# OPERATION OF THE WATER CONTROL STRUCTURES

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OKAN ÇAĞRI BOZKURT

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IN
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Approval of the thesis:

**OPERATION OF THE WATER CONTROL STRUCTURES**

submitted by **OKAN ÇAĞRI BOZKURT** in partial fulfillment of the requirements for the degree of **Master of Science in Civil Engineering Department, Middle East Technical University** by,

| | |
|---|---|
| Prof. Dr. Canan Özgen<br>Dean, Graduate School of **Natural and Applied Science** | _______________ |
| Prof. Dr. Ahmet Cevdet Yalçıner<br>Head of Department, **Civil Engineering** | _______________ |
| Assoc. Prof. Dr. Nuri Merzi<br>Supervisor, **Civil Engineering Dept., METU** | _______________ |
| Assoc. Prof. Dr. Zuhal Akyürek<br>Co-Supervisor, **Civil Engineering Dept., METU** | _______________ |

**Examining Committee Members:**

| | |
|---|---|
| Assoc. Prof. Dr. İsmail Yücel<br>Civil Engineering Dept., METU | _______________ |
| Assoc. Prof. Dr. Nuri Merzi<br>Civil Engineering Dept., METU | _______________ |
| Assoc. Prof. Dr. Zuhal Akyürek<br>Civil Engineering Dept., METU | _______________ |
| Assoc. Prof. Dr. Mete Köken<br>Civil Engineering Dept., METU | _______________ |
| Serdar Sürer, M.Sc.<br>Hidrosaf Software Ltd. Co. | _______________ |

**Date:** **22.01.2013**

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Name, Last name : Okan Çağrı BOZKURT

Signature :

## ABSTRACT

### OPERATION OF THE WATER CONTROL STRUCTURES

Bozkurt, Okan Çağrı
M.Sc., Department of Civil Engineering
Supervisor: Assoc. Prof. Dr. Nuri Merzi
Co-Supervisor: Assoc. Prof. Dr. Zuhal Akyürek

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Floods are one of the most important natural disasters regarding damages caused by them. Major reasons of huge damages of floods are unplanned urbanization, narrowing of river beds and incorrect operation of water control structures. Geographic Information Systems (GIS) can provide important tools to be used in flood modeling studies. In this study, Lake Mogan, Lake Eymir and İncesu Detention Pond subbasins are studied for flooding events within GIS framework. These subbasins are important catchment areas of city of Ankara with total drainage area of 1070 $km^2$. Soil Conservation Service (SCS) method is used to obtain flood hydrographs for 12 hour duration and 50, 100 and 500 year return periods. Flood routing procedure is applied to obtain discharges at the outlet of the Mogan and Eymir Lakes and İncesu Detention Pond. Operation performance of water control structures are tried to be estimated by using hydrographs which are obtained for different scenarios. Results show that elements of Lake Mogan Water Control Structure do not have capability to discharge 500 year storm safely to the downstream of the lake. However, 100 year storm can be routed without creating problem if necessary small precautions are taken. On the other hand, water control elements of Lake Eymir and İncesu Detention Pond can transmit obtained flood volumes to the downstream parts by assuming that closed conduit at the exit of İncesu Detention Pond can safely convey resultant flood discharges.

**Keywords:** Flood control strucutres, SCS method, Geographic Information Systems, Mogan and Eymir lakes, Incesu Detention Pond.

# ÖZ

## SU KONTROL YAPILARININ İŞLETİLMESİ

Bozkurt, Okan Çağrı
Yüksek Lisans, İnşaat Mühendisliği Bölümü
Tez Yöneticisi: Doç. Dr. Nuri Merzi
Ortak Tez Yöneticisi: Doç. Dr. Zuhal Akyürek

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Taşkınlar yarattığı hasarlar bakımından üzerinde durulması gereken en önemli doğal afetlerden birisidir. Taşkınların büyük çapta hasara yol açmasının temel nedenleri plansız bir şekilde artan şehirleşme, dere yataklarının daraltılması ve taşkın kontrol yapılarının gerektiği gibi işletilememesidir. Coğrafi Bilgi Sistemleri (CBS), taşkın modelleme çalışmalarında kullanılabilecek önemli araçlar sağlayabilirler. Bu çalışmada, Mogan Gölü, Eymir Gölü ve İncesu Sel Kapanı havzaları, CBS kullanılarak taşkın olayları bakımından incelenmiştir. Bu havzalar 1070 $km^2$'lik drenaj alanları ile Ankara'nın önemli alt havzalarındandır. 12 saat süreli, 50, 100 ve 500 yıllık tekerrür sürelerine sahip taşkın hidrografları Soil Conservation Service (SCS) metodu kullanılarak elde edilmiş ve taşkın öteleme işlemi yapılmıştır. Havza çıkışlarında bulunan taşkın kontrol yapılarının performansları, farklı koşullarda gelen değişik sağanakların hidrografları kullanılarak ölçülmeye çalışılmıştır. Elde edilen sonuçlar Mogan Gölü Su Kontrol Yapısı elemanlarının 500 yıllık sağanağın yaratacağı taşkını mansap tarafına güvenli bir şekilde aktaramayacağını göstermiştir. Ancak birtakım düzenlemelerle 100 yıllık sağanağın sorunsuz bir şekilde mansap tarafına aktarılabileceği görülmüştür. Diğer taraftan Eymir Gölü ve İncesu Sel Kapanı su kontrol yapılarının, elde edilen taşkın hacimlerini güvenli bir şekilde mansap tarafına geçirebildiği hesaplanmıştır. Bu çıkarım yapılırken İncesu Sel Kapanı çıkışında bulunan kapalı kutu kondüvinin söz konusu taşkın debilerini geçirebileceği varsayımı yapılmıştır.

**Anahtar Kelimeler:** Taşkın kontrol yapıları, SCS metodu, Coğrafi Bilgi Sistemleri, Mogan ve Eymir gölleri, İncesu Sel Kapanı.

*To my mother*
*Anneme*

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**TABLE OF CONTENTS**

## LIST OF TABLES

TABLES

## LIST OF FIGURES

FIGURES

# CHAPTER 1

# INTRODUCTION

## 1.1 General

Flood problems started to be more and more important with the increasing urbanization rates day by day; consequently existing flood control structures become to be insufficient to prevent flooding damages. Flood control structure can be divided into two main branches as internal and external structures. Internal structures are mainly composed of pipelines of city storm water system. On the other hand, different kinds of external structures exist for external structures. Dams, levees, detention ponds are some examples for external structures.

Measuring the operation performance of internal structures is harder than the external structures because almost all the elements of internal systems are under the ground and it is hard to monitor them. Furthermore, physical conditions of the infrastructure elements are not known exactly. Pipeline routes, connection nodes, diameter of pipes, discontinuities and obstruction in the pipes should be known but finding data about these elements are really hard in today's rapidly growing metropolitans. Even if the sources of the problems are known, it is a difficult task to fix them. It requires intensive time, engineering effort and labor force. There is also potential to create social discontent which can affect the daily life of public while solving the problems. Because of these circumstances, decision makers do not prefer these kinds of works and local solutions are employed when a serious problem occurs.

On the other hand, external structures are bigger than internal ones and it is easier to fix the problems. It is necessary to discharge the water of high return period storms in a controlled way by these structures. Although flood control is the main purpose when they were constructed, priorities may change and these structures would be used for different purposes. Those priority changes may be due to ecological reasons or lack of recreation areas. Obviously, these structures cannot fulfill their main function and huge damages may occur when the high return period storms occur in the basin. Decision makers should act to be aware of these issues.

## 1.2 Objective

Operation performances of external water control structures are important to protect the urban areas against floods. In order to evaluate those performances, precipitation-runoff relationship of the watershed should be known. To establish that relation unit hydrograph methods could be used. In case of no runoff or rainfall data exist or not suitable for the derivation of unit hydrograph, synthetic unit hydrograph methods can be used to obtain precipitation-runoff relationships.

Main objective of the thesis study is to examine operation performance of water control structures at the outlet of Lake Mogan, Lake Eymir and İncesu Detention Pond (İmrahor Valley) subbasins. In March of 2011 and 2012, flooding events were occurred around Lake Mogan and these events are the main reason to carry out this study.

Several studies have been carried out on Mogan and Eymir lakes basins at different times by several organizations. Some of them can be summarized as follows:

- *Ankara Taşkın Projesi Planlama Raporu, DSİ, 1963*
- *Ankara Taşkın Projesi Tatbikatı, İ. Batukan, DSİ, 1968*
- *Mogan Gölü Islah Projesi ve İnceleme Raporu, Gölbaşı Municipality, 1988*
- *Mogan Gölü Limnolojik Etüt Raporu, DSİ, 1993*
- *Mogan Gölü Kurtarma Projesi Planlama Raporu, DSİ, 1994*
- *Mogan ve Eymir Gölleri 1. Çevre Kurultayı, Gölbaşı Municipality, 1995*
- *Gölbaşı Mogan – Eymir Gölleri İçin Su Kaynakları ve Çevre Yönetim Planı Projesi, D. Altınbilek et.al., ASKİ, 1995*
- *Determination of Inundation Maps By GIS: A Case Study, T. Aktaş (Master Thesis),1996*
- *Mogan ve Eymir Gölleri ve Çevresi Su Kirliliği İnceleme Raporu, Çevre Kirliliğini Önleme ve Kontrol Genel Müdürlüğü, 2003*
- *Mogan ve Eymir Göllerinin Hidrometeorolojik Özellikleri, (EİE),2005*
- *Ankara Mogan ve Eymir Gölleri Havza Taşkın Planlama Mühendislik Hizmetleri İşi Planlama Raporu, DSİ, 2008*

Most of these studies are related to environmental issues. Design storm duration of the basin is given as 12 hour in *Gölbaşı Mogan – Eymir Gölleri İçin Su Kaynakları ve Çevre Yönetim Planı Projesi* which is the most comprehensive report prepared until today. In this thesis study, precipitation-runoff relationships of study area for 12 hour storm which has 50, 100 and 500 year return periods are obtained by using SCS method. In order to do that CN which is the basic parameter of SCS method are found for Lake Mogan, Lake Eymir and İncesu Detention Pond subbasins. Land use and soil characteristics are used for that purposes. Operation performance of water control structures in this basin are tried to be investigated under the different circumstances by using resultant outflow hydrographs of those different storms. Four basic parameters are used in the analysis of operation studies; these are lake level when the storm starts, capacity of canal between Mogan and Eymir lakes, return period of the storm and weight factor indicating importance of upstream and downstream part of Lake Mogan. By analyzing obtained results, current situations of existing water control structures in study area are investigated.

The thesis is composed of four chapters. In the second chapter, theoretical considerations are given. These considerations are about infiltration studies, unit hydrograph theory, synthetic unit hydrograph methods and continuity equations in reservoir. In the third chapter, general information about water control structures located in Ankara is given. Characteristics of Lake Mogan, Lake Eymir and İncesu Detention Pond (İmrahor Valley) subbasins are tried to be described from flood inundation point of view. Hydrologic modeling studies and procedure about obtaining design hyetograph and hydrograph are explained. Outcomes of case study are also given in this chapter. Finally, conclusions and recommendations are stated in chapter four.

## CHAPTER 2

## THEORETICAL CONSIDERATIONS

### 2.1 General Rainfall-Runoff Studies

Chow et al. (1988) carried out extensive research about rainfall-runoff relationships. Some of the important issues are tried to be explained in below sections.

#### 2.1.1 Infiltration

Water drops start to penetrate into the soil when they reach to the ground. This process is called as infiltration. Condition of soil surface, vegetative cover, properties of soil (porosity, hydraulic conductivity etc.) and the current moisture content are the main factors that affect the infiltration rate. Properties of soils may have great spatial variability even in small areas. Because of this situation and time variations, infiltration is a multi-faceted process which cannot be described easily. In order to describe infiltration process various mathematical equations are developed.

Basically four moisture zones occur during infiltration. These zones from top to the bottom are saturation zone, transmission zone, wetting zone and wetting front (Figure 2.1). As seen from figure, saturation zone is the top layer near the surface, transmission zone is the second layer from the top and it exhibits transmission between unsaturated flow and uniform moisture content. In wetting zone moisture decreases with depth. A sharp discontinuity occurs between wet soil above and dry soil below. This section is defined as wetting front. Hillel (1980) stated that wetting front may penetrate from a few centimeters to meter depending on physical properties of soil and amount of infiltration.

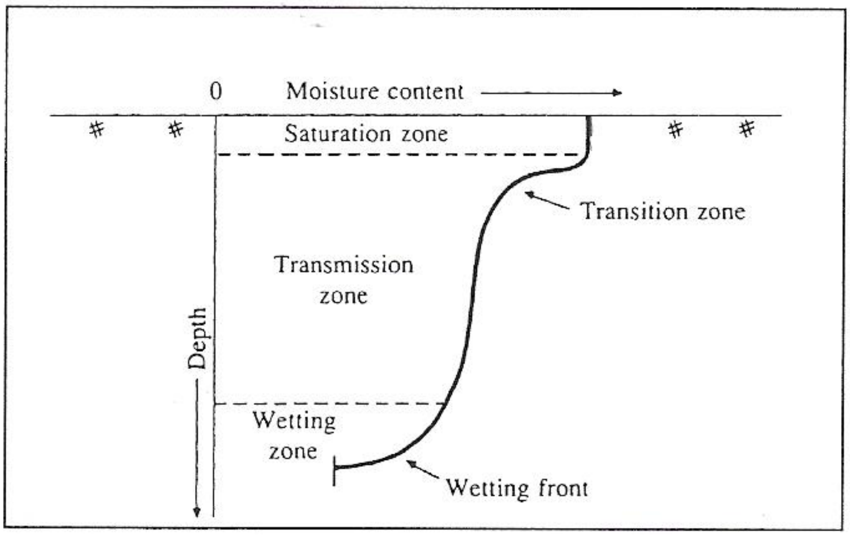



**Figure 2.1** Moisture Zones during Infiltration (Chow, 1988)

### 2.1.2 Infiltration Rate

Infiltration rate $f$ is the rate at which water penetrates into the soil at the surface and it is expressed in centimeter per hour. If ponding is occurred on the surface, infiltration process happens at potential infiltration rate. Normally actual infiltration rate will be less than potential rate while rate of supply of water is less than it. Rainfall event is a good example for this situation.

The cumulative infiltration $F$ is defined as accumulated depth of water which is infiltrated during a specified time interval. This value is equal to the integral of the infiltration rate over the given period (Equation 2.1) and infiltration rate is defined as the time derivative of the cumulative infiltration (Equation 2.2). In Equation 2.1, $\tau$ is defined as the dummy variable of time.

$$F\,(t) = \int_0^t f(\tau)\,d\tau \tag{2.1}$$

$$f(t) = \frac{d\,F\,(t)}{dt} \tag{2.2}$$

#### 2.1.2.1Horton's Equation

This is the one of the first infiltration equations which is developed by Horton (1933, 1939). As a result of observations, Horton stated that infiltration begins at rate of $f_0$ and exponentially decreases until a constant rate $f_c$ (Figure 2.2). Infiltration rate is formulated as below (Equation 2.3).

