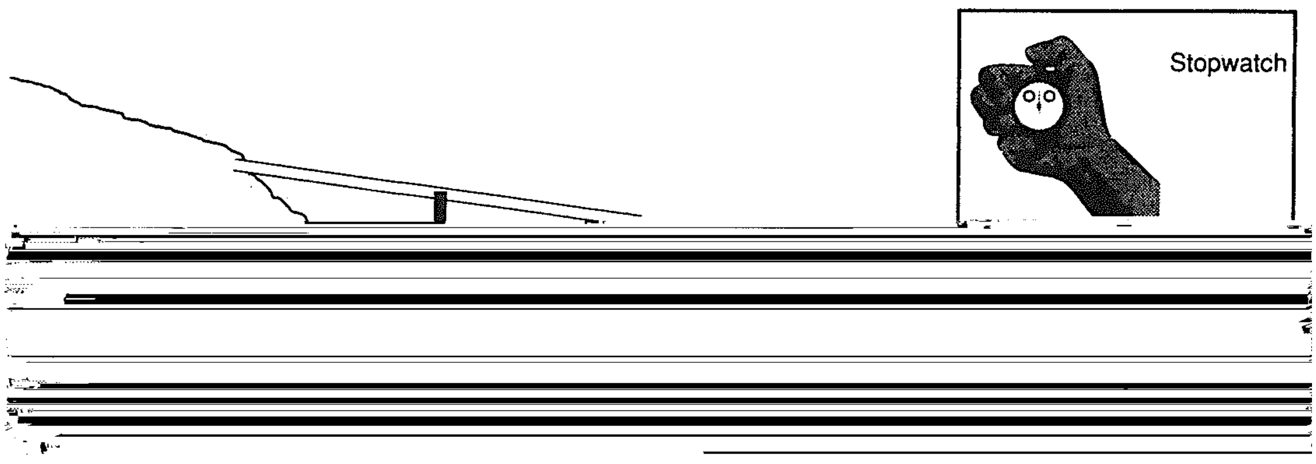
l d c

Community water-supply schemes are generally designed for water consumption in the approximate range of 15 to 60 litres per person per day. Allowance has also to be made for water use by livestock, for future growth in population and demand, and for losses of water by eakage etc. from the system.



An oil d m belo a bamboo po

Discharge measurements and estimates

F a , ac a d a e

Floats are a simple way of measuring the velocity of a stream, but they are not very accurate. The surface velocity is obtained by measuring the time (t secs) for a float to travel a measured distance (L metres). It is best to choose a straight, uniform river section about 30m long, and to time the float over a number of repeated runs. A piece of fruit makes a good float, as it is less affected by wind than a wooden stick. A factor of about 0.85 should be used to convert surface velocity to average velocity.

Surface velocity (m/s) = L / t

Average velocity (m/s) = 0.85 x L / t

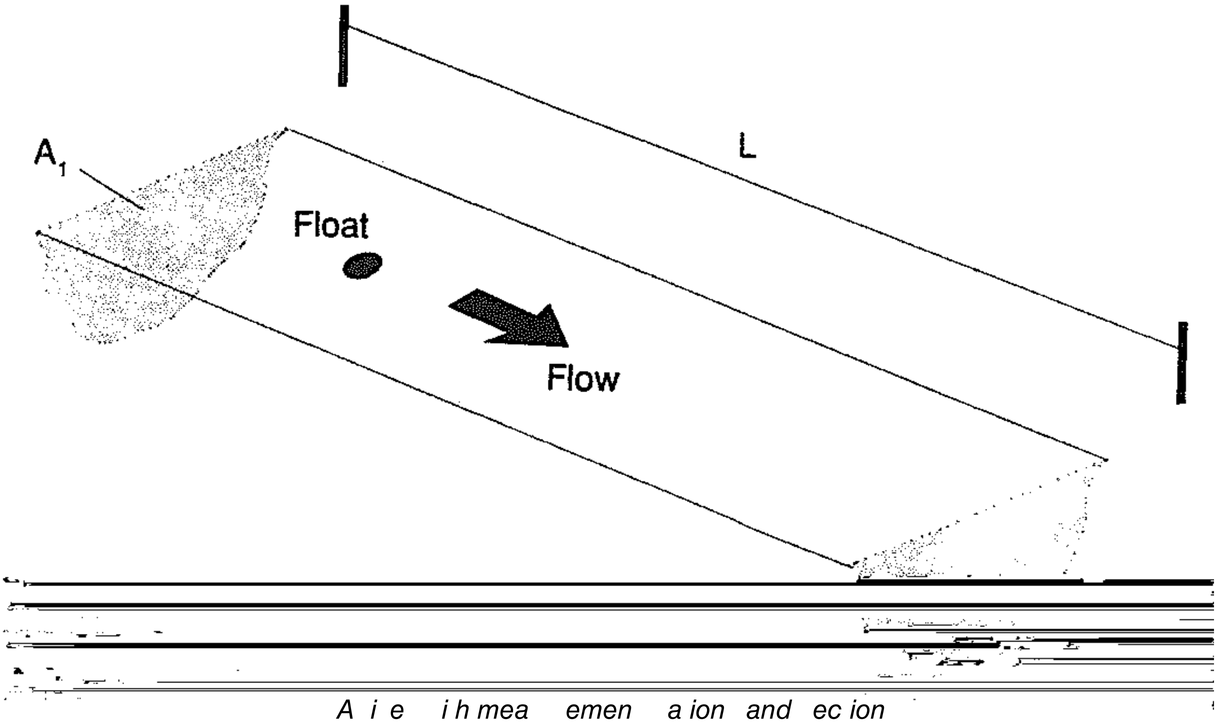
The cross section of the stream should be measured up carefully in a number of places along the test distance, and the average cross-sectional area calculated (A sq m).

