7.0 FREEBOARD

7.1 General

For water control structures, freeboard is the marginal height of a structure provided above the normal water surface to achieve specific design objectives including flood retention or passage, protection against wave overtopping, and to account for uncertainty.

An increment of freeboard is ordinarily provided to:

- Reduce the likelihood of failure or damage due to overtopping of the structure or structure component.
- Provide greater protection at critical locations and causing initial overtopping to occur at pre-determined, less hazardous locations.
- Provide satisfactory hydraulic performance by containing the water (e.g. splash) within the structure or by excluding tailwater from entering the hydraulic jump area.
- Account for uncertainty in assumptions, differences between theoretical equations and reality, and factors that are too small or intractable to be determined or quantified.

Factors such as bed forms, superelevation, etc. which may influence the normal water surface and which can be reasonably quantified are typically included in the design water surface and not the freeboard. Similarly, factors that may affect the level of protection such as settlement, deflections, frost action, etc. are normally considered as separate components and not as freeboard.

Also, uncertainty inherent with a flow rate and/or volume probability estimate is more appropriately treated in the context of sensitivity and risk. Therefore, it is normally not included in freeboard, but rather considered in the selection of the level of protection required for the project.

7.2 Freeboard Requirements

The freeboard required for a particular structure or structure component will depend on its location, structure type and function.

For example, in the case of a chute spillway for a dam, the freeboard required at the crest section of the spillway structure will be dictated by the freeboard criteria for the dam. At the chute section, the freeboard will be based on preventing overtopping of the walls; and at the stilling basin, it will be based on excluding tailwater from entering the hydraulic jump area and affecting the jump action.

Criteria for establishing freeboard for dams can be obtained from CDA (1999) and USBR Technical Memorandum No. 2 (1981). Further information on freeboard requirements for specific structures or structure components is presented in later sections.

For small reservoirs and/or small basins, CDA (1999) provides the following guidelines for establishing freeboard:

- Wave conditions and set-up due to a wind with a 1/1000 Annual Exceedance Probability (AEP) with the reservoir at its maximum normal level.

- Wave conditions and set-up due to the 1/100 AEP maximum annual wind with the reservoir at its maximum extreme level based on the selected IDF.

For small, low consequence dams, the above CDA (1999) guidelines may be overly conservative particularly where the dam is being designed for an IDF that has a higher AEP (e.g. 1:100 year flood) than the wind event indicated by CDA (1999). In such cases, it may be appropriate to consider the following criteria for establishing freeboard for small, low consequence dams:

- Wave conditions and set-up due to a wind with an AEP equal to that of the IDF, to a maximum of 1/1000, with the reservoir at its maximum normal level.

- Wave conditions and set-up due to a wind with a 1/2 AEP wind or a minimum of 0.3 m with the reservoir at its maximum extreme level based on the selected IDF. The lesser value may be adopted where other factors, such as the IDF, are deemed to be quite conservative.

Freeboard criteria for irrigation canals are provided in Alberta Agriculture (1991), Alberta Environment (1988), and USBR (1967).