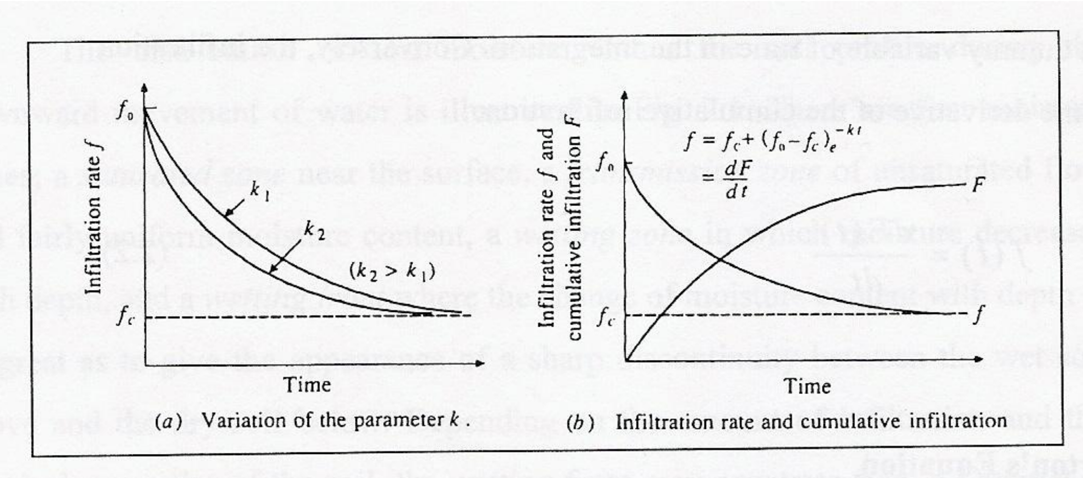



**Figure 2.2** Infiltration by Horton's Equation a) Variation of the parameter k, b) Infiltration Rate and Cumulative infiltration (Chow, 1988)

$$f(t) = f_c + (f_0 - f_c)e^{-kt} \tag{2.3}$$

k: decay constant having dimensions $[T^{-1}]$

In 1970's Eagleson (1970) and Raudkivi (1979) have shown that Richard's equation which was presented in 1931 (Equation 2.4) can be used to derive Horton's equation by assuming that $K$ and $\mathrm{D}$ are constants independent of moisture content of the soil. ($\mathrm{D}$ is soil diffusivity, $\mathrm{K}$ is hydraulic conductivity). With these assumptions Equation 2.4 reduces to Equation 2.6.

$$\frac{d\theta}{dt} = \frac{\partial}{\partial z}\left(D\,\frac{\partial\theta}{\partial z} + K\right) \tag{2.4}$$

$$\theta = \frac{volume\ of\ water}{total\ volume\ of\ soil} \tag{2.5}$$

where $\theta$ is the soil moisture content,

$$\frac{d\theta}{dt} = D\,\frac{\partial^2\theta}{\partial z^2} \tag{2.6}$$

Equation 2.6 is the standard form of a diffusion equation and could be solved to yield the moisture content as a function of time $\mathrm{t}$ and depth $\mathrm{z}$. Horton's equation which is Equation 2.3 results from solving for the rate of moisture diffusion $D(\partial\theta\ /\ \partial z)$ at the soil surface.

**2.1.2.2 Philip's Equation**

Richard's equation (Equation 2.4) is solved by Philip (1957, 1969) by assuming that $K$ and $\mathrm{D}$ can vary with the moisture content. In order to that Boltzman transformation $B(\theta) = zt^{-1/2}$ is used to convert Richard's equation into an ordinary differential equation in $\mathrm{B}$ and equation is solved to yield an infinite series for cumulative infiltration $F\ (t)$. It is approximated by

$$F\ (t) = St^{1/2} + Kt \tag{2.7}$$

$\mathrm{S}$: function of the soil suction potential, sorptivity

$K$: hydraulic conductivity

By differentiation Equation 2.7 reduces to Equation 2.8.

$$f\ (t) = \frac{1}{2}\,St^{-1/2} + K \tag{2.8}$$

$f\ (t)$ tends to $K$ while t $\rightarrow\infty$. In this equation first term represents the soil suction head and second term represents the gravity head. When horizontal column of soil is considered, soil suction becomes the only force drawing water into the column. As a result Philip's equation reduces to Equation 2.9.

$$F\ (t) = S\ t^{1/2} \tag{2.9}$$

### 2.1.3 Green-Ampt Method

Simplified form of infiltration was proposed by Green and Ampt in 1911 (Figure 2.3). It is explained by Chow as follow:

> *"The wetting front is a sharp boundary dividing the soil moisture content $\theta_i$ below from saturated soil of moisture content $\eta$ above. The wetting front has penetrated to a depth $L$ in time $t$ since infiltration began. Water is ponded to a small depth $h_0$ on the soil surface."*

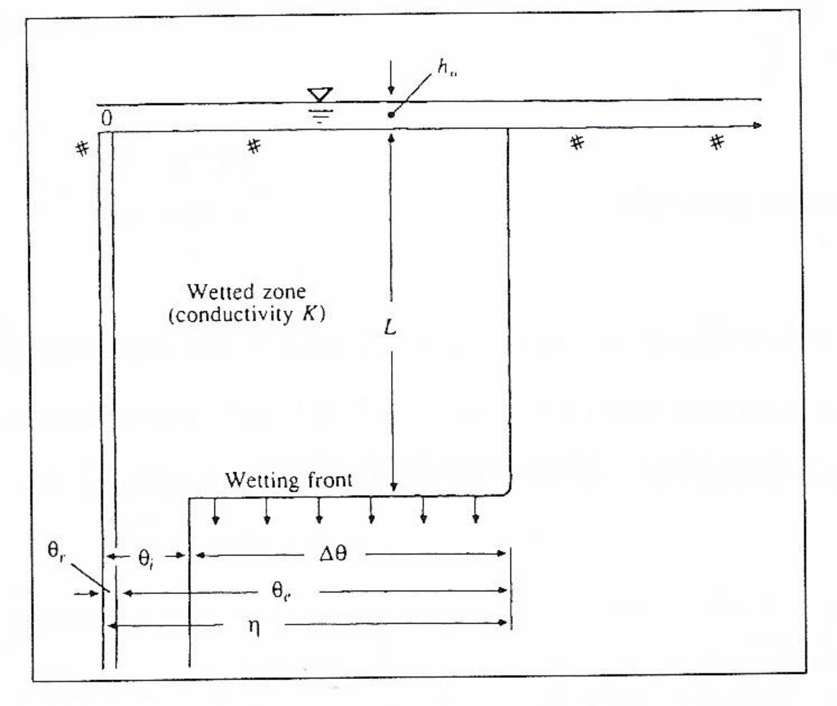



**Figure 2.3** Variables in the Green-Ampt Method (Chow, 1988)

Green-Ampt equation for cumulative infiltration $F$ is obtained by using continuity and momentum equations. It is given in Equation 2.10.

$$F\,(t) - \varphi\,\Delta\theta\,ln\left(1 + \frac{F\,(t)}{\varphi\,\Delta\theta}\right) = Kt \tag{2.10}$$

$K$: hydraulic conductivity

$\varphi$: wetting front soil suction head

$$\Delta\theta = \eta\,\eta - \theta_i \tag{2.11}$$

$\eta$*:* porosity of the soil

$\theta_i$: initial moisture content of the soil

Infiltration rate $f$ could be found by using Equation 2.12 when $F$ is found by Equation 2.10.

$$f\ (t) = K\ \left(\frac{\varphi\Delta\theta}{F\ (t)}\right) + 1 \tag{2.12}$$

To apply Green-Ampt method hydraulic conductivity *K*, porosity $\eta$, wetting front suction head φ have to be estimated.

### 2.1.4 SCS Method

In 1972 Soil Conservation Service developed a method to compute abstractions resulted with storm rainfall. According to this method, it is accepted that the depth of the excess precipitation $P_e$ is at most equal to depth of precipitation *P,* and retained depth of water $F_a$ is at most equal to the some potential maximum retention S. This phenomenon can be seen in Figure 2.4.

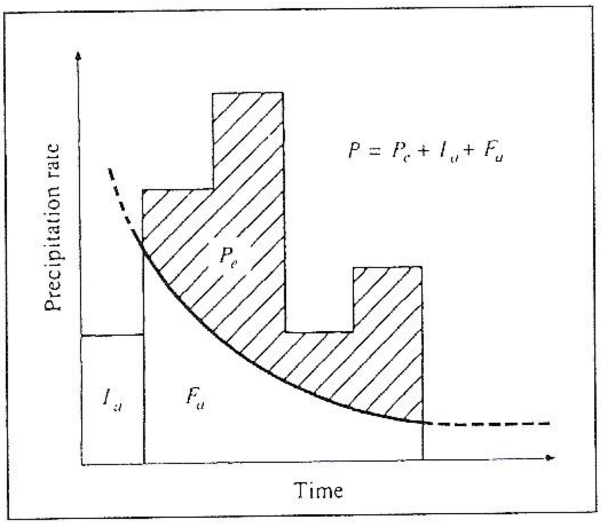



**Figure 2.4** Variables in the SCS Method (Chow, 1988)

As seen from figure first part of the rainfall $I_a$ (initial abstraction) do not lead to runoff so potential runoff will be equal to $P$ - $I_a$. According to hypothesis that SCS method based on ratios of two actual to the two potential quantities are equal to each other (Equation 2.13).

$$\frac{F_a}{S} = \frac{P_e}{P - I_a} \tag{2.13}$$

Depth of precipitation can be expressed as follow (Equation 2.14):

$$P = P_e + I_a + F_a \tag{2.14}$$

By combining Equation 2.13 and 2.14 and solving for $P_e$, one gets below equality.

$$P_e = \frac{(P - I_a)^2}{P - I_a + S} \qquad (2.15)$$

Equation 2.15 is the basic equation of SCS method to calculate the depth of excess rainfall. An empirical relation was also developed as a result of studies on small experimental watersheds. This relation is given as

$$I_a = 0.2\,S \qquad (2.16)$$

So Equation 2.15 can be formed as

$$P_e = \frac{(P - 0.2\,S)^2}{P + 0.8\,S} \qquad (2.17)$$

SCS plotted the data which were obtained from the experiments on watersheds (Figure 2.5). A dimensionless curve number (CN) is defined in order to standardize these curves. It is defined as 0 $\leq$ CN $\leq$ 100. Relation between the curve number CN and potential maximum retention S (in inches) are given in Equation 2.18.

$$S = \frac{1000}{CN} - 10 \qquad (2.18)$$

Curve numbers which are shown in Figure 2.5 are appropriate for normal antecedent moisture conditions (AMC II). Equivalent curve numbers for dry (AMC I) and wet (AMC III) conditions can be computed by Equation 2.19 and 2.20. Classification of antecedent moisture classes are given in Table 2.1.

$$\text{CN (I)} = \frac{4.2\,CN(II)}{10 - 0.058\,CN(II)} \qquad (2.19)$$

$$\text{CN (III)} = \frac{23\,CN(II)}{10 + 0.13\,CN(II)} \qquad (2.20)$$

**Table 2.1** Classification of Antecedent Moisture Classes (AMC) for the SCS Method of Rainfall Abstractions (Chow, 1988)

| AMC Group | Total 5-day Antecedent Rainfall (in) | |
|---|---|---|
| | **Dormant Season (Nowember - March)** | **Growing Season (April - October)** |
| I | Less than 0.5 | Less Than 1.4 |
| II | 0.5 to 1.1 | 1.4 to 2.1 |
| III | Over 1.1 | Over 2.1 |

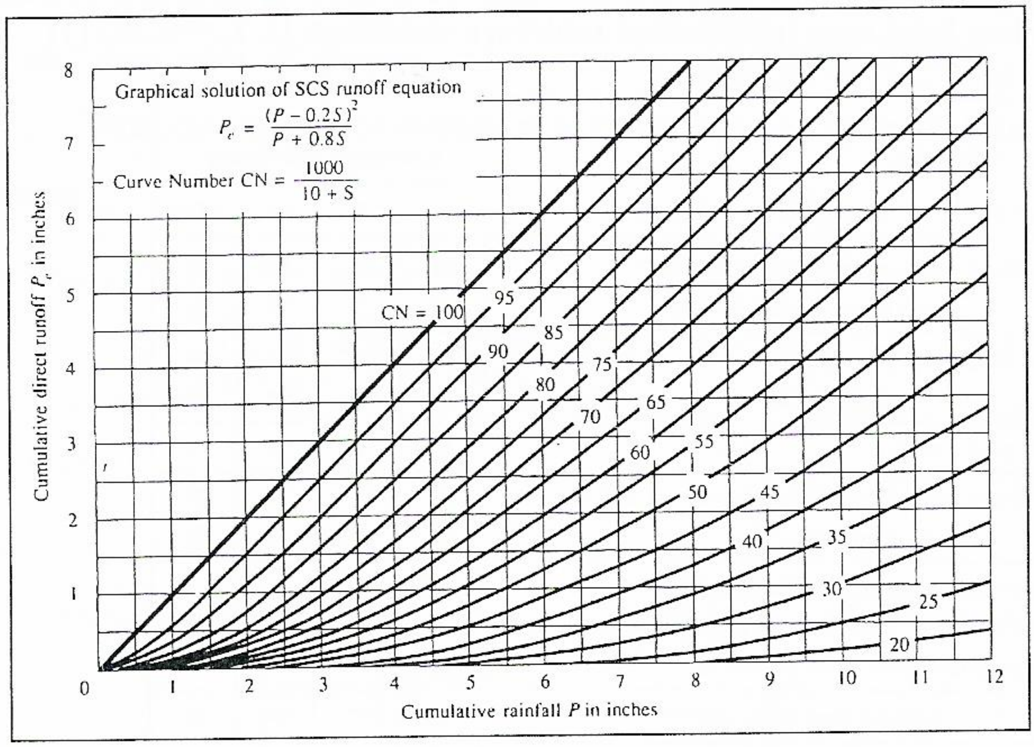



**Figure 2.5** Solution of the SCS Runoff Equations (Chow, 1988)

### 2.1.5 Infiltration Indices

Infiltration rate may be assumed as constant while dealing with problems regarding hydrograph analysis due to difficulty in finding actual infiltration curve for each storm (Cook, 1946). There are two indices used for finding approximate average infiltration loss from rainfall; W-index and Φ –index (Usul, 2005).

#### 2.1.5.1 The W – Index

Definition of W-index is given by Usul as follow:

> *"W-index is the average infiltration for the time interval $t_n$, during which the rainfall rate is larger than the infiltration rate. It is calculated by using the formula:"*

$$W = \frac{P-R}{t_n} \tag{2.21}$$

Where P and R are the total precipitation and the total runoff during $t_n$ (Figure 2.6).

