

# Understanding Event Probability

Water management is not an exact science as rainfall is an integral part of the hydrological, and therefore the water management, cycle. Just as it is impossible to accurately predict quantities of rainfall, it is impossible to provide definitive answers to most water management questions. However, it is possible to define probabilities and risks of occurrence of particular events.

Care should be taken when communicating and interpreting probabilities and risks, and rigorous terminology should always be used. Probabilities and risks which are based on historical data carry an implicit assumption that history will repeat itself.

The following are more common risk terminologies used in water management practices. More detailed descriptions and understandings can be found in Australian Rainfall and Runoff 1987 (AR&R).

## Average Recurrence Interval (ARI)

The average recurrence interval is the average interval between exceedances of that value or event when viewed in the long (ideally infinite) term.

All data above an arbitrary base value are used when ranking event values for determining the ARI. The ARI is usually expressed in years. It should be noted that, a rainfall (or flood) ARI of 100 years does not imply the event will only occur every 100 years; it is also feasible that the event will occur five times in five successive years and not occur for another 495 years. The terms “100 year return interval” and “the one-in-hundred-year-storm” falsely advocate the former interpretation.

## Annual Exceedance Probability (AEP)

The annual exceedance probability is the probability of exceedance of a given event within a period of one year. It is based on data that uses only the highest event in each year of record.

The AEP is often used for the probability expressions associated with large and extreme events and some flood estimation methods. The AEP is generally expressed as a fraction or percentage.

## Probability (P) of Exceedance in L Years

Probability of exceedance in L years is a descriptive risk term that relates the event exceedance probability to the design or useful life of the resource or structure. In probability terms it can be expressed as:

$$P = 1 - \exp(-L/T)$$

where T is the ARI.

## Probable Maximum Precipitation (PMP)

The probable maximum precipitation refers to the greatest depth of precipitation for a given duration that is meteorologically possible for a given size storm area at a particular location at a particular time of year. The Probable Maximum Flood (PMF) has a similar definition and is related directly to the PMP (Also refer to Fact Sheet No.2.)

Due to the variable nature of the hydrological cycle, the use of risk analyses and probabilities should be encouraged in water management strategies.

Where **historical data** are used to determine these risks, care must be taken to include as much relevant historical data as are possible. This reduces the element of skewing in risk analyses. In this way, although absolute answers are rarely available, water management strategies may be assessed a logical and justifiable manner.

Because water management involves expressions of risk, the impacts of failure must always be assessed. Where appropriate, contingency failure strategies should be established and regularly audited and monitored.

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**Sensitivity analyses** provide means of assigning boundaries or limits to water management scenarios by asking “what if...?” type questions. Sensitivity analyses should be carried out on parameters which are thought to be important or on those which are not very well understood, such as hydraulic conductivity of soil, process plant water use etc.

Where hydrological analyses are used in a water management study, it should be clearly understood that a large proportion of the quantitative analyses is probabilistic only. The broad assumptions and the extent to which historical data play a part are documented in the industry standard *AR&R*. This document should be referred to when a more detailed understanding of event probability is required.