WATER LEVEL MONITORING

BENCHMARKING

PACIFIC SALMON FOUNDATION

Benchmarking is the process of establishing a fixed, permanent elevation reference point (benchmark) against which all water level measurements are referenced. It is often used to establish a local datum for water levels, but can be tied to a known elevation (i.e., geodetic datum). It is important for water level monitoring because it ensures that readings from a staff gauge or automated level logger (see related summaries) are accurate and comparable over time. By referencing measurements to a benchmark, one can reliably track water level changes, calculate discharge, and produce long-term records that are scientifically valid and useful for modelling or regulatory purposes.

SUMMARY OF METHOD

There are four main steps involved with benchmarking:

1. **Site selection:** Choose a permanent, secure site near the stream for the benchmarks (e.g., bedrock, large stable concrete structure, large tree). Ideally, three benchmarks should be established for each monitoring station to generate redundancy, and to provide a basis for assessing vertical stability of the benchmarks. All benchmarks must have a unique identifier (ID).

2. **Installation:** Establish the benchmark by placing a physical marker (e.g., metal wedge anchor, tree spike) at an elevation that will remain fixed over time. Ensure the benchmark remains accessible, visible, and intact for future measurements.

3. **Referencing:** Survey the elevation of all benchmarks relative to each other, and relative to the staff gauge and stilling well. Survey the water surface elevation for comparing to water level observations.

4. **Recording:** Record the benchmark location, elevation, and installation details (e.g., ID, coordinates, site description or sketch) to ensure future users can reliably locate the benchmark.

Photo credit: Ally Wall

IMPORTANT CONSIDERATIONS

Benchmarks should be located on solid, immovable ground that is unlikely to shift due to erosion, frost heave, vegetation growth, vandalism, or construction activity. At least one benchmark should be located above high water, but close enough to the monitoring hardware to allow accurate surveying, and easy to locate for re-surveying. The other benchmarks can be located below high water if sufficiently secure (e.g., wedge anchor in bedrock).

At least annual or semi-annual re-surveying (depending on desired data grade) is important to confirm no vertical movement in the monitoring hardware, for ensuring accurate readings. If a vertical shift is detected, the cause of the shift should be rectified, the water level recordings should be corrected for the shift, and the frequency of re-surveying should be increased.

If the staff gauge and/or stilling well are not perfectly vertical, their slope and length should be measured during surveying to relate the bottom elevation of the hardware (e.g., level logger port) to the benchmarks.

A basic engineer's level (i.e., construction level) can be used for the benchmark survey. A tripod with a dome head (i.e., rounded top) allows quick, smooth positioning of the leveling instrument, speeding up field setup.

STREAM CHARACTERISTICS

- Safe access for surveying monitoring hardware may be impeded by a muddy streambed
- Benchmark may need to be distant from the monitoring hardware for streams with frequent flooding and/or channel changes (unstable bed or banks)

MEASUREMENT CHARACTERISTICS

- Manual data acquisition
- Frequency of surveys determined by frequency of site visits, desired data grade, and hardware stability

SITE ACCESSIBILITY FACTORS

- Suitable for remote foot access
- Can avoid entering stream during high flow
- Initial set up involves medium-sized equipment (e.g., rock bolts, rock drill, hammer, wrench)
- Ongoing monitoring involves medium-sized equipment (e.g., 1 m survey tripod & stadia rod when collapsed)

SCALE OF EFFORT: INITIAL SET UP

Equipment cost: very low
Field time: low; 1-2 hours
Field expertise: moderate

SCALE OF EFFORT: ONGOING MONITORING

Equipment cost: negligible
Field time: low; ~1 hr
Field expertise: moderate
Analysis time: low; <1 hr
Analysis expertise: moderate

PRODUCTS TO CONSIDER

Level: Leica NA332 Automatic Level
Tripod: Duratech Aluminum Tripod With Dome Head
Stadia rod: SitePro Aluminum Leveling Rod (available in 5m and 7m lengths)

ADDITIONAL RESOURCES

Community Flow Monitoring Network, 2023
Environment and Climate Change Canada, 2023
Resources Information Standards Committee, 2018
Water Survey of Canada, 2022a,b
World Meteorological Organization, 2010