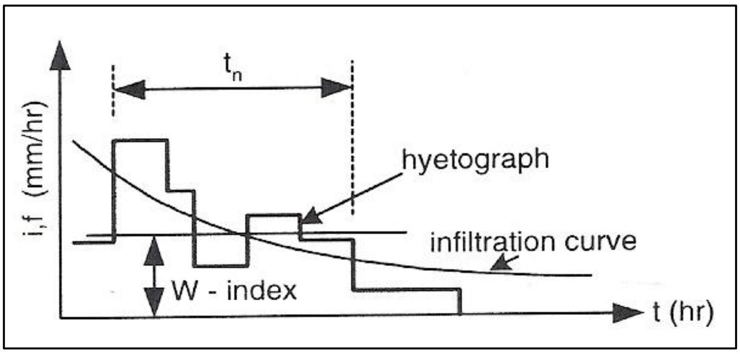



**Figure 2.6** W – Index (Usul,2005)

### 2.1.5.2 The Φ – Index

This is a widely used index in hydrograph analysis. It is defined as average infiltration rate above the depth or volume of rainfall is equal to depth or volume of surface runoff (Figure 2.7). It seems to be so simple form of infiltration process. However, it gives reasonable results especially for large basins (Usul, 2005).

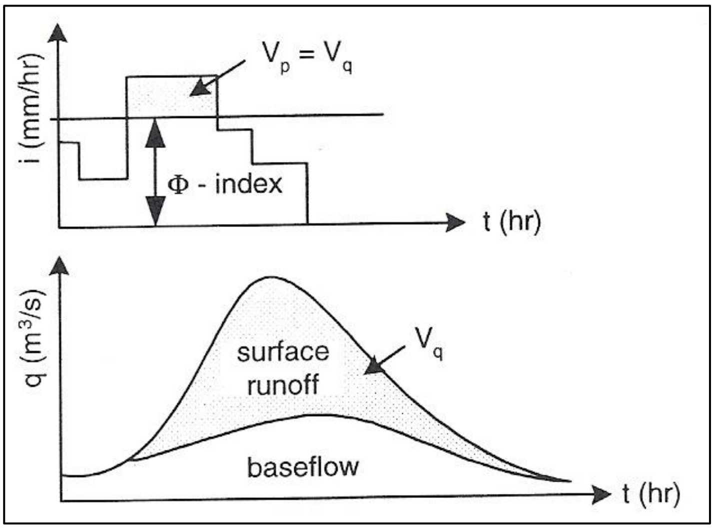



**Figure 2.7** Φ – Index (Usul,2005)

## 2.2 The Unit Hydrograph

Theory of unit hydrograph was proposed by Sherman in 1932 and expanded by other researchers. Hydrograph of surface runoff which is resulting from 1 cm (1 mm if the basin is in arid or semi-arid regions) of excess precipitation which is occurred uniformly over the watershed area at a uniform rate during a specified time duration is defined as unit hydrograph of that basin. Derivation of different hydrographs resulting from any amount of excess rainfall can be done by using unit hydrograph of a basin. There are five basic assumptions behind the theory. These are given as follows: (Chow, 1988)

1. Excess rainfall has a constant intensity within a specified period of time.
2. Excess rainfall is uniformly distributed throughout the basin area.
3. Base time of direct runoff resulting from excess rainfall is constant for a specified duration of rainfall.
4. Ordinates of the hydrograph of a specified duration rainfall are directly proportional to the total amount of direct runoff.
5. There is only one unit hydrograph for a basin.

## 2.3 Synthetic Unit Hydrograph

Derivation of unit hydrograph can be possible only if runoff and corresponding rainfall data are available. Obtained hydrograph is valid for the point where the streamflow data were measured. However, it is not possible to put necessary equipment to the every point of catchments and also available records may not be suitable to derive unit hydrograph. Furthermore it should be noted that there are many catchments without any rainfall or runoff data. That situation created a need for synthetic unit hydrographs. There are various methods to obtain synthetic unit hydrograph for a basin. By considering available data and assumptions used in methods, suitable method should be chosen for a basin. Some of synthetic unit hydrograph methods are described briefly in below sections.

### 2.3.1 SCS Dimensionless Hydrograph

In this method ratio of discharge to peak discharge and time, the ratio of time to the time of rise are used to express synthetic unit hydrograph. In figure 2.8-a dimensionless unit hydrograph which is prepared from various unit hydrographs of various watersheds can be seen. Peak value of discharge and time of rise may be estimated by using a simplified model of triangular unit hydrograph. That triangular unit hydrograph can be seen in Figure 2.8-b.

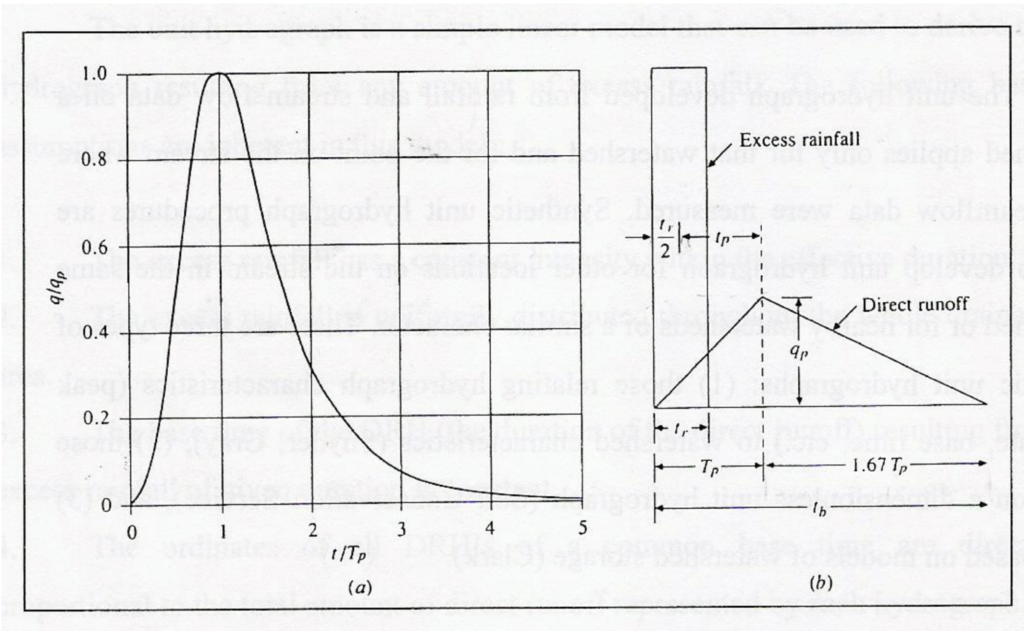



**Figure 2.8** SCS Synthetic Unit Hydrographs (a) dimensionless (b) triangular (Chow, 1988)

Formulae that are used in method are as follows:

$$q_P = \frac{C\ A}{T_P} \tag{2.22}$$

$$t_p \cong 0.6\ T_c \tag{2.23}$$

$$T_P = \frac{t_r}{2} + t_P \tag{2.24}$$

$$t_b = 2.67\ T_p \tag{2.25}$$

Where $q_p$ is the peak discharge ($m^3/s$), C is a constant (2.08), A is the drainage area ($km^2$), $t_p$ is the basin lag (hr), $T_c$ is the time of concentration (hr), $T_p$ is the time of rise (hr) and $t_b$ is the base time (hr).

### 2.3.2 Snyder Method

After studying watersheds located mainly in the Applachian Highlands, of the USA, and having areas varying in size from 10 to 10000 $mi^2$ Synder found synthetic relations for some characteristics of a standard unit hydrograph (Figure 2.9-a). Geomorphological characteristics like area, shape, channel slope, stream density, topography and channel storage are considered as the affecting parameters of the shape of hydrograph. For a given excess rainfall duration five characteristics of a required unit hydrograph (Figure 2.9-b) may be calculated by using the relations found by Synder. Those five characteristics are peak discharge per unit of area $q_{pR}$, basin lag $t_{pR}$ (time difference between the centroid of the excess rainfall hyetograph and unit hydrograph peak), base time $t_b$, and widths of the unit hydrograph at 50 and 75 percent of the peak discharge $W_{50}$, $W_{75}$.

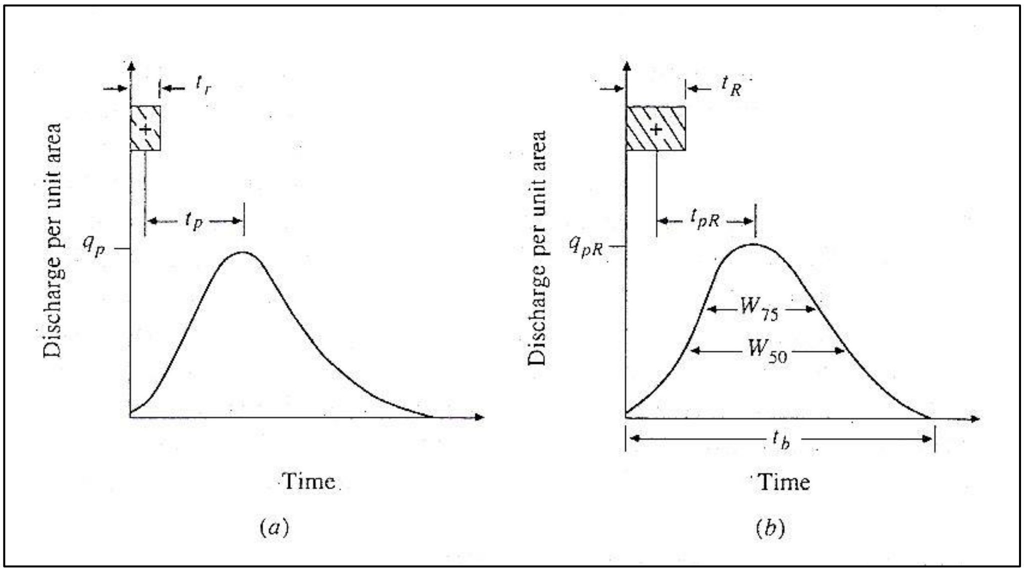



**Figure 2.9** Snyder's Synthetic Unit Hydrograph (a) standard (b) required (Chow, 1988)

Standard unit hydrograph is defined as one whose rainfall duration $t_r$ is related basin lag $t_p$ by

$$t_p = 5.5\ t_r \tag{2.26}$$

Basin lag for standard unit hydrograph is defined as follows

$$t_p = C_1 C_t (L L_c)^{0.3} \tag{2.27}$$

Where $t_p$ is basin lag in hour, L is length of main stream from the outlet to the upstream divide in kilometers; $L_c$ is the distance from the outlet to a point on the stream nearest the centroid of watershed area in kilometers; $C_1$ = 0.75; $C_t$: coefficient derived from the gaged watersheds in the same region.

Peak discharge of standard unit hydrograph, $q_p$ (per unit discharge area) is given as

$$q_p = \frac{C_2\ C_P}{t_p} \tag{2.28}$$

Where $C_2$ = 2.75, $C_p$ is a coefficient which is derived from gaged watershed in hydrologically similar regions.

In order to compute $C_t$ and $C_p$ for a gaged basin, the values of L and $L_c$ are measured from topographic maps. Duration of effective rainfall $t_R$ (hr), basin lag $t_{pR}$ and peak discharge per unit area $q_{pR}$ ($m^3/s/km^2$) are obtained from previously determined unit hydrograph. $t_R = t_r$, $t_{pR} = t_p$ and $q_{pR} = q_p$ in case of $t_{pR} = 5.5\ t_R$. If $t_{pR}$ is quite different than 5.5 $t_R$, standard basin lag is computed by following equation.

$$t_p = t_{pR} + \frac{t_r - t_R}{4} \tag{2.29}$$

Then $t_r$ and $t_p$ computed by solving equations 2.26 and 2.29 simultaneously and $C_t$ and $C_p$ values are obtained by using equations 2.27 and 2.28. These values can also be used for hydrogically similar ungaged watersheds.

Peak discharge of the required unit hydrograph is given as

$$q_{pR} = \frac{q_p t_p}{t_{pR}} \tag{2.30}$$

The base time in hours of the unit hydrograph may be determined from Equation 2.31.

$$t_b = \frac{5.56}{q_{pR}} \tag{2.31}$$

Widths in hours of the unit hydrograph at 50 and 75 percent of the peak discharge is given as

$$W = C_w q_{pR}^{-1.08} \quad (2.32)$$

Where $C_w$= 2.14 for the 50 percent width and 1.22 for the 75 percent of the width. One third of width is distributed before the peak and two third is distributed after the peak value.

### 2.3.3 Mockus Method

This method is a widely used method in Turkey because of its simplicity. Shape of unit hydrograph is triangular and it enables easy drawing. It is advised to use this method in watersheds whose time of concentration values are smaller than 30 hours (Kızılkaya, 1988). Time of concentration value may be calculated as using equations 2.33 and 2.34.

$$T_c = 0.00032 \frac{L^{0.77}}{S^{0.385}} \quad \text{(for rectangular shape watersheds)} \quad (2.33)$$

or

$$T_c = \frac{L^{1.15}}{3100\, H^{0.385}} \quad \text{(for circular shape watersheds)} \quad (2.34)$$

Where

$T_c$: time of concentration (hour)

L: Main channel length (m)

S: harmonic slope of main channel or average watershed slope

H: elevation difference between upstream and downstream point of watershed (m).

Precipitation duration corresponding to time of concentration, D is found as

$$D = 2\sqrt{T_c} \quad (2.35)$$

Other formulae that are used in calculations are as follows:

$$T_P = \sqrt{T_c} + 0.6 T_c \quad (2.36)$$

$$T_r = 1.67\, T_P \quad (2.37)$$

$$q_P = K \frac{A}{T_P} \quad (2.38)$$

$$Q_P = q_P\, h_a \quad (2.39)$$

Where $T_p$ is the time to peak (hour), $T_r$ is time of recession (hour), $q_p$ peak discharge per unit drainage area ($m^3$/s/mm), K basin parameter. In usual practice it is taken as 0.208 however it is a rough estimate and it is not easy to determine exact value. $Q_p$ is peak discharge of the basin for the specified precipitation duration and $h_a$ is the excess rainfall depth (mm) which is a function of basically basin characteristics, land use and cover.

### 2.3.4 Mc Math Method

Kızılkaya (1988) state that this method gives good results for plain drainage areas and it should not be used for side brooks on steep slope areas. Peak discharge value is calculated by using Equation 2.40.

$$Q = 0.0023\, C\, I\, S^{1/5}\, A^{4/5} \tag{2.40}$$

Where Q discharge (m3/s), C is a coefficient which is a function of soil type, topography and vegetation, I is precipitation rate of the desired frequency (mm/hour), S is the parameter which is equal to main channel slope times 1000 and A is the watershed area (ha).

