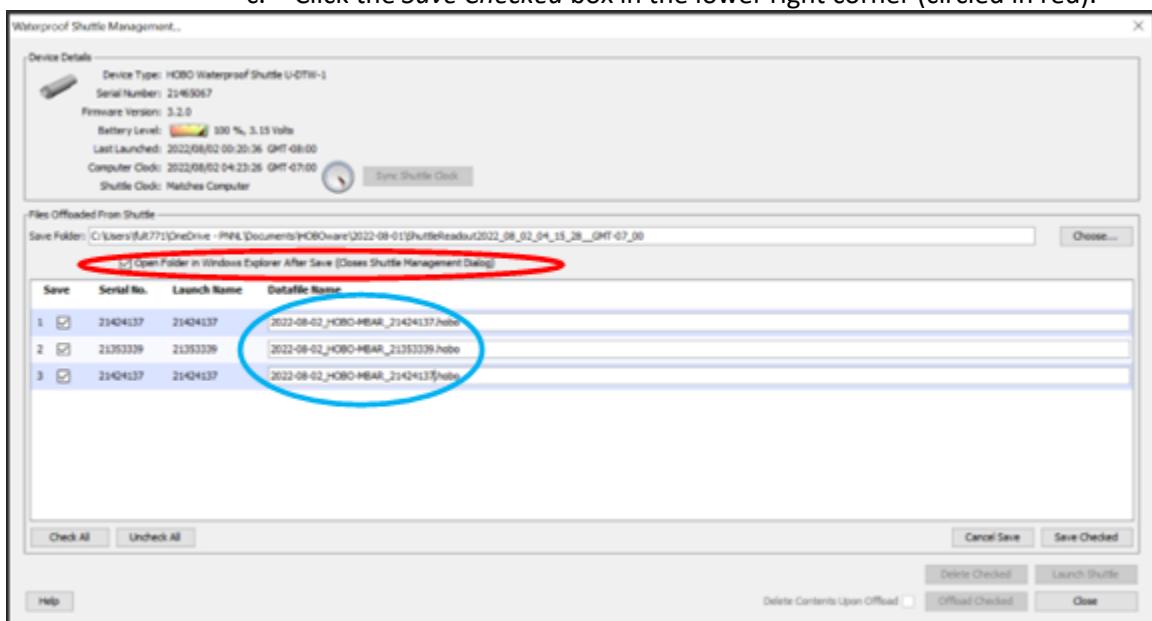


Figure 13

3. Save the .hobo datafiles to your computer (NOTE: Offloaded datafiles are identified by logger SN in the dialog box shown below, circled in blue):
 - a. Rename the datafiles using the following naming convention, separating each item by an underscore:
 - Data download date (e.g., "2022-08-02_")
 - Sensor type in all caps (i.e., "HOBO_")
 - Primary parameter unit of interest in all caps (i.e., MBAR_)
 - Logger SN (e.g., "XXXXXXXX", where XXXXXXXX is the 8-digit SN).
 - b. Check the box *Open Folder in Windows Explorer After Save*.
 - c. Click the *Save Checked* box in the lower right corner (circled in red).



Figure

14

4. Once the datafiles have been saved, the *Shuttle Management* window will close and Windows Explorer will open to the location of the saved files (see figure below). Individual shuttle readouts will be stored separately by download date and time based on your computer clock , (e.g., \Documents\HOBOWare\2022-08-01 \ShuttleReadout2022_08_02_03_51_46_GMT-07_00).
5. View the graph and data table to ensure the sensors are logging correctly (i.e no NAs in the table and the data isn't a straight line).
6. When finished, remove the logger from the coupler. The green LED stops glowing when you disconnect the logger or the USB cable.
7. Put the data in this folder: <https://tinyurl.com/SSS-HOBO>

Barotroll Download

When you download data from the sensor, the data log is copied from the sensor memory to the PC, but the *Log* is not removed from the sensor's memory. After a log is downloaded, it can be exported to a CSV file format that can be used by spreadsheet programs. NOTE: The time the log file was downloaded is concatenated to the end of the log file name.

 To remove an existing *Log* from memory, the log must be deleted using the Delete button (i.e., the Trash icon).

1. Connect the sensor to the Docking Station, open WinSitu, and click "Yes" to connect.
2. Select the **Logging** tab.
 - a. Select the *Log* you intend to download (can be either a running, suspended, stopped, or deleted *Log*).
 - b.  Click the Download button and select *All data*. The log is copied to the connected PC into your Win-Situ working directory folder. **View or change the working directory using *File > Settings*.**
 - At the end of the download, Win-Situ gives you the option of viewing the data. Always click "Yes" and review the log on the **Data** screen. Check the header info to make sure the data was recorded using the preferences you set in **NOTE: Data can be viewed anytime by selecting it in the Data tab.**
3. Put the data in this folder: <https://tinyurl.com/SSS-AtmosphericPressure>

MiniDOT Cleaning

1. Disassemble the minidot from the brick, sunshade, and do-not-disturb sign (cut zip ties)
2. Wipe the exterior of the minidot dry with a cloth
3. Remove the copper shield (unscrew the 3 screws and take it off)
4. Carefully but thoroughly clean the sensing window with a paper towel. The window has a soft rubber coating that you do not want to damage, but you do want to remove any algae, mud, or other foreign matter on the window. Rinsing and gentle rubbing with a paper towel are generally sufficient.
5. Reinstall the copper shield.

