

NEED OF FLOW MEASUREMENT

The branch of engineering science deals with discharge measurement is called “Hydrometry”. Management of water resources or engineering mainly depends upon measurement of water at different stages in irrigation system is of great concern. Some important stages need flow measurement or management are discussed here.

- Flow Measurement

The measurement or assessment of volume of water passing per unit time from any point is called measurement of flow

- Distribution of water from head works to main canals

All the main canals have specific design and discharge carrying capacity. To meet the designed water levels of canals off taking from head works, fixed discharge is diverted to these canals to irrigate their command areas. Discharge indicating gauges are fixed at several places in each canal and are monitored continuously to maintain designed discharge.

- Distribution of water among provinces

Average annual water available from all the rivers is proportionally distributed among provinces. Proportionality of water follows the agreement among provinces “Water accord 1991”. Electronic Telemetry system has been recently installed at all the head works to monitor flows around the clock to all the provinces.

- Maintaining designed depth of water in canals

To meet the designed discharges of outlets according to their command areas, it is essential to operate/run canals at designed full supply level. For maintaining full supply levels of distributaries and minors, measured discharge is provided/allowed from their parent canals, through regulatory gates.

- Equity in Water Distribution among farmers.

Equal distribution of water among farmers is of great concern. Evaluation of equity in water distribution among farmers can be made possible through regular flow measurements in watercourses or at farm levels.

- Measured irrigation to crops

Saving of precious irrigation water is dire need of current drought situations. At farm level different techniques are adopted for saving of water. Thus it is very important to irrigate crops according to their water requirements and to avoid over or under irrigation by applying measured quantities of water. Over irrigation may participate in waterlogging while under irrigation will cause low yield.

- **Watercourse Design**

First requirement for deciding design of a watercourse, is the discharge of that watercourse only. Any additional discharge, e.g. tubewells or special quota of rice etc., is also adjusted in design. Hence measurement of discharge is basic need for design of a watercourse.

- **Planning and Designing of Irrigation and Drainage Structures**

Different types of hydraulic structures are constructed on irrigation channels and on surplus water carrying drains. All such structures are designed for passing of a limited quantity of discharge.

BASIC TERMINOLOGY USED IN FLOW MEASUREMENT

1-Discharge.

It is measurement of volume of water in flowing condition. Units of discharge commonly used are

- a. **Cusec**
- b. **Musec/Cumecs**
- c. **LPS**
- d. **G.P.M**
- e. **A.F**

- a. **Cusec.**

If one cubic foot volume of water is passing in one second from a certain point, then discharge is called 1 cusec or ft^3/sec .

- b. **Musecs/Cumec.**

If one cubic meter volume of water is passing in one second from a certain point, discharge is called 1 cumec/musec or m^3/sec .

- c. **Liter Per Second.**

If one liter volume of water is passing in one seconds from a certain point, discharge is called 1 lps or 1liter per second.

d. Gallon Per Minute

If one gallon of water is passing in one minute time from any point, then discharge at that point is called 1 Gallon Per Minutes or G.P.M.

e. Acre Foot

When an area of one acre is filled with water to a depth of one foot, then volume of water is called 1 acre foot (AF). 1-Acre Foot = 43560 ft³

2 - Conversion Table

1 Cusec	=	28.31 lps
1 Cumec	=	1000 lps
1 Gallon (US)	=	3.78 liters
1 Gallon (UK)	=	4.55 liters
One liter	=	0.001 m³
1 A.F	=	43560 ft³
1-Hectare	=	100m x 100m
1- Hectare	=	2.47 acre
1- acre	=	198 ft x 220 ft = 60m x 66m
1 m	=	3.28 ft
1 inch	=	2.54 cm

3- Gross Command Area (GCA).

It is the total area that is within command of an outlet. It also includes that land to which canal water is not allowed. Canal water is not sanction to some area due to various reasons, e.g topographic position. Gross Command Area is generally expressed in acres.

4 - Culturable Command Area (CCA)

That area of an outlet which is under cultivation within command of outlet. Culturable Command Area is generally expressed in acres or hectares.

5 - Water Allowance.

It is the quantity of irrigation water allowed for 1000 acres of culturable land. This also helps in designing an outlet for its command area i.e Bahawalpur water allowance is 4.2 cusec /1000 Acre of land.

6 - R.D

Reduce Distance (RD) is measurement of distance from head of channel to any point. This distance is measured in feet. 1 – RD = 1000 ft e.g. distance of 4500 feet is written as RD 4 + 500

7- R.L

Reduced Level (RL) is elevation of any point with reference to sea level. It is shown in feet or meters.

8 - Reach

It is a particular length of a canal/distributary from one point to other point i.e length between two successive points

9 - Location of an Outlet.

Distance of an outlet in feet from head of canal/distributary indicates its numbers. “R” or “L” is added to this number which shows that outlet is off-taking from left (L) or right (R) side of canal/distributary. e.g 4500- R

10 -Upstream/Downstream.

If we are using a flume or standing on a hydraulic structure, then upstream (U/S) is the side from where water is entering in the flume or structure and downstream (D/ S) is the side where water is going out from flume or structure.

11 - Inlet.

It is the point of a hydraulic structure where water is entering to that structure.

12 - Outlet.

It is the point of a hydraulic structure where water is going out from that structure.

13 - Perimeter.

Length of cross section or the length of a section of canal/distributary/watercourse, which is in contact with water.

14 - X-Section.

Cross-Section (X-Section) of channel is from which water passes. It is the dimension of a section, i.e. depth and width of flow

15 - Free Flow.

When water passes through a hydraulic structure and downstream water level does not affect the water level of upstream, flow is called free flow.

16 - Submerged Flow.

When water passes through a hydraulic structure and downstream water level affects the water level of upstream, called submerged flow.

17 - Duty of Water:

It is the area irrigated per cusec discharge, during a base period.

18 - Delta of Water

It is the total requirement of water of a crop from sowing time till maturity

Wheat	= 16 inches
Cotton	= 28 inches
Sugar Cane	= 70 inches
Maize	= 13 inches
Rice	= 55 inches
Potato	= 18 inches
Onion	= 30 inches

19 - Conveyance Efficiency

Ratio of discharge at tail of a watercourse to the discharge at head of a watercourse e.g. if discharge at tail of watercourse is 1.5 cusecs while discharge at head of same watercourse was 2 cusecs then

$$\text{Conveyance efficiency} = 1.5/2 \times 100 = 75\%$$

$$\text{Losses} = 25\%$$