### 2.3.5 Rational Method

It is one of the oldest methods to estimate runoff value of specified rainfall rate. Kızılkaya (1988) stated that good results are obtained on the basins whose drainage area is 25 $km^2$. In Turkey, it is used for areas whose drainage area is less than 1 $km^2$. Peak runoff rate is calculated by the formula given in Eqn. 2.41.

$$Q_p = \frac{1}{3.6}\, C\, I\, A \tag{2.41}$$

Where $Q_p$ is the peak runoff rate ($m^3$/s), C is a dimensionless runoff coefficient, I is the average rainfall intensity (mm/hour) for a critical period of time, A is the drainage area ($km^2$).

The most important issue in applying Rational Method is determining runoff coefficient. Suitable value should be chosen by considering watershed area and storm frequency.

## 2.4 Flood Routing

Water flow varies with time as the wave progress downstream and cross sections of the channel or reservoir is not constant. Because of these circumstances, movement of flood waves are highly complicated natural phenomenon. In Figure 2.10 change in flood hydrograph due to storage could be seen. It is easily seen that; total inflow between times $t_0$ and $t_1$ is equal to $\int_{t_0}^{t_1} I\, dt$, similarly total outflow and storage between times $t_0$ and $t_1$ are equal to $\int_{t_0}^{t_1} Q\, dt$ and $\int_{t_0}^{t_1} (I - Q)\, dt$ respectively where $I$ is the inflow rate to reach and $Q$ is the outflow rate from reach. By considering storage equality, continuity equation can be written as follows:

$$I - Q = \frac{dS}{dt} \tag{2.42}$$

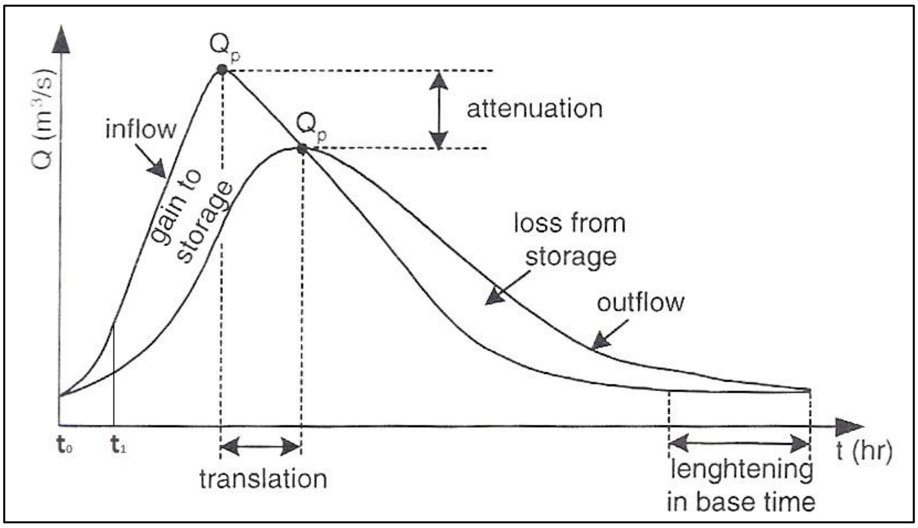



**Figure 2.10** Change in Flood Hydrograph due to Storage (Usul, 2005)

Where dS/dt is the change in storage. This equation can be written for specified time interval Δt as follows.

$$\bar{I} - \bar{Q} = \frac{\Delta S}{\Delta t} = \frac{S_2 - S_1}{\Delta t} \tag{2.43}$$

$$\frac{I_1 + I_2}{2} - \frac{Q_1 + Q_2}{2} = \frac{S_2 - S_1}{\Delta t} \tag{2.44}$$

Equation 2.44 is the basic equation that is used in flood routing procedures. In this equation there are two unknowns with one equality which are $S_2$ and $Q_2$. Because of that, solution is obtained by using physical characteristics of the system.

Routing phenomenon may be grouped into two main categories as reservoir routing and channel routing depending on the place where the flood wave travels.

### 2.4.1 Reservoir Routing

Puls method is generally used in reservoir routing procedure. In that procedure, it is assumed that water surface in reservoir remains constant at all times and relationship between the storage and discharge is constant (Usul, 2005).

Equation 2.44 can be transformed into Equation 2.45 to get usable equation in routing procedure.

$$(I_1 + I_2) + \left(\frac{2S_1}{\Delta t} - Q_1\right) = \left(\frac{2S_2}{\Delta t} + Q_2\right) \tag{2.45}$$

A new relationship between discharge and storage can be formed by using elevation versus storage and elevation versus discharge relations of reservoir (Q versus 2s/Δt ± Q relations) (Figure 2.11). After obtaining these relationships routing procedure can be calculated easily.

As an alternative solution for reservoir routing procedures, iterative analysis can also be employed with the help of computer programs.

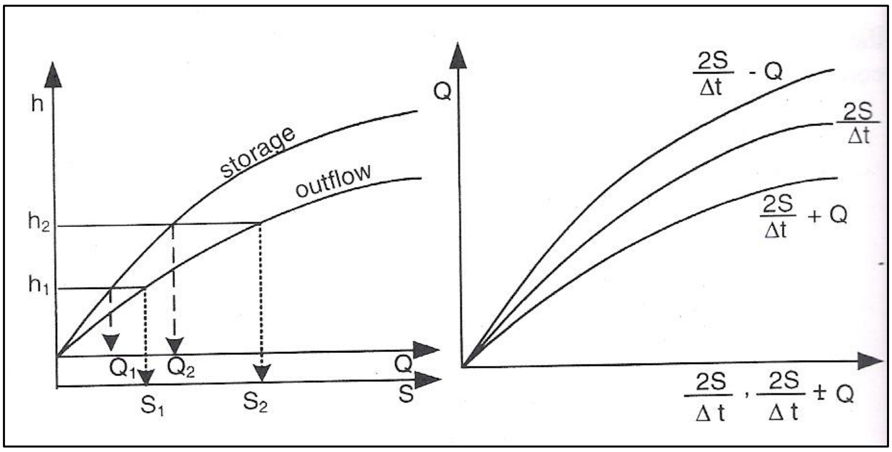



**Figure 2.11** Q vs (2S/Δt ± Q) Relationships (Usul, 2005)

### 2.4.2 Routing in Natural Channels

Routing in channels is a bit more complicated due to the fact that the storage is not only a function of outflow but also inflow. Basic elements that affect the storage in stable river reach are inflow to and outflow from the reach and hydraulic characteristics of channel section. Storage in natural channels is shown in Figure 2.12. Prism storage is defined as the storage below a parallel line to the river bed. On the other hand, wedge storage is defined as the storage between that parallel line and actual water profile. Wedge storage becomes positive in rising stage and becomes negative in falling stage since inflow drops faster than outflow. Two different storage values are seen in falling and rising stages and storage during rising becomes greater than during falling (Figure 2.13) (Usul, 2005).

In channel routing procedure, McCarthy's Muskingum method is generally used. In this method, sum of prism storage (K Q) and wedge storage [K X (I - Q)] is taken as total storage. Storage function is given as follow:

$$S = K\,Q + K\,X\,(I - Q) \tag{2.46}$$

Where K is the storage constant for a certain river reach (Prasad, 1967) with the dimension of time and X is a dimensionless constant. Equation 2.46 can be transformed into Equation 2.47.

$$S = K\,[X\,I + (1 - X)\,Q] \tag{2.47}$$

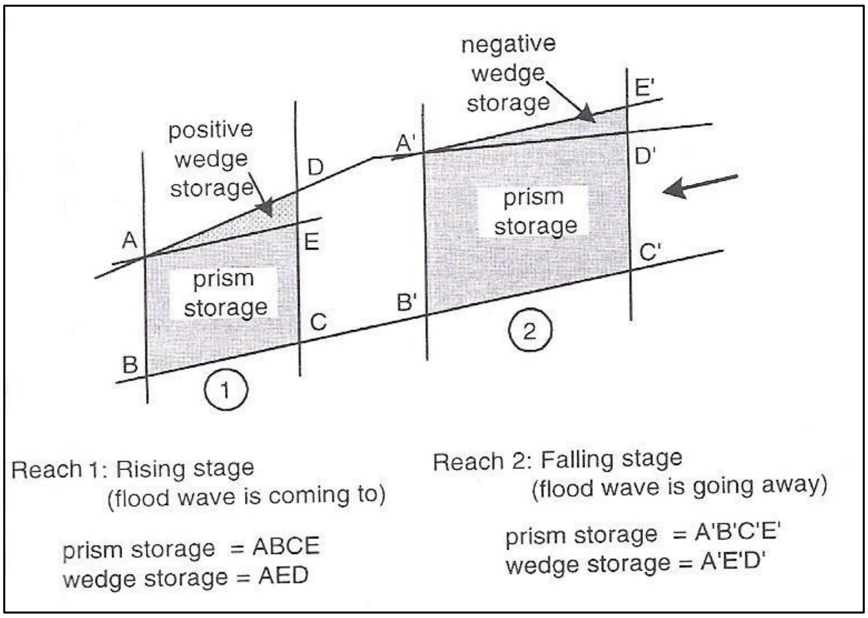



**Figure 2.12** Storage in Natural Channels (Usul, 2005)

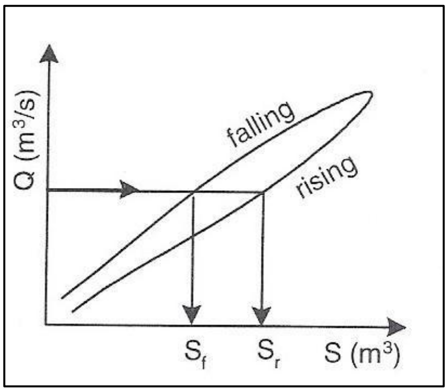



**Figure 2.13** Outflow vs Storage in Natural Channels (Usul, 2005)

Travel time of the center of mass of flood wave from upstream end to downstream end is found to be equal to value of K. The determination of the value of K is derived from observed inflow, outflow and storage values of earlier floods.

The dimensionless constant X value represents the effective weights of inflow and outflow on storage (WMO, 1974). The value of X changes between 0.0 and 0.5. Maximum attenuation occurs when the value of X is equal to 0.0 and no attenuation will occur in flood hydrographs when it equals to 0.5.

When storage values are plotted against weighted discharges, $[X\, I + (1 - X)\, Q]$, the slope of line gives the value of K. However, X value should be determined previously. Trial and error or graphical methods can be used to determine X value.

After obtaining K and X values, continuity equation (Equation 2.45) can be written in the following form:

$$I_1 + I_2 + \frac{2\,K\,[X\,I_1 + (1-X)Q_1]}{\Delta t} - Q_1 = \frac{2\,K\,[X\,I_2 + (1-X)Q_2]}{\Delta t} + Q_2 \tag{2.48}$$

By rearranging equation 2.48 for inflow and outflow terms, following equations could be obtained:

$$Q_2 = \frac{\Delta t - 2\,K\,X}{2\,K\,(1-X) + \Delta t}\,I_2 + \frac{\Delta t + 2\,K\,X}{2\,K\,(1-X) + \Delta t}\,I_1 + \frac{2\,K\,(1-X) - \Delta t}{2\,K\,(1-X) + \Delta t}\,Q_1 \tag{2.49}$$

or

$$Q_2 = C_0 I_2 + C_1 I_1 + C_2 Q_1 \tag{2.50}$$

Values of coefficients $C_0$, $C_1$ and $C_2$ should add up to 1.0 and K and $\Delta t$ values should have the same unit of time.

# CHAPTER 3

# CASE STUDY

## 3.1 Catchment Area of Ankara City

All the streams passing through Ankara belong to the Sakarya Basin. Main and most problematic ones are Çubuk, Hatip, İncesu and Dikmen streams. These streams come together and take the name of Ankara Creek. Total catchment area of Ankara Creek which is inside the city is approximately 3300 $km^2$. Whole catchment area can be seen in Figure 3.1.

According to İzbırak (1978), all the streams that belong to Ankara Creek are torrent type streams according to climatic factor classifications. It is also claimed by Ateş (1985) that these streams have irregular regimes. These types of streams are seen in regions where all the precipitation in a year occurs in a one or two season. Runoff values will increase when precipitation and snow melt rates increase and it will decrease or stream will totally dry in periods when precipitation stops or temperature increases (Atalay, 2004).

Floods occur in a very short time and may have dangerous effects on mountainous regions and arid areas. There are various historical floods which occurred on those catchments in recent past. Some of them are listed in Table 3.1.

**Table 3.1** Historical Floods in Ankara (Batukan, 1968)

| Date | Location | Precipitation (mm) | Mortality | Real Injury | Remarks |
|---|---|---|---|---|---|
| 04.05.1946 | Hatipçayı<br>Bendderesi | 18.2<br>14.7 | 1 child | | |
| 07/08.05.1947 | Hatipçayı | 22.9 | 2 people | More than 100 house were flooded | |
| 14.12.1947 | | 70 | | | Daily precipitation |
| 09.07.1950 | | 4.8 | | | |
| 22.05.1951 | | 31.6 | | | |
| 12/15.6.1951 | İncesu, Dikmen | 17.5 | | 30 houses were flooded | |
| 20/23.07.1952 | Hatipçayı | | | Post office building collapsed in Kayaş. | |
| 17.02.1953 | Çubukçayı<br>Varlık district | 23.5<br>13.2 | | | Average of 6 days |
| 01.05.1953 | Kavaklıdere<br>Bahçelievler | 9.1 | | Approximately 150 houses were flooded. | 20 houses were flooded in Etimesgut. |
| 11.09.1957 | Hatipçayı<br>Kayaş | 125<br>(Odabaşı Village) | 169 people | 21,458,649 TL | 500 $m^3/s$ runoff occured in Bendderesi as a result of 2 hour precipitation on 250 $km^2$ area. |
| 18/21.06.1961 | Hatipçayı, İncesu, Dikmen and Çubukçayı | 57.5 | 3 people | 17,760,000 TL | |