Discharge (cubic metres per second)

= average velocity × cross sectional area of stream

= 0.85 × (L / t) × A

Discharge (l /s) = 1000 × 0.85 × (L / t) × A



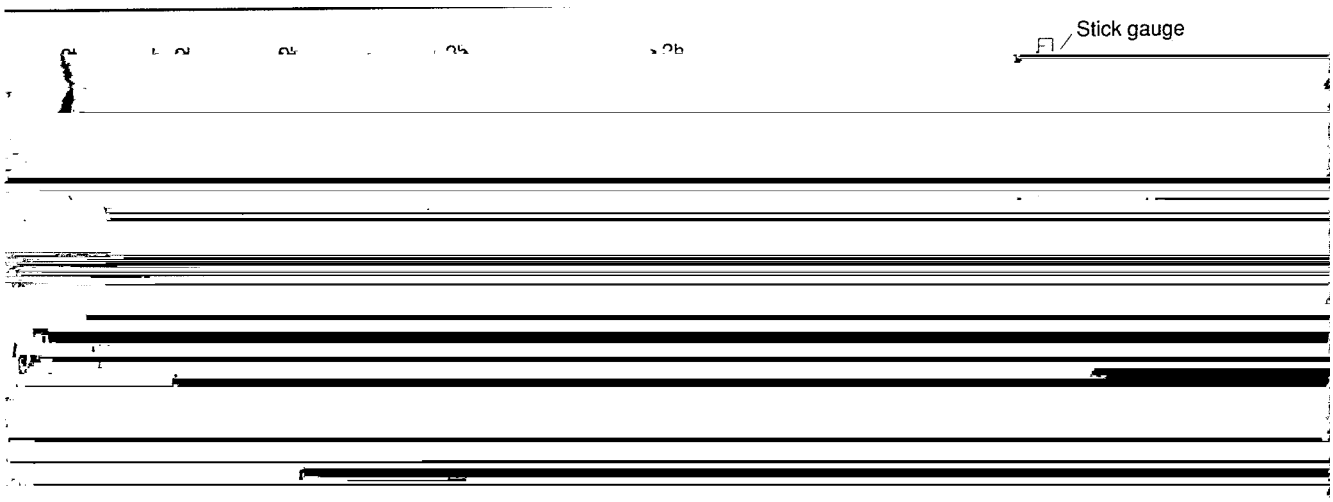
A i e i h mea emen a ion and ec ion

We c a e

Portable weirs made of steel plate can be used for measuring the flow of small streams or springs. They can give accurate measurements, if they are installed carefully. The weir should be set vertically, perpendicular to the stream, and with the crest horizontal. A free fall is required over the weir crest. Leaking must be prevented around the sides of the weir, possibly by using a polythene sheet.

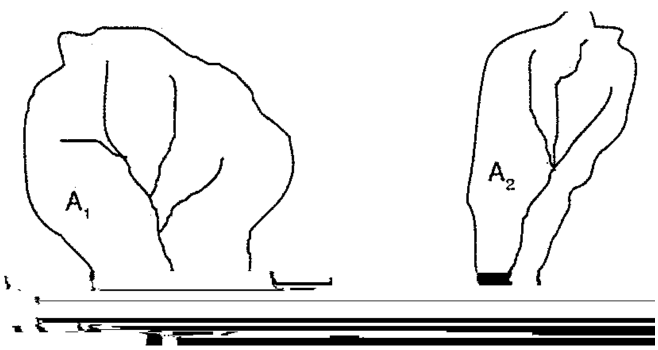
A stick gauge, marked in centimetres, is set vertically at the side of the stream upstream of the weir. It is used to measure the head, h (m), which is the difference between the upstream water level and the crest of the weir. It is important to check that the gauge zero is truly at weir-crest height. This may be done using a spirit level and string line, or water-filled flexible plastic tubing.

There are different shapes of weir, each of which has a standard formula for calculation of discharge. Details for two common weir shapes are given opposite.



