Reservoir Mass Curve and Storage:

During high flows, water flowing in a river has to be stored so that a uniform supply of water can be assured, for water resources utilisation like irrigation, water supply, power generation, etc. during periods of low flows of the river. A mass diagram is a graphical representation of cumulative inflow into the reservoir versus time which may be monthly or yearly. A mass curve is shown in Fig. below for a 2-year period. The slope of the mass curve at any point is a measure of the inflow rate at that time.
Required rates of draw off from the reservoir are marked by drawing tangents, having slopes equal to the demand rates, at the highest points of the mass curve. The maximum departure between the demand line and the mass curve represents the storage capacity of the reservoir required to meet the demand. A demand line must intersect the mass curve when extended forward, otherwise the reservoir is not going to refill. The vertical distance between the successive tangents represents the water wasted over the spillway. The salient features in the mass curve of flow in Fig. below are:

a-b: inflow rate exceeds the demand rate of x cumec and reservoir is overflowing
b: inflow rate equals demand rate and the reservoir is just full
b-c: inflow rate is less than the demand rate and the water is drawn from storage
c: inflow rate equals demand rate and $S1$ is the draw off from the reservoir (Mm3)
c-d: inflow rate exceeds demand rate and the reservoir is filling
*d*: reservoir is full again
d-e: same as *a-b*
e: similar to *b*
e-f: similar to *b-c*
f: inflow rate equals demand rate and $S2$ is the draw off from the reservoir
f-g: similar to *c-d*

To meet the demand rate of x cumec the departure $S2 > S1$; hence, the storage capacity of the reservoir is $S2$ Mm^3. If the storage capacity of the reservoir, from economic considerations, is kept as $S1$ Mm^3, the demand rate of x cumec cannot be maintained during the time *e-f* and it can be at a lesser rate of y cumec ($y < x$).
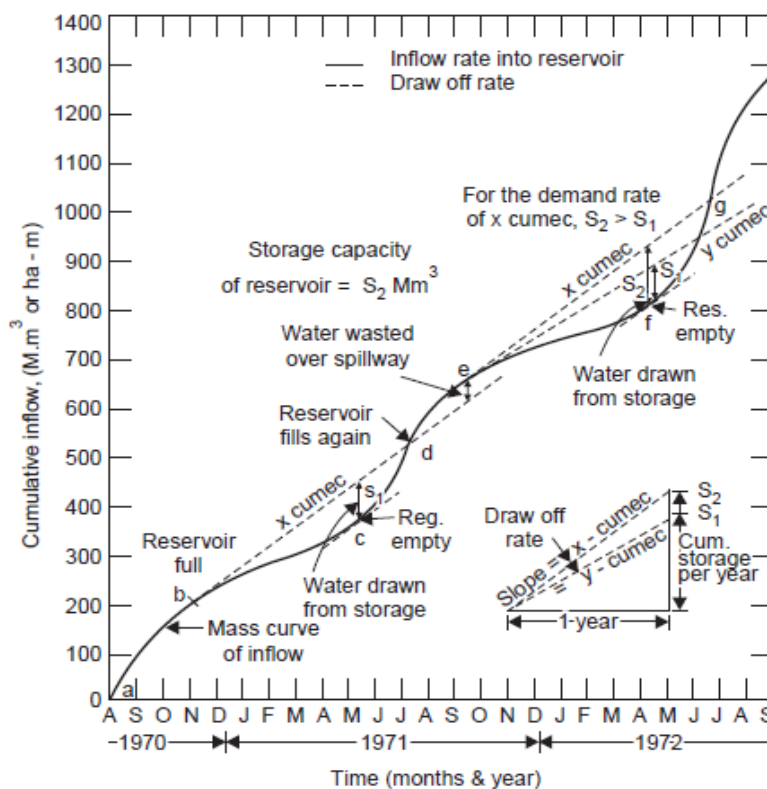
Storage capacity of reservoir from mass curve

The use of mass curve is to determine:

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(*i*) The storage capacity of the reservoir required to meet a particular withdrawal rate.
(*ii*) The possible rate of withdrawal from a reservoir of specified storage capacity.

The observed inflow rates have to be adjusted for the monthly evaporation from the reservoir surface, precipitation, seepage through the dam, inflow from adjacent basins, required releases for downstream users, sediment inflow, etc. while calculating the storage capacity of the reservoir.

Conclusions:

A mass curve (or Rippl diagram) is a cumulative of net reservoir inflow, the figure below shows a typical mass curve.

