Measuring Low Flow Rates

- Battery Operated Flowmeters
- Volumetric Calculations by Stopwatch
- Pump Electricity KW-H Meters

Battery Operated Flowmeters

For use in remote areas, or as an alternative to installing a large flowmeter, battery powered flowmeters or small scale digital meters are an option for measuring low flow rates.

Volumetric Calculations by Stopwatch

A bucket and stopwatch is a simple alternative to measure constant flow rates. The method is useful for low-flow diversions such as gravity springs or small pumps. At least three trials should be conducted and averaged. A five gallon bucket is useful for measuring flow rates up to 50 GPM:

1. Measure the volume of a container or other storage vessel.
2. With a stopwatch, time how long it takes to fill the vessel.
3. Repeat the above steps at least three times and take the average. It is a good idea to do a few trial runs before recording any data so that one can get a feel for the timing and accuracy required.
4. The flow rate is the volume of the vessel divided by the average time it took to fill.
   Example:

$$t = \frac{11.2s + 13s + 13.5s}{3} = 12.6\ seconds \qquad Flow\ rate = \frac{V}{t} = \frac{5\ gallons}{12.6\ seconds} = 0.40\ \frac{gal}{sec}$$

The flow rate is 0.40 gallons/second or 24 gallons/minute.

This volumetric method should not be used when water levels or pump conditions change significantly over time. Under variable pumping conditions you may need to install a flowmeter.

Pump Electricity KW-h Meters

Electricity records can be used to report water diversions by correlating electricity use with pumping rates. Electricity consumption is calibrated to a particular flow quantity, which produces a value of KW-Hours per acre-foot pumped using the equation below. In order to use this method, natural variations in “suction lift” must be less than 5% of the “total lift” (see diagram below) as is frequently the case for pumps installed in check-dams or ponds with stable water levels fed by small tributaries. Electricity records can be used to derive flow rates by using the following equation:

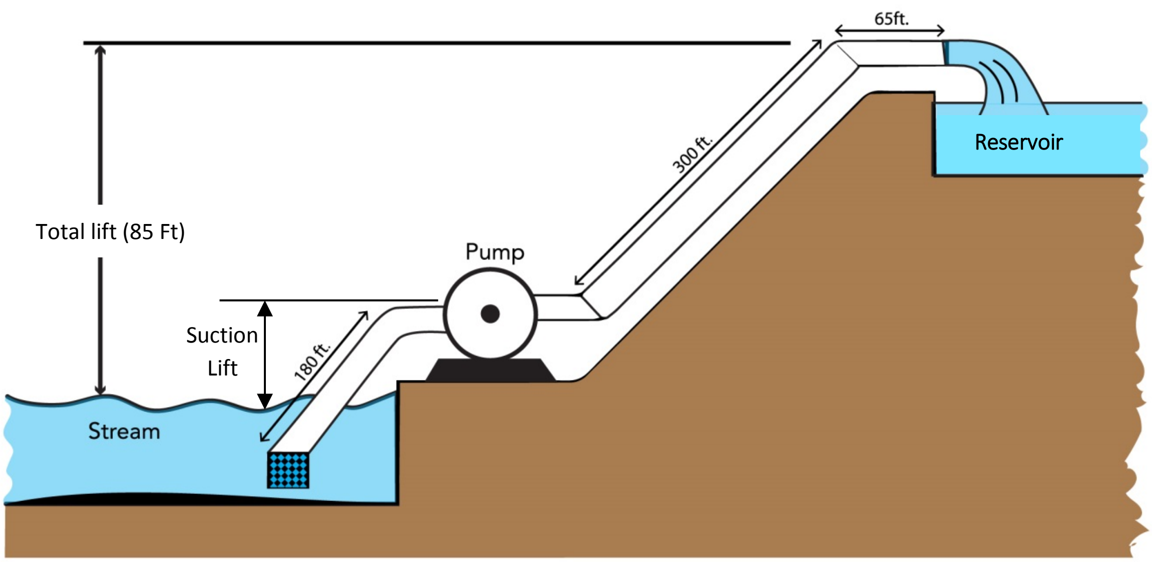
$$Gallons = \frac{318{,}600\ x\ KWh\ x\ E_f}{TDH}$$

Gallons = volume pumped over a specified period of time.
KWh = electricity use in kilowatt-hours over a specified period of time.
E_f = the product of ‘pump efficiency’ and ‘motor efficiency’.
TDH = is the Total Dynamic Head against which the pump is operating. It includes the vertical lift, plus all the friction losses between the point of entry and the point of discharge.
318,600 is the conversion factor.

The Division recommends consulting a professional specializing in flow measurements to perform a pump capacity test if system efficiency (E_f) or total dynamic head (TDH) are unknown. The use of electricity records is not recommended if water levels or pumping conditions change significantly over time. Under variable pumping conditions you should consider installing a flowmeter.

Example Using Power Records

Example: *The pump lift (elevation difference) between the river and a pump discharge is 85 feet. Friction head losses along a 545-foot mainline are 2 feet per 100 feet of pipe, or a total of 11 feet of head loss. The pipe exits freely to the atmosphere with no exit pressure loss. TDH is the sum of the pumping lift, friction losses and exit pressure head, for a total of 96 feet. The system efficiency E_f is 72%. Applying these values and the recorded monthly electrical use of 1,627 KWh to the above equation results in an estimated water use of approximately 3,887,716 gallons (or 90 GPM).*



- ✓ Fluctuations in suction-lift must be small compared to the total lift.
- ✓ Discharge pressure must be stable.