



LAKE OBSERVATIONS

BY CITIZEN SCIENTISTS & SATELLITES



Lake Gauge Materials

Materials Needed

- 1- [Watermark Style A Stream Gauge](#)
- 1- [1X8X8' Ground contact pressure treated board](#) (or [2X8X8' board](#)).
- 1 - [7' Galvanized Steel U-Channel Sign Post](#)
- 2- [Stainless Steel Hex bolts 5/16" X 3"](#) (or 4" if using a 2X8 board)
- 2 - [5/16" Stainless Steel hex nut](#)
- 2 - [5/16" Stainless steel flat washer](#)
- 2 - [5/16" Stainless Steel split lock washer](#)
- 10-12 - [#10 X 3/4" Stainless Steel screws](#)
- 2 - [#6 X 1/2" stainless steel screw](#)
- 1 - [Small bubble level](#)
- **6-12 – [3" Exterior Deck screws](#) (only if installing on an existing fixed pier or dock)
- 1- [Eye screw](#)
- 1- [Line Level](#)
- 1- [Mason's Line](#)

Tools Needed

- Measuring tape
- Sharpie & pencil
- Cordless Drill/driver
 - Screwdriver bits
 - 3/8" drill bit suitable for wood & metal (1/2" would be okay as well)
- 24" level
- Ratchet wrench
 - 1/2" socket
- Adjustable wrench
- [Post Pounder](#) (recommended) or sledge hammer (this will work, but it's more difficult)
- LOCSS Sign

**If installing a gauge on an existing fixed pier or dock, omit the U-channel sign post, hex bolts, nuts, flat washers and lock washers and instead purchase 3" deck screws. For installing on a pier or dock ONLY do the steps below that are marked with *

Building The Gauge

1. Use a Sharpie and mark the back of the steel post at 24", 36", 48" and 60" from the bottom.
2. * Cut the pressure treated lumber in half, making 2 boards that are 4' in length. You will use a single 4' long board for each gauge.
3. Drill a 3/8" hole in your board for your bottom hex bolt. This hole will be located 1 1/2" inches from the end of your board, and centered across the width of the board. Be very careful to drill this straight through the board, as an angled hole will make it very tough to assemble. This end of the board will be the bottom of the gauge.



LAKE OBSERVATIONS BY CITIZEN SCIENTISTS & SATELLITES



4. Put the hex bolt and flat washer through the hole on the face of the board, making sure the flat washer rests flatly on the board. Draw a horizontal line across the board at the top most edge of the flat washer. Remove the bolt and flat washer.
5. * Place the gauge on the face of the board, making sure that the bottom of the gauge is slightly above the line that was drawn in step 4. Center the gauge horizontally on the board using your measuring tape to be sure that all 4 corners of the gauge are an equal distance from the edge of the board.
6. * Being careful to hold the gauge firmly in place, use a #10 screw to attach the top-right corner of the gauge to the wooden board. Do not tighten the screw completely.
7. * Recenter the gauge on the board if needed. Use a #10 screw to attach the bottom-left corner to the gauge board.
8. * Use #10 screws to attach the remaining corners of the gauge to the board, as well as at least 2 other points on the gauge. We typically attach a gauge at 6-8 points.
9. Using a straight edge, draw a horizontal line on the board equal to the top edge of the gauge. Continue this line along the sides and back of the gauge board.
10. Flip the gauge board assembly so that the gauge is facing down. On the back of the board, draw a vertical line down the center of the gauge board.
11. Put the hex bolt and flat washer through the hole near the bottom of the board, making sure the head of the bolt and the flat washer are on the same side of the board as the gauge.
12. Lay the gauge assembly face down so that the hex bolt at the bottom is sticking up. Place the steel post on the back of the gauge board, with the top of the steel post aligning with the top of the board, and making sure that the hex bolt is both the gauge board and one of the holes in the post.
13. Rotate the post on the hex bolt as needed until it is roughly centered horizontally. Use the horizontal line you drew on the back of the board as a guide.
14. When it is centered, find a hole on the post that is at least 1/2" above the horizontal line that corresponds to the top of the gauge. Thread a pencil through this hole and make a mark on the wood. Make sure this mark intersects the vertical line that marks the center of the board.
15. Remove the post from the back of the board and measure to be sure that the mark you made is at least 1/2" above the top of the gauge and is centered horizontally. If it is, drill a 3/8" hole through the board at that point. Be very careful to drill this straight through the board, as an angled hole will make it very tough to assemble. This will be the spot that a hex bolt attaches the top of the gauge assembly to the steel post.