T o common ei

he e Q = di cha ge o e ei (m /), L = leng h of no ch (a de ned in g e, in m) and h = head (m)



Q_1
(kno n)

Q_2
(no kno n)

- for the recorded basin, measure the catchment area A1 which drains to the measurement station;
- for the unrecorded basin measure the catchment area A2 which drains to the point where the ﬂow is to be estimated;
- obtain the dry season ﬂow 01 for the recorded
  - y season ﬂow 2 (f)30 (or the unr)20 (ecor)20 (ded bas

d) From local reports (or records) of dry season depth, coupled with survey of the cross section and slope of the stream, and using the Manning equation:

$Q = \frac{A R^{2/3} 5^{1/2}}{n}$	Q = discharge (m3/s) A = area (m2) R = A/P where P = wetted perimeter (m) s = slope (m/m) n = Mannings roughness coefficient	suitable values of n are: straight river with earth bed: 0.02 - 0.025 straight river with with stony bed: 0.03 - 0.04 straight river with earth bed: 0.03 - 0.05 straight river with stony bed: 0.04 - 0.08

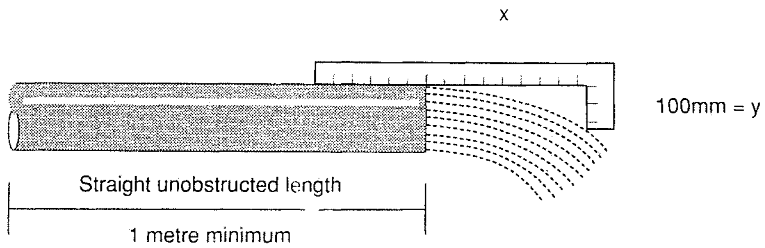
C a d c a e b e e e

T e e a be ea ed b e e e d :

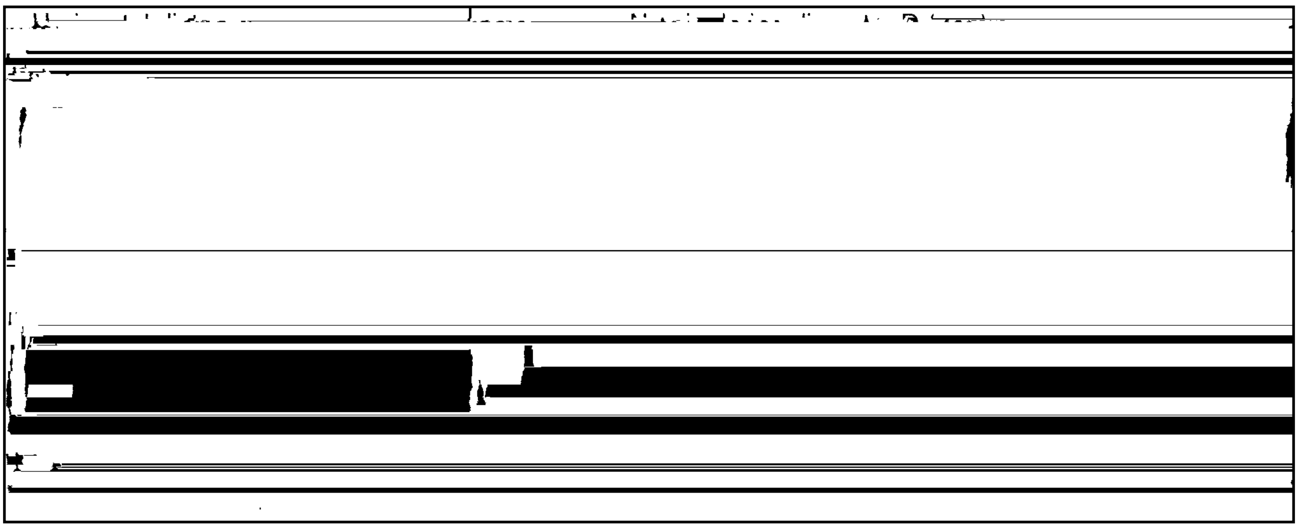
1. Using a V-notch weir set in a steel tank or earth channel
2. Using a calibrated ori□ce plate and pressure gauge on an upstream tapping (the pressure difference across an ori□ce plate will depend on the □ow rate)
3. Measuring the co-ordinates of the water trajectory from a horizontal pipe, as shown below.

$$Q = (CAx)\sqrt{\frac{g}{2y}}$$

where C is a coefficient
in range 1.0 to 1.1
for x >20, y>20
g = 9.81 m/s/s



Mea emen of o f om a ho i on al pipe



Wa e o f om ho i on al pipe (li e / econd) o ing comple el f ll a he end

F e a :

Cairncross, S. and Feachem, R., *Small a e pplie* , Ross Institute Bulletin No. 10, 1978.

Herschy, R. W., *S eam o mea emen* , Elsevier, 1985.

Text: Ian Smout Illustrations and design: Rod Shaw

WEDC, Loughborough University of Technology, Loughborough, Leicestershire LE11 3TU, UK.