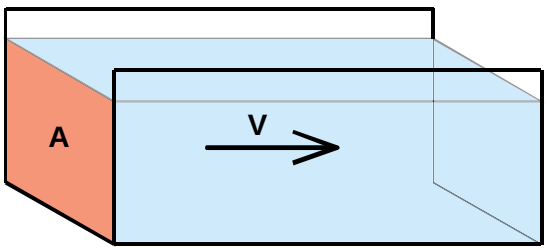
Calculating Discharge From Flow Velocity

Geolux RSS-2-300 W flow meter measures flow velocity at the water surface. This measurement can be used to calculate actual discharge – the total volume of water that passes through a channel cross-section in a specific period of time. Discharge measurement is important for a wide variety of purposes including flood and pollution control, irrigation, watercourse regulations and broadly as an input data for dimensioning of almost any new structure on the open channel flows.

Discharge is calculated by multiplying mean flow velocity and channel cross-section area. The cross-section area is the area of the slice in the water column made perpendicular to the flow direction.

For ideal case, let us assume the rectangular channel profile, with constant flow velocity at all points, as in Picture 5.



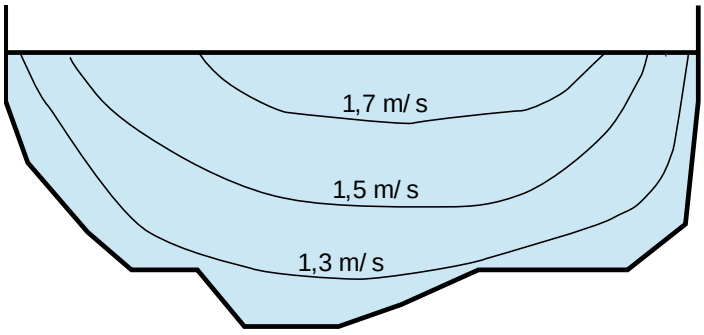
Picture 5. Simple channel diagram

The discharge can be calculated according to the formula:

$$Q = V * A$$

where Q is discharge (for example in m^3/s), V is flow velocity (for example in m/s), and A is cross-section area (for example in m^2).

For real-world measurements it is important to understand that the velocity of the moving water varies both across the stream channel and from the surface to the bottom of the stream due to friction, as in Picture 6.



Picture 6. Flow velocity in a typical cross-section

In order to determine the discharge in a realistic channel, the area must be precisely measured by measuring water depths at a series of points across the stream and multiplying by the width of the stream within each segment represented by the depth measurement. The mean cross-section flow velocity needs to be determined from measured surface flow velocity. Studies performed by USGS reveal that, typically, the mean velocity is 80-95% of the surface velocity, the average being 85%.

Knowing non-rectangular area of the stream cross-section, and knowing the surface flow velocity, the following formula can be used:

$$Q = 0{,}85 * V * A$$

More details about water flow measurements can be found in the following technical note:

https://www.bae.ncsu.edu/programs/extension/wqg/319monitoring/TechNotes/technote3_surface_flow.pdf