- The slope of the mass curve at any time is a measure of the inflow at that time.
- Demand lines drawn tangent to the high points of the mass curve represent rates of withdrawal from reservoir.
- Maximum departure between the demand line and the mass curve represent the reservoir capacity required to satisfy the demand.
- The vertical distance between successive tangents represents water wasted over the spillway.
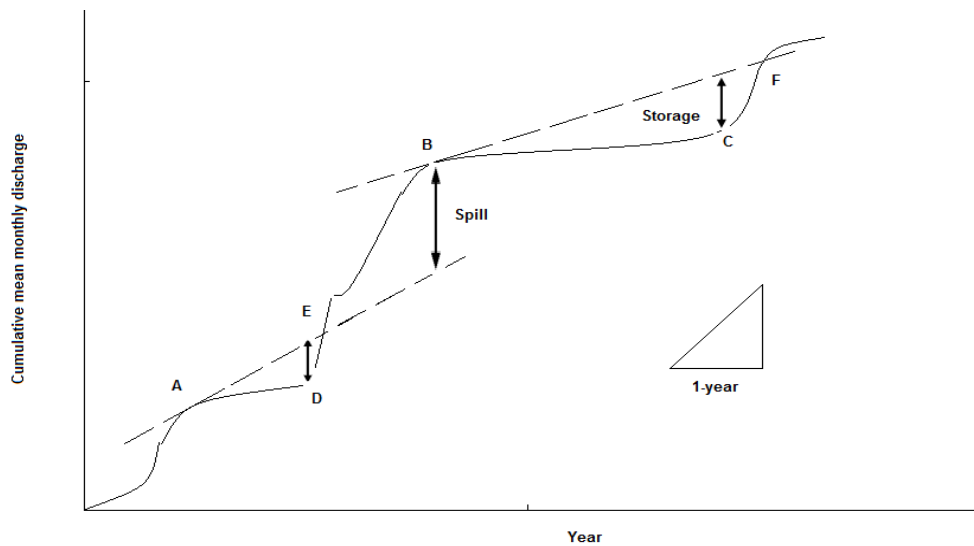
Typical mass curve

Typical mass curve

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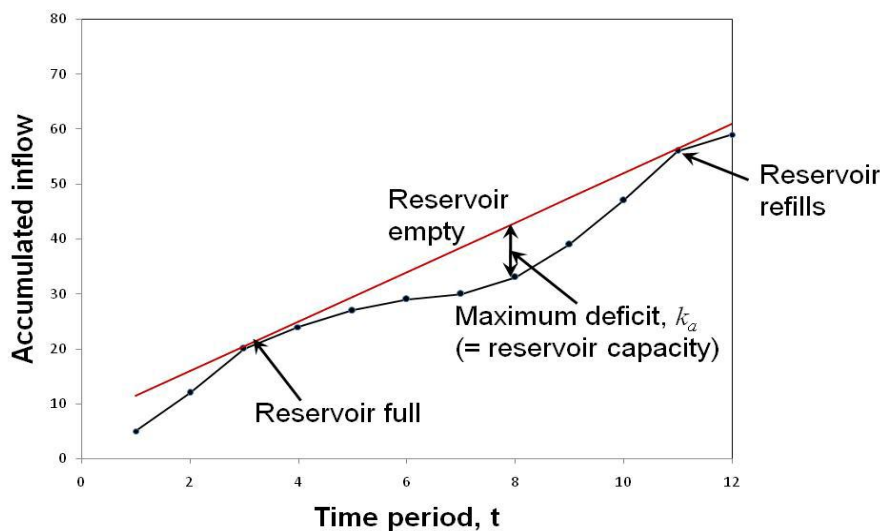
Example (1): **Find the required storage for the following stream?**

Month	Inflow (supply) m^3/month	Outflow (demand) m^3/month	Losses m^3/month
1	45	7	1
2	45	8	1
3	14	8	1
4	10	8	1
5	8	9	2
6	5	11	3
7	2	11	3
8	2	11	2
9	2	11	2
10	2	11	2
11	1	11	1
12	1	11	1

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Month	Inflow (supply) m^3/month	Outflow (demand) m^3/month	Losses m^3/month	Storage m^3/month
1	45	7	1	37
2	45	8	1	73
3	14	8	1	78
4	10	8	1	79
5	8	9	2	76
6	5	11	3	67
7	2	11	3	55
8	2	11	2	44
9	2	11	2	33
10	2	11	2	22
11	1	11	1	11
12	1	11	1	0
	137	117	20	