LAKE OBSERVATIONS BY CITIZEN SCIENTISTS & SATELLITES



16. Test for fit: Thread hex bolts with flat washers through the top and bottom holes of the gauge board. The flat washer and the head of the hex bolt should be on the same side of the board as the gauge. Place the gauge face down, with the hex bolts point up. Lay the steel post on top of the gauge board, threading the hex bolts through the holes in the steel post. Place a lock washer and a hex nut on the threaded portion of each hex bolt. The lock washer should go on first and come in contact with the steel post, followed by the hex nut. Finger tighten.

*If you have trouble threading the hex bolts through the wood and the steel post, it's possible that the holes were not drilled straight. In this case, use a 3/8" drill bit to slightly widen one of the holes, then the other, until you are able to get a good fit.

Installing in the lake

17. Begin by repeating step 16 above to be sure that everything fits together well. When doing this, align the post so that the hex bolt at the top of the gauge threads through the first or second hole from the top of the steel post. The goal is to have the gauge board attached as close to the top of the steel post as possible.
18. * Choosing the location for the gauge is a process that is different for each installation. Choose a spot that can be easily read from the shore or the dock. Also, the goal is to drive the post at least 3 feet into the lakebed. If you attach the board to the steel post as instructed in step 17, you will have about 3 3/4 feet of post below the gauge board. Also remember to factor in the seasonal fluctuation of the lake when determining where to locate the gauge. If it is at the end of a long dry season, and the lake level is very low, you should aim finish the installation where the water level is very low on the gauge. Alternatively, if the lake levels are high at the moment, you should aim to finish the installation where the water level will be high on the gauge.
19. * For Installation on an Existing Pier or Dock ONLY. Drill pilot holes in the gauge board, and drive deck screws through the gauge board into the fixed pier. Use at least 5 screws to firmly attach the gauge board to the pier.
20. Walk into the lake to your desired gauge location and stand the post up vertically. Make note of the water level in relation to the markings you made with a sharpie on the back of the post. This is the depth of the water at this spot & when you are finished, the water level should be at least 3 feet higher on the post than it is now (which means that the post was driven 3 feet into the lakebed).
21. *Slightly* tighten the bottom hex bolt using the ratchet wrench with 1/2" socket on the head of the hex bolt, while using the adjustable wrench to prevent the hex nut on the back of the assembly from turning. DO NOT OVERTIGHTEN or you may not be able to attach the top hex bolt.
22. Remove the top hex bolt assembly (bolt, flat washer, lock washer, and hex nut) and rotate the gauge board downward (the pivot point will be the bottom hex bolt).
23. Have 1 person hold onto the gauge board so that the steel post is vertical (you can check with the 24" level). Person #2 will use the post pounder to drive the steel post into the lake bed. Be sure to stop frequently & use the 24" level to make sure that the post is vertical.