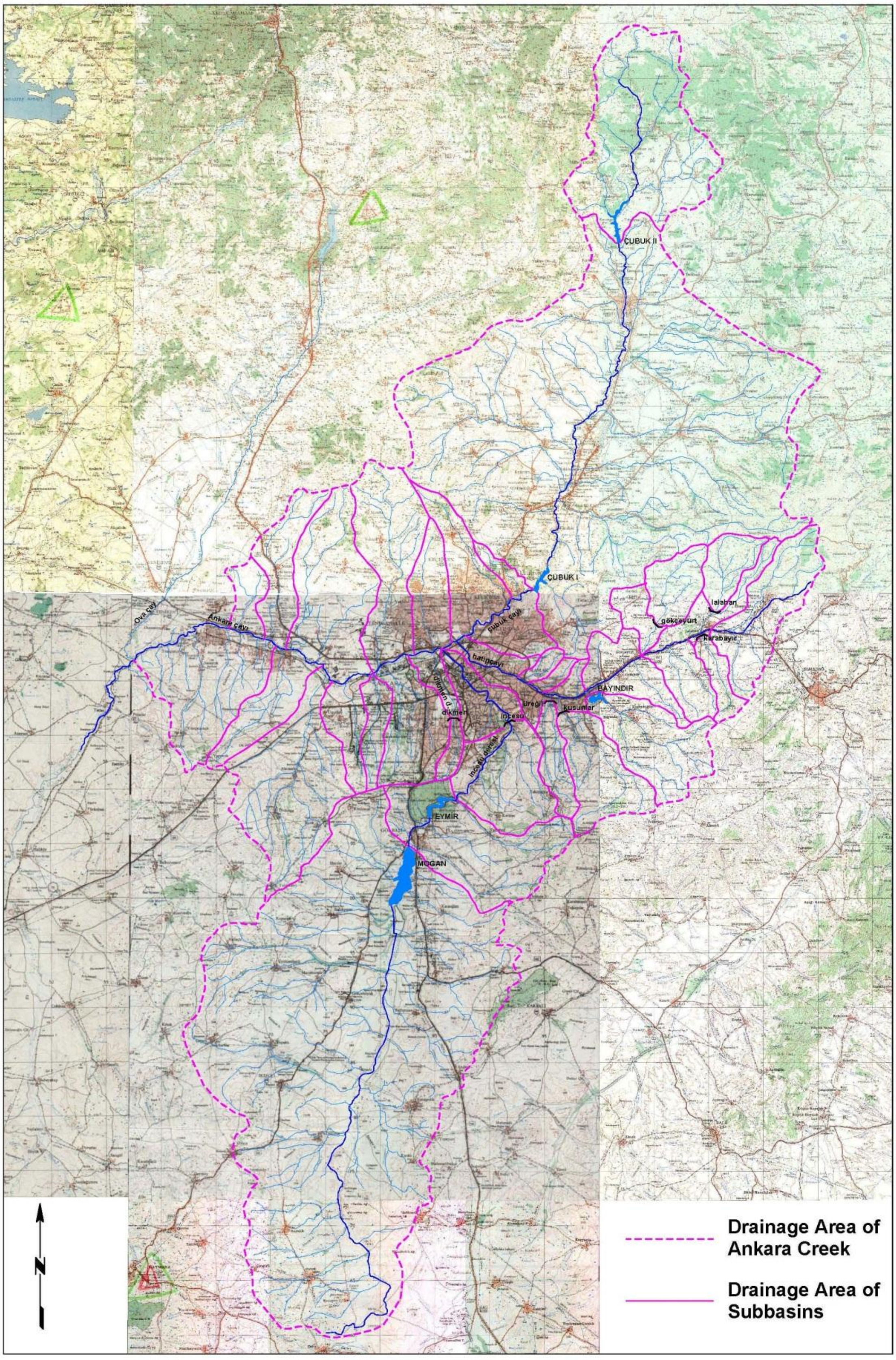



**Figure 3.1** Catchment Area of Ankara Creek

As can be seen from Table 3.1, 175 people lost their lives between 1946 and 1961. Most destructive flood occurred in 1957. Places where had been influenced by flood disaster were poor quarters which are Mamak, Saimekadın, Kayaş and Cebeci (especially Demirlibahçe district). According to narrative, before Hatip Creek overflowed its banks, the weather was sunny and people were continuing their ordinary life. When the flood wave came, water height reached to 7-8 meters in some places. Since most of the houses' construction materials were adobe, they collapsed and damaged easily and people in panic tried to survive themselves by swimming in flood waves. Because of the lack of technology, rescue equipment and boat; caiques in *Gençlik Parkı* (a local carnival area) had to be used in rescue operations. These situations led to increase mortality unfortunately (Cantek, 2006).

Because of high urbanization, some places which were considered as rural areas previously, have turned out to be part of city centre. As a result of this, precipitated water turned into runoff more quickly and lowlands started to be flooded.

Until that time any flood control structure were not been constructed except Çubuk I Dam which was built in 1936. In order to prevent flooding damage, State Hydraulic Works prepared *Ankara Taşkın Projesi Planlama Raporu* in 1963 and *Ankara Taşkın Projesi Tatbikatı* in 1968. According to those projects several flood control structures had been constructed (Figure 3.2). Some detailed information given in that reports about those structures are summarized below.

### Çubuk I Dam

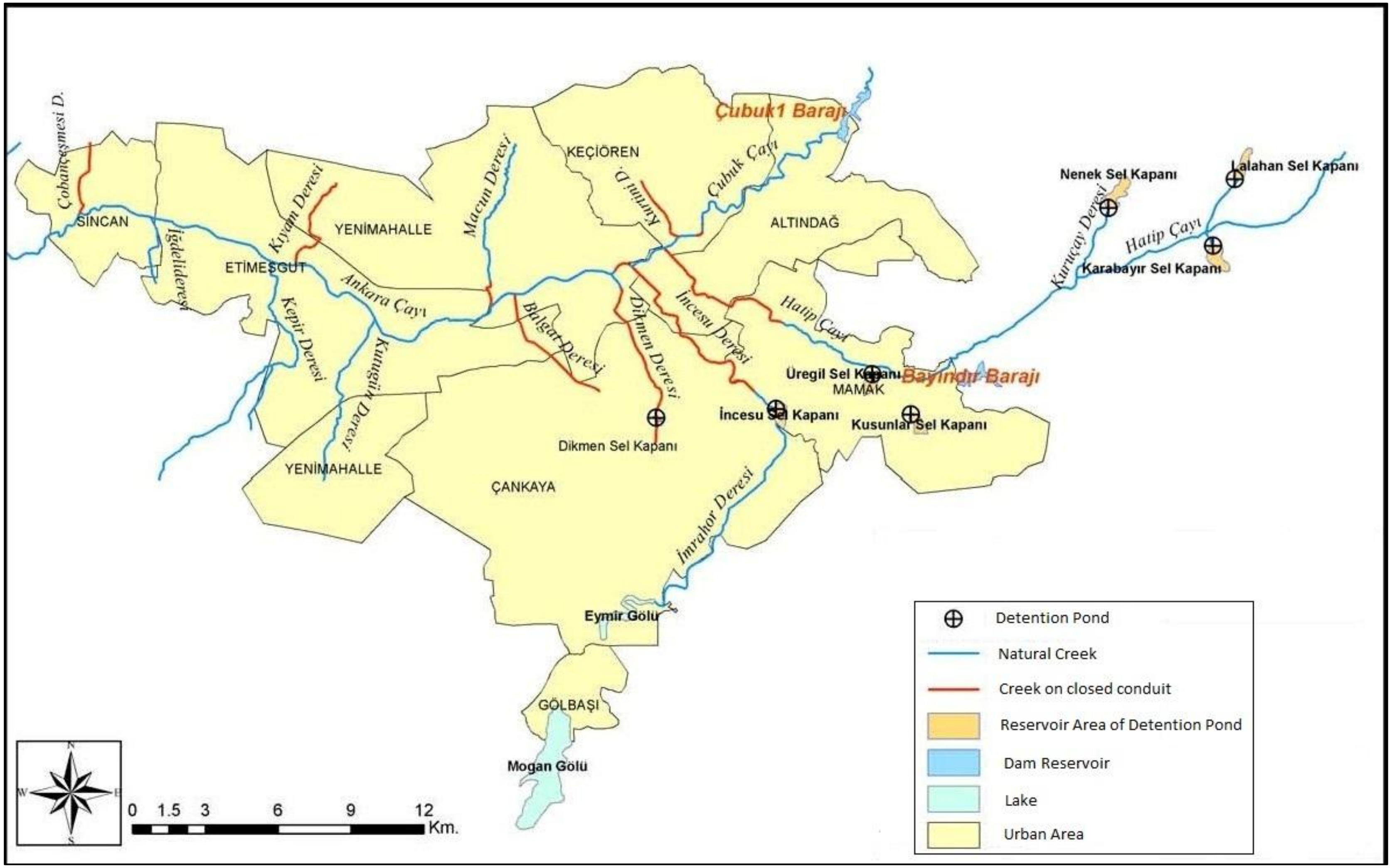
This dam is located on Çubuk Creek and it is the first dam constructed in the capital city of Turkey, Ankara. Construction of the dam was started in 1930 and ended in 1936. Flood control and supplying municipal water were the main purposes although irrigation water were supplied to some part of downstream areas initially. By increasing population and water demand of Ankara city, irrigation purpose of dam was cancelled in 1960's and it began to operate only for municipal water demand. Sewer line connected to the dam reservoir was also an important effect in making that decision. (Batukan, 1968)

In 1968, reservoir volume was 13.5 $hm^3$ and 38% of domestic water demand of Ankara was provided from Çubuk – I dam. Since dead volume has already been filled with sediment, it is only used for recreation purpose nowadays. Municipality has started some operations in order to reoperate this dam effectively a couple of years ago and studies are still carried on. Some characteristics of Çubuk I Dam are given below in Table 3.2.

**Table 3.2** Characteristics of Çubuk I Dam

| | |
|---|---|
| **Purpose** | Water Supply & Flood Control |
| **Creek** | Çubuk Creek |
| **Height** | 25 m. |
| **Type** | Concrete Gravity |
| **Volume of Body** | 0.12 $hm^3$ |
| **Reservoir Volume at Normal Water Level** | 5.60 $hm^3$ |
| **Reservoir Area at Normal Water Level** | 1.20 $km^2$ |

**Figure 3.2** Flood Control Structures of Ankara (Pekin, 2007)



### Çubuk II Dam

It is the second dam located on Çubuk Creek. Construction of this dam has started in 1961 and finished in 1964. Main purpose of this dam was supplying municipal water, protecting Çubuk Region against floods, and creating another recreation site for Ankara. Dam is still actively used for supplying domestic water. Some characteristics of dam are given in Table 3.3.

**Table 3.3** Characteristics of Çubuk II Dam

| | |
|---|---|
| **Purpose** | Water Supply & Flood Control |
| **Creek** | Çubuk Creek |
| **Height** | 69 m. |
| **Type** | Earth fill |
| **Crest Elevation** | 1117.00 m. |
| **Crest Length** | 230.00 m. |
| **Volume of Body** | 1.10 $hm^3$ |
| **Maximum Water Elevation** | 1115.25 m. |
| **Reservoir Area at Maximum Water Level** | 1.29 $km^2$ |
| **Minumum Water Elevation** | 1075.00 m. |
| **Reservoir Volume at Normal Water Elevation** | 24.60 $hm^3$ |
| **Reservoir Area at Normal Water Elevation** | 1.20 $km^2$ |
| **Active Volume** | 22.60 $hm^3$ |
| **Spillway Crest Elevation** | 1113.00 m. |
| **Capacity of Spillway** | 238.00 $m^3/s$ |
| **Spillway Crest Length** | 38.00 m. |
| **Diameter of Sluiceway** | 3.00 m. |
| **Length of Sluiceway** | 496.00 m. |

### Üreğil Detention Pond

Üreğil detention pond was built on Yazıdere Creek which is the most downstream tributary at the left bank of Hatip Creek. Drainage area of this detention pond was measured as 20 $km^2$ while project studies were done. Characteristics of this small detention pond are given in Table 3.4.

### Kusunlar Detention Pond

It is one of the first detention ponds which was constructed by State Hydraulic Works. It was built on Kusunlar Creek which is one of tributaries of Hatip Creek. Characteristics of this small detention pond are given in Table 3.5.

### Kayaş-Bayındır Dam

This dam was constructed on Bayındır Creek (third downstream tributary of Hatip Creek) for water supply and flood control purposes. Construction lasted three years and finished in 1965. Basic characteristics of dam are given in Table 3.6.

**Table 3.4** Characteristics of Üreğil Detention Pond

| | |
|---|---|
| **Type** | Earth fill |
| **Height** | 12 m. |
| **Volume of Body** | 67,875 $m^3$ |
| **Crest Elevation** | 946.00 m. |
| **Maximum Water Elevation** | 945.00 m. |
| **Minumum Water Elevation** | 936.50 m. |
| **Total Storage Volume** | 335,000 $m^3$ |
| **Dead Volume** | 15,000 $m^3$ |
| **Maximum Reservoir Area** | 10.4 ha |
| **Probable Maximum Flood** | 110 $m^3/s$ |
| **Crest Elevation of Spillway** | 943.00 m. |
| **Diameter of Sluiceway** | 1.00 m. |
| **Capacity of Sluiceway** | 4 $m^3/s$ |

**Table 3.5** Characteristics of Kusunlar Detention Pond

| | |
|---|---|
| **Type** | Earth fill |
| **Height** | 13.50 m. |
| **Crest Elevation** | 957.49 m. |
| **Maximum Water Elevation** | 956.49 m. |
| **Probable Maximum Flood** | 154 $m^3/s$ |
| **Crest Elevation of Spillway** | 955.49 m. |
| **Diameter of Sluiceway** | 0.80 m. |
| **Capacity of Sluiceway** | 10 $m^3/s$ |

**Table 3.6** Characteristics of Kayaş - Bayındır Dam

| | |
|---|---|
| **Purpose** | Water Supply & Flood Control |
| **Creek** | Bayındır Creek |
| **Height** | 30 m. |
| **Type** | Earth fill |
| **Crest Elevation** | 990.00 m. |
| **Crest Length** | 437.00 m. |
| **Crest Width** | 10.00 m. |
| **Volume of Body** | 553,000 $m^3$ |
| **Maximum Water Elevation** | 988.16 m. |
| **Minumum Water Elevation** | 972.00 m. |
| **Reservoir Volume at Normal Water Elevation** | 6.97 $hm^3$ |
| **Reservoir Area at Normal Water Elevation** | 0.71 $km^2$ |
| **Dead Volume** | 1.00 $hm^3$ |
| **Flood Control Volume** | 1.00 $hm^3$ |
| **Total Volume** | 7.97 $hm^3$ |
| **Spillway Crest Elevation** | 986.50 m. |
| **Capacity of Spillway** | 128.70 $m^3/s$ |
| **Spillway Crest Length** | 28.00 m. |
| **Diameter of Sluiceway** | 2.50 m. |
| **Length of Sluiceway** | 216.30 m. |

**Karabayır Detention Pond**

Basic characteristics of pond are given in Table 3.7.

**Table 3.7** Characteristics of Karabayır Detention Pond

| | |
|---|---|
| **Creek** | Karabayır Creek |
| **Type** | Earth fill |
| **Height** | 13 m. |
| **Volume of Body** | 59,000 $m^3$ |
| **Crest Elevation** | 1084.60 m. |
| **Maximum Water Elevation** | 1083.25 m. |
| **Minumum Water Elevation** | 1077.00 m. |
| **Total Storage Volume** | 300,000 $m^3$ |
| **Dead Volume** | 60,000 $m^3$ |
| **Maximum Reservoir Area** | 6.5 ha |
| **Probable Maximum Flood** | 87 $m^3/s$ |
| **Crest Elevation of Spillway** | 1082.00 m. |
| **Diameter of Sluiceway** | 1.00 m. |
| **Capacity of Sluiceway** | 4.55 $m^3/s$ |
| **Drainage Area** | 14 $km^2$ |

**Lalahan Detention Pond**

Basic characteristics of pond are given in Table 3.8.

