Hydrological and hydraulic processes and definitions

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Runoff

- Flow that enters the river system following precipitation (rainfall)
- A key area of study in hydrology
- Can be separated into different components
  - Fast/Direct
  - Slow
- Sometimes expressed as a percentage
Stage is the water level measured above datum, symbol “h”
Measured in metres above a datum
Discharge

> Discharge is the rate of volume of water flowing through a river section, symbol “Q”

> Measured in
  - cubic metres per second or
  - cumec or
  - m$^3$/s
Mean flow velocity

Discharge divided by flow area

\[ V = \frac{Q}{A} \]

The velocity is at right angles to the cross-section, units m/s

It is a typical value for the section

In flood conditions we may calculate average velocities in the channel and for the flood plains
Velocity distribution

Variation across a section

Variation with depth
A rating curve

Plot of stage against discharge
Conveyance “K”

> A measure of the capacity of a river, Conveyance “K” depends on stage, \( h \)

\[ Q = K(h) \sqrt{s} \]

> \( Q \) is discharge,

> \( s \) is water surface gradient
The upstream effects of a “control” on water level e.g.
- ponding behind a weir
- raised water level from constricting the flood plain
Water surface profile

> Plot of stage against distance along the channel

Backwater Profile

- Distance m
- Level m AOD
- Bed level
Hydraulic radius

> Represents the shape of the cross section

> Ratio of Area, $A$ to Wetted Perimeter, $P$

$$R = \frac{A}{P}$$
Flow resistance

> The effect of the river bed and banks to slow down the water flow

> Causes:

[Diagram showing various river bed features: Large scale feature, Ripple, Dune, Vegetation]
Solid material transported by the flow
Trash

> Floating debris carried by the flow
Compound channel
Functions of floodplains

Washland (water storage)
Floodway (water movement)
Floodway
Probability and frequency

> Probability
  - The chance that some event (e.g. a flood this year) might happen

> Frequency
  - The rate of incidence of an event - especially from observations

> Often data on frequency is used to estimate probability
Flood probability

> Annual Probability, P
  - The chance that the condition will be equalled or exceeded in any year
  - Sometimes expressed as a percentage

> Return Period, T
  - The average interval in years between occurrences of the condition

> Relationship
  - $T = 1/P$
Probability and frequency

> Probability
  - The chance that some event (e.g. a flood this year) might happen

> Frequency
  - The rate of incidence of an event - especially from observations. Often data on frequency is used to estimate probability

> Design life
  - The service life of an asset intended by the designer. This assumes some rate of deterioration up to a point where the asset requires replacement/refurbishment
Probability of an event occurring or being exceeded during the design life of an asset structure

\[ P = 1 - \left( 1 - \frac{1}{T} \right)^{DL} \]

> DL is the design life of the asset in years

> T is the return period of the event for which the asset is designed

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Any questions?

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