MiniDOT: Downloading

1. Remove the sensor housing (white plastic tube) from the sensor core (the part that consists of the sensor and circuit board) by unscrewing it from the black cap.

2. To download the data, simply connect the sensor to your laptop using the supplied USB cable. (Upon connection, the LED immediately below the USB port should blink green.)
3. In Explorer, click on “Local Disk” (you can read the contents of a miniDOT just like a USB drive). You will see three Java files (.jar) and a data folder. MiniDOTs store data files (aka “log files”) as text files (.txt) in the data folder on the sensor’s hard drive (local memory). The data folder on each miniDOT is named “7450-SensorSN” where SensorSN = the unique 6-digit serial number associated with each miniDOT:

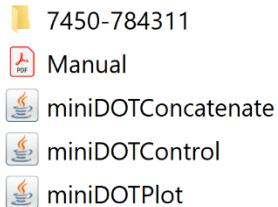


Figure 15

4. Right-click on the data folder to copy it.
5. Once you’ve copied the folder, paste it into the appropriate folder on the RC2 shared drive. Sensor data is stored on the RC2 shared drive by site ID and date. The file folder structure has already been created for you, so all you need to do is locate the folder for each data. MiniDot data should be put in this folder: <https://tinyurl.com/SSS-Minidot>
6. It’s a good idea to quickly review the data to make sure the miniDOTs were 1) turned on and 2) recorded “good” data. Data is recorded once every minute (i.e., the logging interval) on the even minute once you turn the sensor on (flip switch to “Record”) and stops recording new data when you turn the sensor off (flip switch to “Halt”). A new log file is created every day starting at midnight Greenwich Mean Time (GMT; subtract 8 hours from GMT to convert to Pacific Standard Time, PST). The miniDOT keeps time in Unix time, which is the number of seconds that have passed since January 1, 1970. You can convert Unix time to PST here: <https://www.epochconverter.com/>
7. Each log file contains five columns of data and one row or data record for every minute data was recorded.
 - a. Unix time
 - b. BV = battery voltage (V)
 - c. Water temp (°C)
 - d. DO (mg/L)
 - e. Q (sensor quality based on degree of light penetration; manufacturer-specific)
8. ***Open the text file located on the shared drive*** and check that the data values are representative of the conditions you would expect for the streams that you sampled that day (e.g., temperature, DO concentration). You should be able to recognize two different kinds of data: a) continuous blocks of data that were recorded during each chamber metabolism test followed by b) continuous blocks of data that were recorded when the miniDOT was in the cooler during transport, etc.
9. ***When you’re certain that you copied the data correctly to the shared drive, and that the data looks reasonable***, delete the data folder from the miniDOT by right clicking the folder and selecting delete.
10. Disconnect the sensor by closing the Control window or simply unplug the USB cable. The Explorer window will close on its own, so you will have to open a new Explorer window each time you connect a new sensor. Then flip the switch “halt”

11. Replace the sensor housing and hand-tighten until the silicon O-ring is fully inserted below the lip of the housing. DO NOT OVERTIGHTEN or it will be very difficult to remove next time. NOTE: miniDOTs have the serial number (SN) recorded on the instrument both internally (located on the white circuit board just above the black cap) and externally (on the top of the housing near the cable tie-off). Be careful not to separate or mix-up multiple sensor inner cores from their housings, e.g., DO NOT replace the housing from one sensor on the sensor core of a different sensor or the serial numbers will not match, and you could record the wrong SN in the field. The data stored on the miniDOT is associated with the SN on the inner core. It's a good idea to work with them one at a time.

Cotton Strips

1. Once at the lab, dump the ethanol into a waste container and then place all tubes in a fume hood and remove the caps. Leave them overnight to allow the ethanol to evaporate.
2. The next morning put the tubes (without caps) in a drying oven at 40°C. Dry for a minimum of 24 h and potentially longer. It is critical that the strips are dry.
3. Once dry, cap all the tubes and put them in an air-tight container (e.g., bin with sealing lid) along with some desiccant (e.g., silica gel).
4. [Put cotton strip photos and videos in this folder https://tinyurl.com/SSS-CottonStripPhotosAndVideos](https://tinyurl.com/SSS-CottonStripPhotosAndVideos)

Digitizing Metadata

1. Each afternoon, digitize the metadata using this google form: <https://tinyurl.com/SSS-Retrieve>.
2. Digitize metadata for sensors that were redeployed here: <https://tinyurl.com/SSS-ReDeploy>
3. Put miniDOT/HOBO photos here: <https://tinyurl.com/SSS-EnvContext>
4. Double check that you have taken a photo of the completed metadata sheet.

Appendix A: Equipment Lists

Equipment: Cotton Strips

- Pre-labeled 50ml tubes (1 tube per site)
- 70% ethanol (~ 100 ml per site)
- Waste container for 70% ethanol
- Cooler with blue ice
- Nitrile gloves
- Leatherman tool