**Table 3.8** Characteristics of Lalahan Detention Pond

| | |
|---|---|
| **Creek** | Şaraplı Creek |
| **Type** | Earth fill |
| **Height** | 17 m. |
| **Volume of Body** | 99,000 $m^3$ |
| **Crest Elevation** | 1117.90 m. |
| **Maximum Water Elevation** | 1116.20 m. |
| **Minumum Water Elevation** | 1105.50 m. |
| **Total Storage Volume** | 600,000 $m^3$ |
| **Dead Volume** | 60,000 $m^3$ |
| **Maximum Reservoir Area** | 13.5 ha |
| **Probable Maximum Flood** | 157.50 $m^3/s$ |
| **Capacity of Spillway** | 95.00 $m^3/s$ |
| **Width of Spillway** | 50.00 m |
| **Crest Elevation of Spillway** | 1115.00 m. |
| **Diameter of Sluiceway** | 1.00 m. |
| **Capacity of Sluiceway** | 4.84 $m^3/s$ |
| **Drainage Area** | 34 $km^2$ |

### Nenek (Gökçeyurt) Detention Pond

Basic characteristics of pond are given in Table 3.9.

**Table 3.9** Characteristics of Nenek (Gökçeyurt) Detention Pond

| | |
|---|---|
| **Creek** | Kuruçay Creek |
| **Type** | Earth fill |
| **Height** | 17 m. |
| **Volume of Body** | 115,000 $m^3$ |
| **Crest Elevation** | 1056.25 m. |
| **Maximum Water Elevation** | 1055.00 m. |
| **Minumum Water Elevation** | 1044.00 m. |
| **Total Storage Volume** | 750,000 $m^3$ |
| **Dead Volume** | 100,000 $m^3$ |
| **Maximum Reservoir Area** | 16 ha |
| **Probable Maximum Flood** | 175 $m^3/s$ |
| **Crest Elevation of Spillway** | 1052.50 m. |
| **Diameter of Sluiceway** | 1.00 m. |
| **Capacity of Sluiceway** | 5.00 $m^3/s$ |
| **Drainage Area** | 40 $km^2$ |

### İncesu Detention Pond

Basic characteristics of pond are given in Table 3.10.

**Table 3.10** Characteristics of İncesu Detention Pond

| | |
|---|---|
| **Creek** | İncesu Creek |
| **Type** | Earth fill |
| **Height** | 12 m. |
| **Volume of Body** | 55,000 $m^3$ |
| **Crest Elevation** | 904.50 m. |
| **Maximum Water Elevation** | 903.00 m. |
| **Minumum Water Elevation** | 893.50 m. |
| **Total Storage Volume** | 817,500 $m^3$ |
| **Dead Volume** | 14,000 $m^3$ |
| **Maximum Reservoir Area** | 26 ha |
| **Probable Maximum Flood** | 240 $m^3/s$ |
| **Crest Elevation of Spillway** | 902.00 m. |
| **Diameter of Sluiceway** | 1.30 m. |
| **Capacity of Sluiceway** | 10.00 $m^3/s$ |

### Dikmen Detention Pond

This structure does not exists anymore. Metropolitan municipality had changed flood control system during the construction works in Dikmen Valley. Basic characteristics of pond when it was first constructed are given in Table 3.11.

**Table 3.11** Characteristics of Dikmen Detention Pond

| | |
|---|---|
| **Creek** | Dikmen Creek |
| **Type** | Earth fill |
| **Height** | 15.60 m. |
| **Volume of Body** | 48,000 $m^3$ |
| **Crest Elevation** | 951.60 m. |
| **Maximum Water Elevation** | 950.00 m. |
| **Minumum Water Elevation** | 942.50 m. |
| **Total Storage Volume** | 230,000 $m^3$ |
| **Dead Volume** | 30,000 $m^3$ |
| **Maximum Reservoir Area** | 5.6 ha |
| **Probable Maximum Flood** | 75 $m^3/s$ |
| **Crest Elevation of Spillway** | 949.25 m. |
| **Diameter of Sluiceway** | 1.00 m. |
| **Capacity of Sluiceway** | 5.00 $m^3/s$ |
| **Drainage Area** | 11 $km^2$ |

As seen from above information, there are various flood control structures in Ankara. However, flooding events were occurred around Mogan and Eymir lakes in March of 2011 and 2012. In this thesis study, water control structures in Lake Mogan, Lake Eymir and İncesu Detention Pond (İmrahor Valley) subbasins will be analyzed.

## 3.2 General Characteristics of Study Area

Whole basin has nearly 1100 $km^2$ catchment area. In this area there are two natural lakes (Mogan and Eymir lakes), two reservoirs (Dikilitaş and İkizce) and one detention pond (İncesu Detention Pond). Detailed information can be seen in below sections.

### 3.2.1 Lake Mogan Subbasin

Lake Mogan (Figure 3.3) is on the 20 km. south of the Ankara in Gölbaşı. Total catchment area of Lake Mogan is 929.02 $km^2$. 245 $km^2$ of this area is declared as environmental protection zone by the decision of Council of Ministers 1990 (Altınbilek, 1995). On that zone it is forbidden to make any construction due to ecological reasons. This zone can be seen in Figure 3.4. Some important characteristics of lake are given in Table 3.12.

**Table 3.12** Basic Characteristics of Lake Mogan (Altınbilek, 1995)

| **Characteristics** | **Minimum** | **Normal** | **Maximum** |
|---|---|---|---|
| Water Level (m) | 971 | 972 | 973.25 |
| Volume ( $hm^3$) | 6.20 | 11.63 | 20.19 |
| Area ($km^2$) | 4.77 | 5.43 | 7.72 |

**Figure 3.3** Google Earth View of Lake Mogan

**Figure 3.4** Google Earth View of Environmental Protection Zone

There are two ponds (Dikiltaş and İkizce) and one more artificial barrier in the basin. The road which connects the Gölbaşı – Haymana Road and Ankara – Konya Road acts as additional water control structure in the basin. However those structures are not taken into account in calculations since those are small irrigation ponds and have insignificant reservoir volume which cannot play an important role when high return period floods are considered. General information about Dikilitaş and İkizce ponds is given below.

#### 3.2.1.1 Dikilitaş Reservoir

Dikilitaş Reservoir was built on Sarıkaya Creek between 1985 and 1987. Thalweg elevation of reservoir was selected as 1031 m. Characteristics of this small pond are given in Table 3.13.

**Table 3.13** Characteristics of Dikilitaş Reservoir (DSİ, 2008)

| | |
|---|---|
| **Creek** | Sarıkaya Creek |
| **Type** | Earth fill |
| **Irrigation Area** | 128.70 ha. |
| **Drainage Area** | 173.2 $km^2$ |
| **Annual Water Budget** | 1.24 $hm^3$ |
| **Total Storage Volume** | 10 $hm^3$ |
| **Active Storage Volume** | 9 $hm^3$ |
| **Maximum Water Elevation** | 1050.00 m. |
| **Height** | 20 m. |
| **Crest Length** | 511 m. |
| **Crest Width** | 7 m. |
| **Volume of Body** | 333,000 $m^3$ |
| **Sluiceway Length** | 192 m. |
| **Diameter of Sluiceway** | 610 mm. |
| **Capacity of Spillway** | 85 $m^3/s$ |

#### 3.2.1.2 İkizce Reservoir

İkizce Reservoir was built on Mencilen Creek between 1975 and 1976. Thalweg elevation of reservoir was selected as 1054 m. Characteristics of this small detention pond are given in Table 3.14.

### 3.2.2 Lake Eymir Subbasin

Lake Eymir (Figure 3.5) is on just downstream part of the Lake Mogan. Total catchment area is approximately 42.49 $km^2$. Some important characteristics of lake is given in Table 3.15.

**Table 3.14** Characteristics of İkizce Reservoir (DSİ, 2008)

| | |
|---|---|
| **Creek** | Mencilen Creek |
| **Type** | Earth fill |
| **Irrigation Area** | 400 ha. |
| **Drainage Area** | 49.7 $km^2$ |
| **Annual Water Budget** | 1.27 $hm^3$ |
| **Total Storage Volume** | 1.27 $hm^3$ |
| **Active Storage Volume** | 1.10 $hm^3$ |
| **Maximum Water Elevation** | 1068.00 m. |
| **Height** | 15 m. |
| **Crest Length** | 288 m. |
| **Crest Width** | 7.5 m. |
| **Volume of Body** | 487,000 $m^3$ |
| **Diameter of Sluiceway** | 600 mm. |
| **Capacity of Spillway** | 52 $m^3/s$ |

**Figure 3.5** Google Earth View of Lake Eymir

**Table 3.15**: Basic Characteristics of Lake Eymir (Altınbilek, 1995)

| **Characteristics** | **Minumum** | **Normal** | **Maximum** |
|---|---|---|---|
| Water Level (m) | 967 | 968.50 | 969.50 |
| Volume ( $hm^3$) | 2.16 | 3.88 | 5.20 |
| Area ($km^2$) | 1.05 | 1.25 | 1.34 |

### 3.2.3 Incesu Detention Pond Subbasin (İmrahor Valley)

Total catchment area of this subbasin is 98.12 $km^2$. Creek bed follows very irregular pattern. There are various waterholes throughout the valley. Those depressions were formed as a result of taking alluvial soil in river bed in order to use in brick-making works (Figure 3.6 & 3.7).


**Figure 3.6** İncesu Creek

Incesu Detention Pond which was constructed in 1965 exists at the end of valley. General characteristics of this structure are given in section 3.1. There is a closed conduit at the exit of structure. Capacity of that conduit is not known very accurately. According to DSI report, capacity is between 48-94 $m^3/s$ (DSİ, 2008). General view of detention pond can be seen in Figure 3.8 & 3.9.


**Figure 3.7** Waterhole in İmrahor Valley


**Figure 3.8** Google Earth View of İncesu Detention Pond

**Figure 3.9** Reservoir Area of İncesu Detention Pond (DSİ, 2008)

## 3.3 Modeling Studies for Catchment Area

### 3.3.1 Digital Maps

To start the modeling studies a digital elevation model (DEM) of the area is required first. The Advanced Spaceborne Thermal Emission and Reflection Radiometer (ASTER) Global Digital Elevation Model (GDEM) (version 1) which is free of charge is used. This digital elevation model product is developed by the Ministry of Economy, Trade, and Industry (METI) of Japan and the United States National Aeronautics and Space Administration (NASA). Accuracies of these products are 20 m at 95 % confidence for vertical data and 30 m at 95 % confidence for horizontal data (web 1). Digital elevation model of study area is given in Figure 3.10.

In order to determine the hydrologic soil groups, three different soil maps are used. These maps are depth of soil, erosion rate and great soil group of the basin. General classification of these soil groups are given in Table 3.16, 3.17 and 3.18 respectively (web 2). Classification of hydrologic soil groups is determined according to Table 3.19 (Figure 3.11).

Land use information is obtained from CORINE (Coordination of Information on the Environment) which is founded by European Union Global Monitoring for the Environment and Security (GMES) (Web 3).

By using these mentioned digital maps and making overlay analysis in ArcGIS, the curve numbers for each unit are estimated with the help of Table 3.20 (Figure 3.12). In order to find average weighted curve numbers of Lake Mogan, Lake Eymir and İmrahor Valley subbasins, areal ratios of each unit is employed.

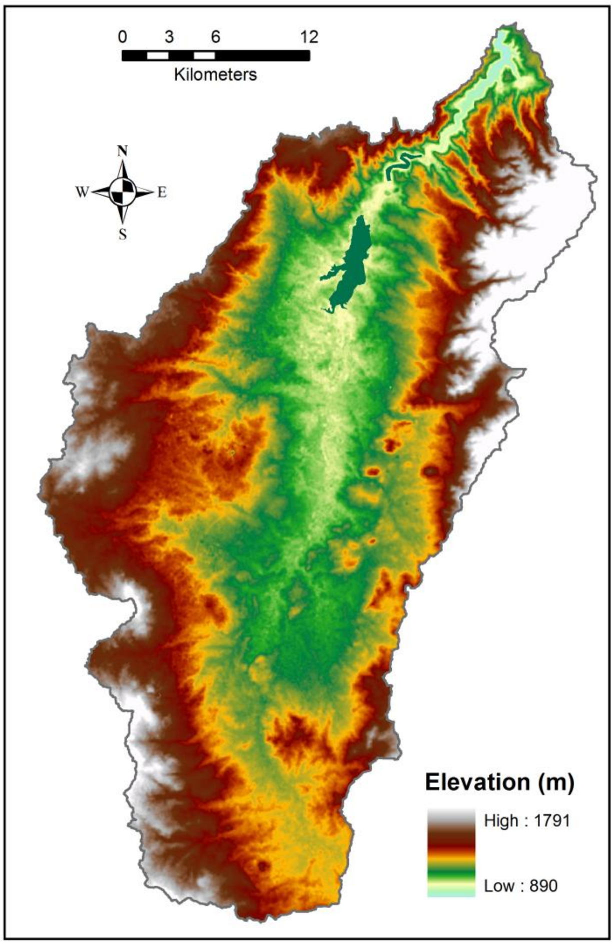



**Figure 3.10** Digital Elevation Model of Study Area

**Table 3.16** Classification of Soil Depths

| SYMBOL | EXPLANATION | VALUE |
|---|---|---|
| A | DEEP (+ 90 cm) | 1 |
| B | MODERATELY DEEP ( 90 - 50 cm) | 2 |
| C | SHALLOW (50 - 20 cm) | 3 |
| D | VERY SHALLOW (20 - 0 cm) | 4 |
| E | LITHOLOGIC | 5 |

**Table 3.17** Classification of Erosion Level

| EXPLANATION | VALUE |
|---|---|
| NONE OR VERY LITTLE WATER EROSION | 1 |
| MODERATE WATER EROSION | 2 |
| INTENSIVE WATER EROSION | 3 |
| VERY INTENSIVE WATER EROSION | 4 |

**Table 3.18** Classification of Great Soil Groups

| SYMBOL | EXPLANATION | VALUE |
|---|---|---|
| CE | CHESTNUT COLOR SOIL | 1 |
| K | COLLUVIAL SOIL | 2 |
| X | BASALTIC SOIL | 2 |
| A | ALLUVIAL SOIL | 1 |
| B | BROWN SOIL | 1 |
| N | LIME-FREE BROWN FOREST SOILS | 1 |
| D | REDDISH MAROON SOILS | 1 |
| Y | HIGH MOUNTAIN PASTURE LANDS | 1 |
| M | BROWN FOREST SOILS | 1 |
| U | LIME-FREE BROWN SOILS | 1 |
| G | GREY BROWN PODZOLIC SOILS | 1 |
| H | HYDROMORPHIC SOILS | 2 |
| O | ORGANIC SOILS | 1 |
| P | RED YELLOW PODZOLIC SOILS | 1 |
| C | SALINE-ALKALI AND SALINE ALKALI MELANGE SOILS | 2 |

