



Reservoir Staff Gauge Guidance

Dam Safety

As part of a larger Operation and Instrumentation program, Ecology’s Dam Safety Office (DSO) requires dam operators to install a reservoir staff gauge at all dams we regulate. Staff gauges are used to:

- Track water elevations.
- Aid maintaining minimum operational and emergency freeboard elevations.
- Track spillway out-flows and water elevations during a large storm event.

After installing a staff gauge, record important reading numbers in your Emergency Action Plan and Operation and Maintenance plan/manual.

Selecting a staff gauge

Every dam is different, so an owner must decide what is the best staff gauge for their reservoir. Staff gauges are generally installed as free standing, strapped to a post or pier, or attached directly to a pond liner. DSO prefers you purchase a staff gauge, but if you wish to make your own please contact us for guidance.

Some key considerations when selecting a staff gauge:

Readability: No matter what type of gauge you use, it should have clear markings that are highly visible at night or in bad weather. Most commercially available gauges have a bright white background with black markings.

Location: The gauge should be easily visible from the crest of the dam or operations facility. Having the gauge located near an outlet or spillway can have additional advantages. To get accurate readings, avoid placing the gauge in flowing water or areas prone to wave action.

Accuracy: Generally, increments of 0.1 feet are adequate for measuring water levels in a reservoir with a spillway. Most commercial staff gauges have markings at every 0.02 feet, and numbered increments of 0.1 to 1 foot. To maintain freeboard limits, increments greater than 0.25 foot is not recommended.

Owners wishing to use larger increments should contact us to discuss options.

Materials: Gauges generally are made of enamel coated metal or fiberglass, and are resistant to a wide range of weather and water conditions. The owner should research which type of material and design is best for their particular situation.

Range of measurement: The owner may choose to set the gauge up to measure water levels from the bottom to the top of the reservoir, but the DSO is primarily interested in water levels from the reservoir’s lower operating limits up to the dam crest.



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To request an ADA accommodation, contact Ecology by phone at 360-407-6872, or visit <https://ecology.wa.gov/accessibility>. For Relay Service or TTY call 711 or 877-833-634

Installing a staff gauge

Free standing or secured on a vertical object

For greatest accuracy, ensure the staff gauge is vertical and well-secured to a stationary object such as a fencepost, pipe, or concrete wall (See Examples 1, 2, and 3). Once the gauge is secure, clearly mark the elevation of the crest, emergency freeboard elevation, and the spillway overflow elevation. The best way to do this is with a piece of reflective tape. It is best to locate these elevations on the staff gauge with survey equipment like a level scope and rod. It can also be done by correlating the known height of a fixed object in the reservoir with a gauge elevation, as described in the example below.

Example: A principle spillway is at an elevation of 100.0 feet at the invert (bottom of the spillway), the emergency spillway invert is at 109.0 feet, and the dam crest elevation is 110.5 feet. When water elevation reaches the principle spillway invert and begins to flow, the installed gauge reads 3.0 feet. The operator would mark this elevation on the gauge with reflective tape, and use it as a base for marking the elevations of the emergency spillway and dam crest.

As a general note, the base of the measurement does not have to be a mean sea level elevation. It can be site specific, so whatever measurement had previously been used at the site, included when the dam was first built, can be used here.

Lined reservoir

Reservoirs lined with plastic or HDPE have unique challenges, and more limited options, since most of the previously suggested staff gauge methods would likely puncture the liner. The most frequently used staff gauge design for this scenario is painting marks on the liner. It may be possible to obtain a staff gauge modified for non-vertical placement, but it may be difficult to find.

The owner may construct their own staff gauge by securing a strip of white PVC or HDPE liner to the reservoir liner. The marks would then be placed on that liner strip. Example 4 shows an example of a liner gauge.

A key issue for setting up a side-slope gauge

A key difference with liner-installed gauges is that you must adjust the distance between elevation marks on an embankment-mounted gauge to compensate for the slope of the embankment. In other words, the marks representing 1 foot vertical increments will be spaced more than a foot apart along the liner, with the distance varying based on the slope of the embankment. Some typical conversions for different embankment side-slopes:

- Slope 2H:1V – one foot of water level rise would correlate to 2.24 feet = 27 inches as measured along the slope.
- Slope 2.5H:1V – one foot of water level rise would correlate to 2.69 feet = 32 inches as measured along the slope.
- Slope 3H:1V – one foot of water level rise would correlate to 3.16 feet = 38 inches as measured along the slope.

Other considerations

- The (typically) black background of the liner does not provide as good a background as the white backing of a typical staff gauge.
- Paint should be water resistant, highly visible, and preferably white for a dark background or black for a light background. Maintenance will be needed, as paint will potentially fade or flake away.
- Another option may be to make the markings with reflective tape.

The liner itself will tend to fade over time, and lines typically become covered in grime and dirt, requiring frequent cleaning and maintenance.

Staff gauge examples



Example 1. Free-standing staff gauge



Example 2. Pier-mounted staff gauge



Example 3. Wall-mounted staff gauge



Example 4. Pond liner mounted staff gauge