CHAPTER 7

ESTIMATION OF PMP USING THE WATERSHED-BASED APPROACH AND ITS APPLICATION IN CHINA

7.1 INTRODUCTION

As mentioned in section 1.4.2, there are two approaches and several methods that can be used for probable maximum precipitation (PMP) estimation. Examples presented in this chapter use the watershed-area based approach developed in China (Wang G., 1999). As discussed in section 1.1, the objective of estimating PMP is to determine the probable maximum flood (PMF), which is critical for engineering design purposes of a specific project. For example, in the case of a reservoir with a large storage capacity and a small flood discharge capability, the flood volume is critical to the design of the project. In this case, the critical PMF is usually of long duration, and the associated weather system supplying the corresponding PMP might typically be a cluster of frontal cyclones over a long duration. If a reservoir has a small storage capacity and a large flood discharge capability, the critical factor is that the peak flow has a shorter duration and the associated meteorology generating the PMP may be a single weather system, such as a tropical cyclone and thunderstorm, of short duration and high intensity. It is thus important to be aware of the critical events for the specific watershed.

The Ministry of Water Resources (MWR; 1980) and the Changjiang Water Resources Commission (CJWRC; 1995) present watershed-area based methods of estimating PMP for PMF requirements associated with a particular project in the design watershed. Detailed discussions of these methods are also available in other literature (for example, Zhan and Zhou, 1983; Wang G., 1999). The WMO report *Estimation of Maximum Floods* (1969*a*) establishes the basis for many of the ideas presented here in sections 7.5, 7.6, and 7.7.

7.2 OVERVIEW OF THE APPROACH

7.2.1 Main characteristics

There are five main characteristics of this approach:

(a) All calculations, including the areal mean precipitation depth and its spatial and temporal distributions, are derived specifically for the design watershed.
(b) All significant historical storm and flood data over the available period are obtained through field surveys and from the literature.
(c) The most appropriate method and storm (for example critical duration, type) for estimating the storm rainfall is determined.
(d) More than one method is applied to determine a range of reasonable results (advisable).
(e) Finally, the reasonableness of results are assessed to ensure the resulting estimates are realistic.

7.2.2 Process

The sequential process for determining PMP/PMF is shown in Figure 7.1. This chapter focuses on presenting the local model method (local storm maximization), the transposition model method (storm transposition) and the combination model method (spatial and temporal storm maximization). These methods are applicable to PMP estimation under different orographic conditions and with different precipitation durations in medium and large watersheds. The rational method (the theoretical model) is applicable only to small and medium areas and is not discussed here.

7.2.3 Project characteristics and design requirements

The PMF information required for typical project designs include three key factors: the flood peak, flood volume and flood hydrograph. Different projects, however, focus on different aspects: for reservoirs with small storage capacities and large discharges the flood peak is critical; for reservoirs with large storage capacities and small discharges, the flood volume is critical; and for reservoirs with small storage capacities and small discharges, all three factors are important. Consequently, the relevant information on the planned project should first be assessed in order to select the right method for estimating PMP as well as the critical extraordinary storms/floods.

7.2.4 Analysis of watersheds, characteristics of storms and floods, and meteorological causes

The objective of this analysis is to determine the types and behaviour of systems that generate storms and floods in the design watershed to assist with