**Table 3.19** Classification of Hydrologic Soil Group

| HSG | VALUE | | |
|---|---|---|---|
| | GSG | DEPTH | EROSION |
| **A** | 2 | - | 3 - 4 |
| **B** | 1 | 1 - 2 | 1 - 2 |
| **C** | 1 | 3 - 4 -5 | 1 - 2 |
| **D** | 1 | 3 | 3 |

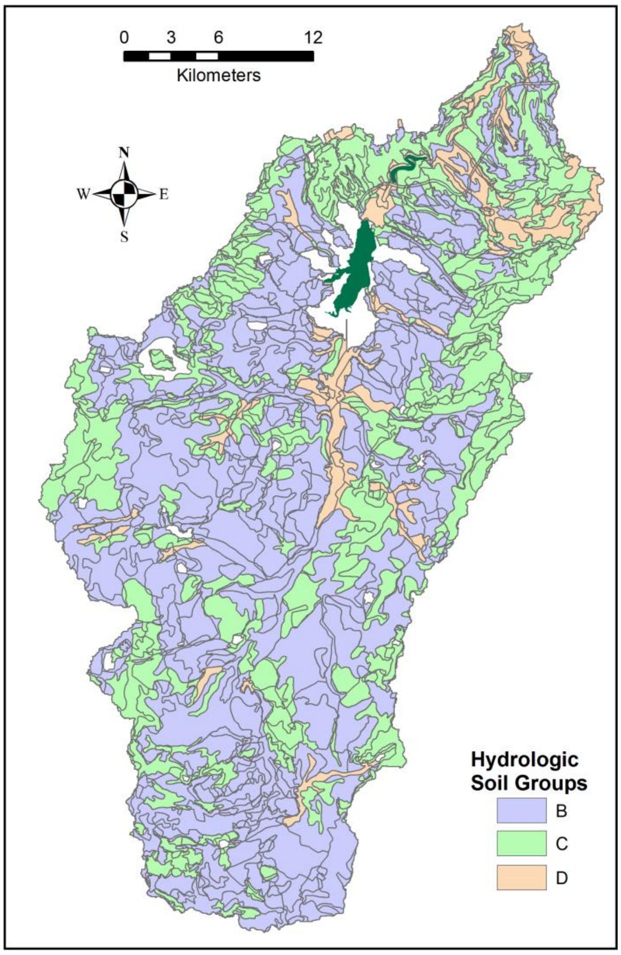



**Figure 3.11** Hydrologic Soil Group of Study Area

**Table 3.20** Runoff Curve Numbers (Hoggan, 1989)

| CURVE NUMBERS (CN) | | | | | |
|---|---|---|---|---|---|
| **LAND USE** | **MIN - MAX** | **HYDROLOGIC SOIL GRUP** | | | |
| | | **A** | **B** | **C** | **D** |
| BARE ROCKS | MAX | 98 | 98 | 98 | 98 |
| | MIN | 98 | 98 | 98 | 98 |
| NATURAL FLORA | MAX | 63 | 77 | 85 | 88 |
| | MIN | 49 | 68 | 79 | 84 |
| MEADOW | MAX | 30 | 58 | 71 | 78 |
| | MIN | 30 | 58 | 71 | 78 |
| URBAN DISTRICTS: COMMERCIAL | MAX | 89 | 92 | 94 | 95 |
| | MIN | 81 | 88 | 91 | 93 |
| BRUSH | MAX | 48 | 67 | 77 | 83 |
| | MIN | 30 | 48 | 65 | 73 |
| CONIFEROUS FOREST | MAX | 45 | 66 | 77 | 83 |
| | MIN | 30 | 55 | 70 | 77 |
| DEVELOPING URBAN AREAS | MAX | 77 | 86 | 91 | 94 |
| | MIN | 77 | 86 | 91 | 94 |
| STREETS AND ROADS | MAX | 76 | 85 | 89 | 91 |
| | MIN | 76 | 85 | 89 | 91 |
| MIXED FOREST | MAX | 45 | 66 | 77 | 83 |
| | MIN | 30 | 55 | 70 | 77 |
| AGRICULTURAL AREA | MAX | 65 | 76 | 84 | 88 |
| | MIN | 58 | 69 | 77 | 80 |
| PASTURE | MAX | 68 | 79 | 86 | 89 |
| | MIN | 39 | 61 | 74 | 80 |
| HERBACEOUS | MAX | - | 80 | 87 | 93 |
| | MIN | - | 62 | 70 | 85 |
| WATER BODIES | MAX | 100 | 100 | 100 | 100 |
| | MIN | 100 | 100 | 100 | 100 |
| FALLOW | MAX | 77 | 86 | 91 | 94 |
| | MIN | 74 | 83 | 88 | 90 |

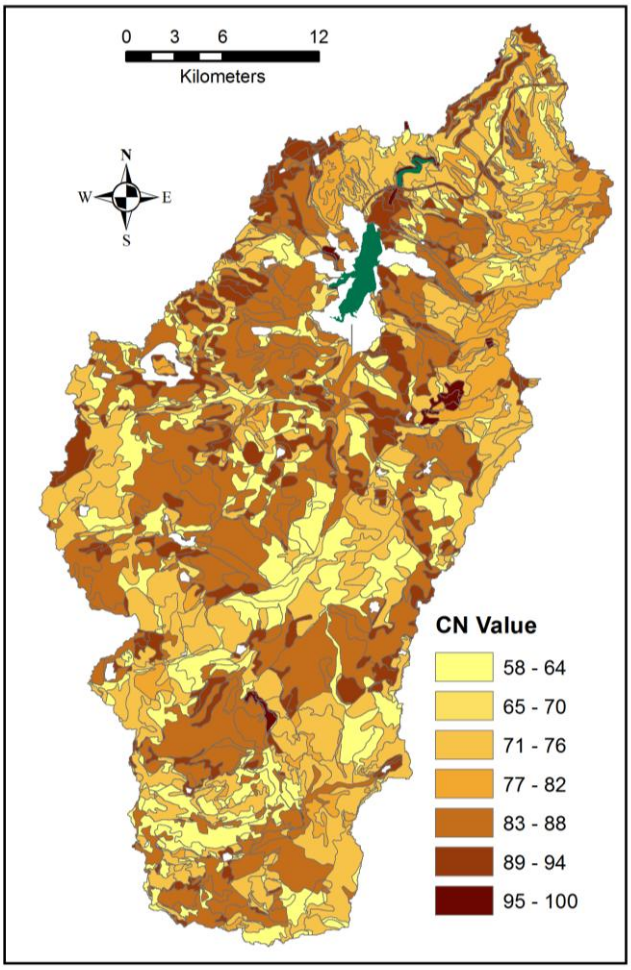



**Figure 3.12** Curve Number Representation of Study Area

### 3.3.2 Basin Processing

Series of steps are performed in ArcGIS with the toolbox of ArcHydro for stream delineation process by using the DEM of the basin. These steps are as follows as in order of process:

- Fill sinks
- Flow direction
- Flow accumulation
- Stream definition
- Stream segmentation
- Catchment grid delineation
- Catchment polygon processing
- Drainage line processing

Explanations about these steps are given below.

- **Fill sinks:** This function is used to fill sinks in a grid. There would be depression cells in DEM and those cells create water trap problem and water cannot flow because of the surrounded higher elevation cells

- **Flow direction:** This function is used for the computations of flow direction. Eight different directions are represented by different numbers. These are 1 (east), 2 (southeast), 4 (south), 8 (southwest), 16 (west), 32 (northwest), 64 (north), 128 (northeast)

- **Flow accumulation:** Accumulated number of cells in a cell is computed by this function

- **Stream definition:** Stream network is determined via this function. Stream threshold value should be given for this purpose. Smaller values results with denser stream network and more delineated catchment.

- **Stream segmentation:** This function enables us to form stream segments by dividing the stream which is developed by stream definition function.

- **Catchment grid delineation:** Sub-basins for each stream segment are delineated by this function.

- **Catchment polygon processing:** Catchment grid is converted into catchment polygon feature by this function. In other words, raster data are converted to vector form.

- **Drainage line processing:** This function is used to convert the stream link grid into a drainage line feature class.

In addition to these steps, average weighted slopes and longest flow paths for İncesu Detention Pond subbasin, Lake Eymir subbasin and neighboring subbasins for Lake Mogan are computed in GIS environment. Time of concentration ($T_c$) for each subbasin is also calculated by using below formula.

$$T_c = \frac{100\, L^{0.8} \left(\frac{1000}{CN} - 9\right)^{0.7}}{1900\, S^{0.5}} \qquad (3.1)$$

where L is the longest flow path of basin, ft, CN is curve number and S is the average watershed slope, %.

In modeling processes, semi-distributed way of modeling is used for Lake Mogan basin and watershed is divided into 8 sub watersheds. All watersheds have direct entrance to the lake. On the other hand, Lake Eymir subbasin and İncesu Detention Pond subbasin are modeled by a lumped way of modeling for the sake of simplicity and also by considering the relatively small catchment areas of these watersheds. Those subbasins can be seen in Figure 3.13.

Obtained results which are determined by explained analysis are given in Table 3.21.

**Table 3.21** Modeling Results for the Subbasins

| NAME of the SUBBASIN | AREA ($km^2$) | CN II | AVERAGE WEIGHTED SLOPE (%) | LONGEST FLOW PATH (m) | TIME OF CONCENTRATION (min) |
|---|---|---|---|---|---|
| SUKESEN CREEK | 32.54 | 78 | 17.20 | 17538 | 208 |
| UPSTREAM OF LAKE MOGAN | 791.43 | 76 | 8.36 | 54448 | 797 |
| KEPİR CREEK | 8.39 | 79 | 7.59 | 6636 | 140 |
| İĞDELİ CREEK | 17.91 | 80 | 11.81 | 12694 | 183 |
| BAĞIRSAK CREEK | 9.73 | 83 | 10.93 | 9613 | 140 |
| GÖLCÜK CREEK | 22.75 | 87 | 8.79 | 13115 | 175 |
| TATLIM CREEK | 14.14 | 75 | 8.71 | 9799 | 201 |
| BURCUPINAR CREEK | 12.59 | 82 | 9.06 | 10730 | 174 |
| INTERMEDIATE ZONES | 19.61 | 80 | 10.00 | 2482 | 53 |
| LAKE EYMİR | 42.49 | 78 | 13.31 | 15179 | 210 |
| İNCESU DETENTION POND | 98.12 | 76 | 20.51 | 26371 | 284 |

## 3.4 Hyetograph Estimation

12 hour duration design hyetographs of 50, 100 and 500 years return periods are determined by using Alternating Block Method from intensity-duration-frequency curves of DMİ's Ankara Station. Point values are converted to areal values by using U. S. Weather Bureau's curves. Determination of proportion of rain to cumulative rain is calculated by using Özdemir's studies; "A-curve" which represents the Ankara city is selected (Özdemir, 1978). And excess water hyetograph is obtained by using SCS method. A more detailed explanation is given below step by step.

**a)** Rain intensity for each return period is determined from intensity-duration-frequency curves of Turkish State Meteorological Service (MGM) (Figure 3.14) except 500 year one. It is calculated by DSİ method (Özdemir, 1978). Formula for that calculation is given as follows:

$$d_T = d_{10} + z_T(d_{100} - d_{10}) \quad (3.2)$$

$z_T$ is given as 1.687 for 500 year.

**b)** Since obtained intensities are valid for point estimations, they are converted to areal values by making use of U.S. Weather Bureau studies (Figure 3.15). For 12 hour duration $P/P_0$ ratio is found as 0.865.

**c)** In order to take into account of the duration of storm, total duration divided into 10 minute intervals. "A curve" is used in that process (Figure 3.16).

