2.3.2 Pan Evaporation Method

The open pan is the most widely used evaporation instrument today, and its application in hydrologic design and operation has a long history. The relationship between potential evapotranspiration (ET_p) and pan evaporation (PE) can be expressed as

$$ET_p = k_2 \, PE \tag{11}$$

where k_2 = pan coefficient (usually taken as 0.7 for Florida conditions, but variable throughout the year) and

PE = evaporation from a National Weather Service standard Class A pan.

The pan integrates the climatic factors and provides a good estimate of ET_p if the pan is serviced as required and the area around it is properly maintained. This situation is seldom the case; therefore, pan data should be used with caution. Doorenbos and Pruitt (1977) point out that pan coefficients are functions of relative humidity (vapor pressure deficit), wind speed, and upwind fetch of the surface surrounding the pan. Class A pan coefficients reported by Doorenbos and Pruitt (1977) for different surrounding ground cover conditions, relative humidities, and daily wind movements are listed in Table 2. They pointed out that for a well-watered grass turf, 8 to 51 cm tall, the pan coefficient could vary from 0.85 for light wind and high relative humidities to 0.40 for very strong winds and low relative humidities. The pan coefficient was also highly dependent on length of upwind fetch and type of ground cover (green crop or fallow).

The diurnal distribution of pan evaporation is also very different from crop ET. Pan evaporation rates usually lag the daily cycle of solar radiation by about 6 hours, whereas crop ET is very nearly in phase with solar radiation. Leaves have very little heat capacity, and their stomata open in response to light and close in the dark. Therefore, crop ET is very responsive to the energy and climate factors during the day, and is essentially nil at night. Evaporation pans continue to lose large amounts of water well into the night (Campbell and Phene, 1976). These factors lead to variability in the exact day-to-day correlations of pan evaporation with ET or ET_p.

2.2.3 Thornthwaite Method

Thornthwaite (1944) presented a method of estimating monthly potential ET from mean monthly temperature and day length.

$$PET = 16 \, L_d \left[\frac{10 \, T_m}{I} \right]^a \tag{12}$$

where PET = 30-day estimate of ET in mm
L_d = daytime hours divided by 12