LAKE OBSERVATIONS BY CITIZEN SCIENTISTS & SATELLITES



24. When you have pounded the post in about 1 ½ feet, check the bottom hex bolt assembly for tightness. If it is loose, tighten in *slightly* using the ratchet wrench and adjustable wrench. Do not overtighten.
25. Drive the steel post into the lakebed until it has gone in at least 3 feet (refer to step 19) & the water level is at a suitable location on the lake gauge itself.
26. Once the post is driven to the appropriate depth, use the 24" level again to make sure the post is vertical or very nearly so. Also check that it is stable & doesn't come out of vertical alignment when pushed to the side. If it is not vertical or stable, you may have to remove the post and install again. (see **Note below for more)
27. Once the post is installed properly, rotate the gauge board & attach the top of the board to the post using the hex bolt, hex washer, lock washer, and hex nut. Tighten using the ratchet wrench with ½" socket and the adjustable wrench
 - If you cannot thread the hex bolt through, you may have tightened the bottom hex bolt too much. To fix it, you could loosen the bottom hex bolt slightly or use a 3/8" drill bit to widen the hole at the top of the board in hopes that the
28. Use #6 screws to attach the small bubble level to the gauge board just above the gauge. Be sure to install it so that the bubble is centered between the two black marks.
29. Make note of the date, time, and water level upon completion of installation. Take a photo of the lake gauge using your phone, making sure location tracking is on. This will help us get the latitude and longitude of the gauge.

** Note: You may come across a lakebed with sediments that are so loose that even after you drive the post in 3 feet, it is not stable. If that's the case here's what we recommend

1. Drill a new hold for the top hex bolt in a location farther down the gauge board. Follow steps 10-15 above. However, the location of this new hole should be roughly at the 0.90 mark on the lake gauge & centered horizontally. You will need to drill the hole with a 3/8" drill bit that is suitable for metal, since you will be drilling through the gauge itself.
2. When you attach the gauge board to the post, align it so that the top hex bolt (the one that passes through the metal gauge) passes through the top hole in the steel post.

Setting it up this way will give you the opportunity to drive the steel post more than 5 ½ feet into the lakebed.

Alternatively, you could use an 8' post, but you would likely need a different length hex bolt for that. You could also attach two 7' posts end to end by overlapping them, aligning the holes on the two posts and connecting using hex bolts and nuts. We have never done this, though, so cannot recommend it.



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Attaching LOCSS Sign

* After completing the above steps, attach the LOCSS sign to the top of the gauge board. To do this, first drill 4 holes at the bottom of the sign using a 3/16" drill bit. The location of these holes may vary and will depend on the actual sign location. Use #10 X 3/4" stainless steel screws to attach the sign to the top of the gauge board, above the gauge and level.

Referencing Your Gauge To A Fixed Point

* It's important to reference your gauge to a fixed point in case your gauge is damaged and must be replaced. This is also important to do in lakes where the gauge must be removed before the lake freezes and replaced in the spring. But referencing your gauge to a fixed point, it will allow us to compare the lake height measurements from before the gauge was replaced to those that are reported after the gauge is replaced.

1. *Find a nearby tree, wooden seawall, or fixed pier, and install your eye screw in this fixed object at a height as close to the top of the gauge as you can get it. This does not have to be exact at this point, and it is fine if you must install the eye bolt higher than the top of the gauge.
2. *Tie one end of the mason's line to the eye screw and unroll/stretch the line out into the water to above the lake gauge.
3. *Hang the line level on the mason's line, and use it to level the string.
4. *Use the measuring tape, to measure the *vertical distance* between the level string and the 3.30 (or other) mark on the gauge. Make note of this distance, being sure whether to indicate whether the string is above or below the gauge. For example: "The 3.30 mark on the gauge is 14 ½ inches below the string levelled with the eye bolt in the trunk of the nearby oak tree".
5. *Leave the eye bolt in the fixed object, but remove the line and line level.

Be sure to complete these steps each time the gauge is installed/reinstalled or straightened, and report it back to the LOCSS project team (see below).

Report Your Installation to the LOCSS Team

Upon completing the installation, first follow instructions on the sign to send in your first measurement. Once you do this, please share the following with the project team by emailing lakelevel@unc.edu:

1. The date and time of installation
2. The location of the gauge. The latitude and longitude (preferred) can be found on google maps, or a detailed description may work as well
3. The lake height upon completing installation
4. The measurement you took referencing your gauge to a nearby fixed point, including a description of the location of the eye screw and the vertical distance between the leveled line and the gauge.
5. Photos! We'd love photos of the lake in general, the lake with the gauge in it, people installing the gauge, etc. Please let us know if you would not want us to post these on our website or social media.