**d)** To obtain total design hyetograph alternating bock method is applied.

**e)** Finally, SCS method is used in finding excess water hyetograph

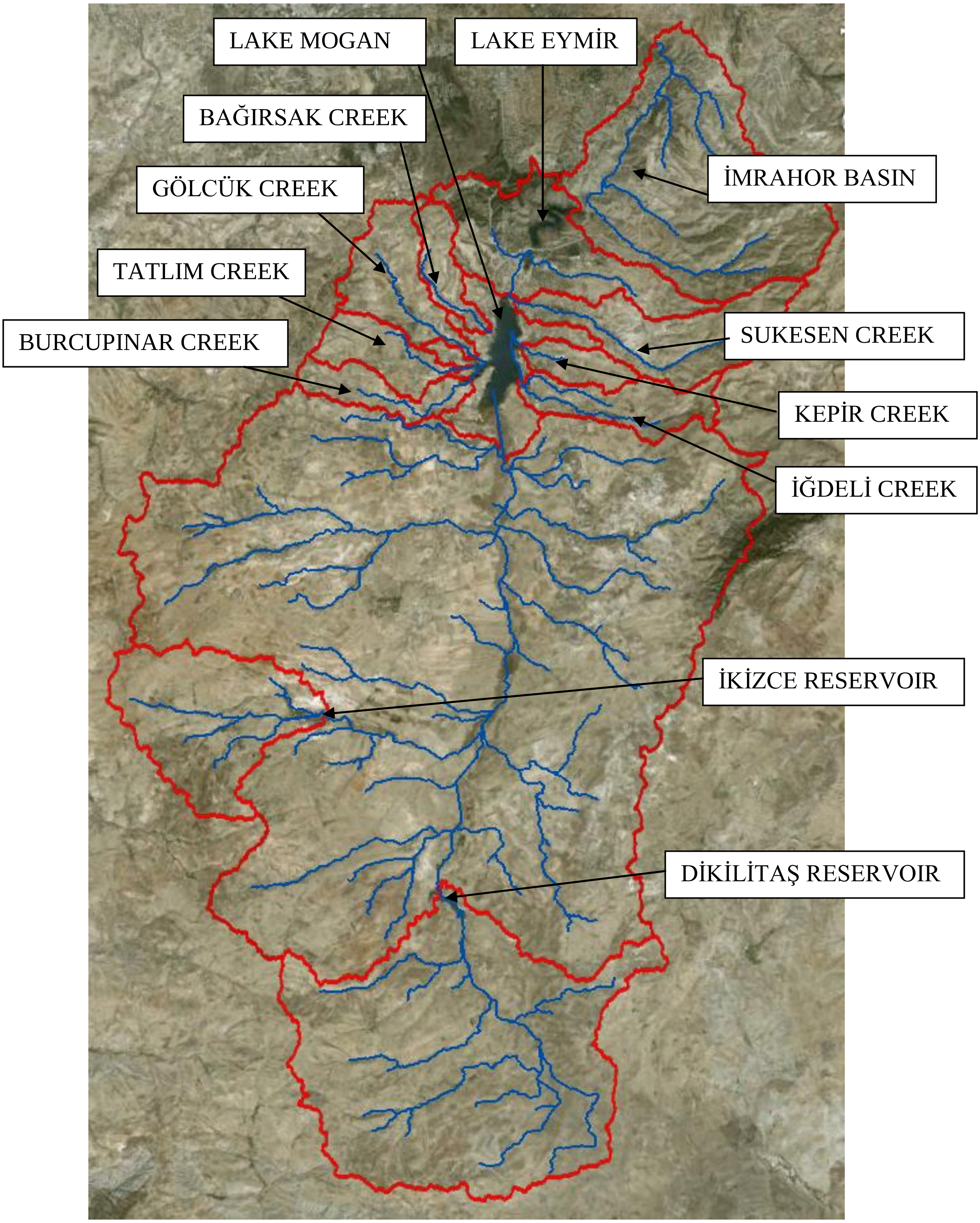



**Figure 3.13** Subbasins of Study Area

**Figure 3.14** IDF Curves of Ankara Meteorological Station

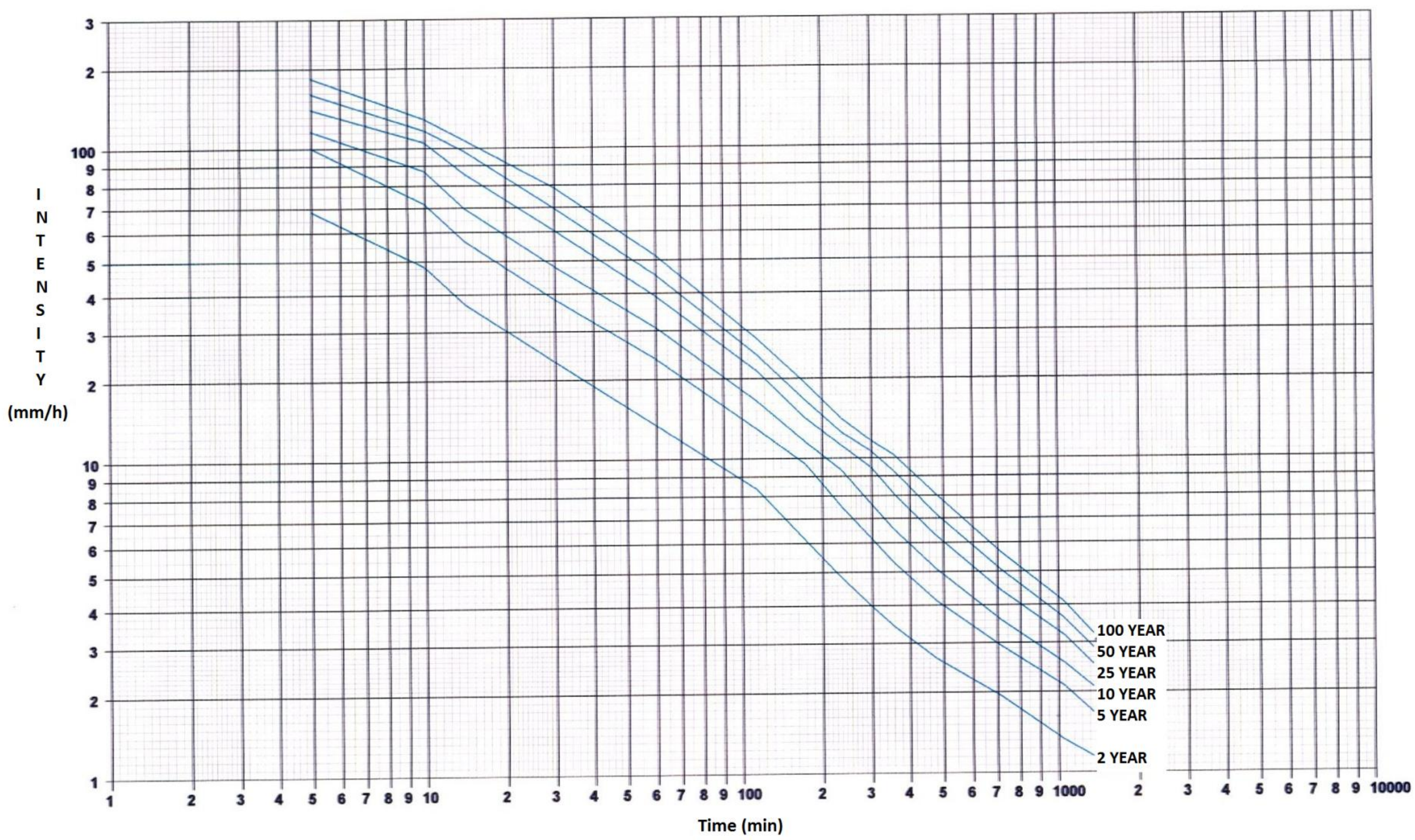
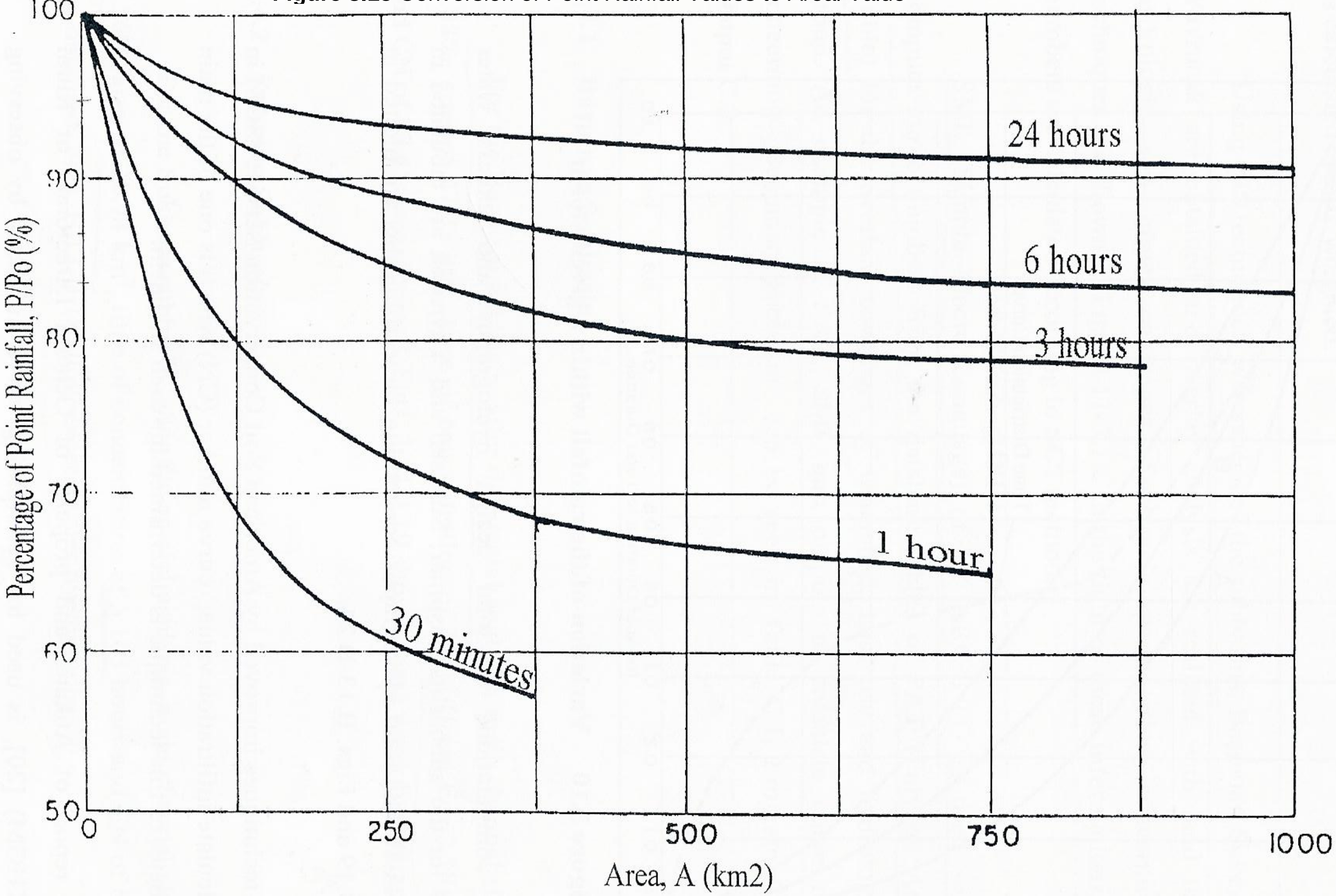


**Figure 3.15** Conversion of Point Rainfall Values to Areal Value



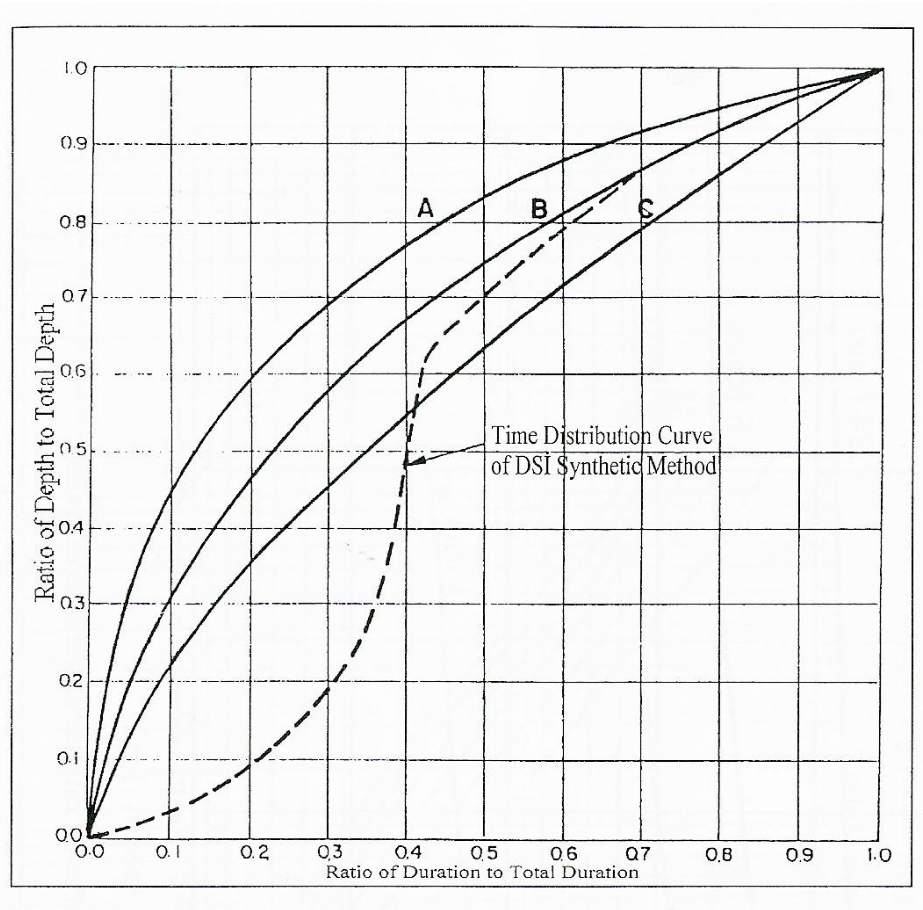



**Figure 3.16** Variation of the Rainfall within a Given Storm (Özdemir, 1978)

Computed rainfall intensities and depths are given in Table 3.22.

**Table 3.22** Rainfall Intensities and Depths

| Return Period $T_r$ (years) | Point Values | | Areal Values |
|---|---|---|---|
| | Intensity (mm/hr) | Depth (cm) | Depth (cm) |
| 50 | 5.00 | 6.00 | 5.19 |
| 100 | 5.60 | 6.72 | 5.81 |
| 500 | 6.98 | 8.38 | 7.25 |

Computations of total design hyetographs and excess water hyetographs are done for all of the subbasins of Mogan and Eymir and İncesu basins. Computations are given in Table A1 – A33 and results are plotted in Figure B1 – B33.

### 3.5 Hydrograph Calculation

Flood hydrographs of all sub-basins are calculated by using SCS method. Total flood hydrographs entering to the Mogan and Eymir lakes and İncesu pond are determined. CN II is used in calculations assuming that CN III would not be appropriate for using in a semi-arid region of Ankara.

Since hyetograph is constructed with 10 minute intervals, SCS unit hydrograph is obtained for 10 minute storm. After obtaining all hydrographs of Lake Mogan subbasins, these hydrographs are superposed to obtain design hydrograph of Lake Mogan basin. Since all subbasins have direct entrance to the lake, channel routing procedure is not applied. Precipitation on lake surface is also added to obtain final design hydrograph. Similar procedure is also applied for Lake Eymir and İncesu Detention Pond basins. Summary of results can be seen in Table 3.23 – Table 3.31 and Figure 3.17 – Figure 3.25.

Flood hydrographs of Lake Mogan basin have two peaks as seen in Figure 3.17 - Figure 3.19. First peak is because of the sub-basins on the left and right sides of the lake. Since upstream basin of the lake is much bigger than the side sub-basins, occurrence of higher peak value takes more time.

Precipitation on lake surface is also added to obtain final design hydrograph for Mogan and Eymir lakes basins. Because of this addition, there are irregular patterns in the first twelve hour parts of the hydrographs.

#### 3.5.1 Lake Mogan Subbasin

Obtained hydrographs for Lake Mogan subbasins are given in Table 3.23 – 3.25 and Figure 3.17-3.19.

**Table 3.23** Results of Hydrograph Analysis of Lake Mogan Subbasins (Tr = 50 year)

| NAME of the SUBBASIN | AREA ($km^2$) | $T_r$ = 50 year | | |
|---|---|---|---|---|
| | | PEAK DISCHARGE ($m^3/s$) | TIME TO PEAK (min) | BASE TIME (min) |
| SUKESEN CREEK | 32.54 | 23.83 | 540 | 1057 |
| KEPİR CREEK | 8.39 | 8.36 | 479 | 948 |
| İĞDELİ CREEK | 17.91 | 16.61 | 506 | 1017 |
| BAĞIRSAK CREEK | 9.73 | 12.85 | 469 | 948 |
| GÖLCÜK CREEK | 22.75 | 35.12 | 490 | 1004 |
| TATLIM CREEK | 14.14 | 8.18 | 546 | 1045 |
| BURCUPINAR CREEK | 12.59 | 13.5 | 499 | 1002 |
| INTERMEDIATE ZONES | 19.61 | 37.66 | 398 | 808 |
| UPSTREAM OF LAKE MOGAN | 791.43 | 188.30 | 934 | 2000 |
| DESIGN HYDROGRAPH | 929.09 | 192.77 | 884 | 2000 |
| TOTAL FLOOD VOLUME | 10.99 $hm^3$ | | | |

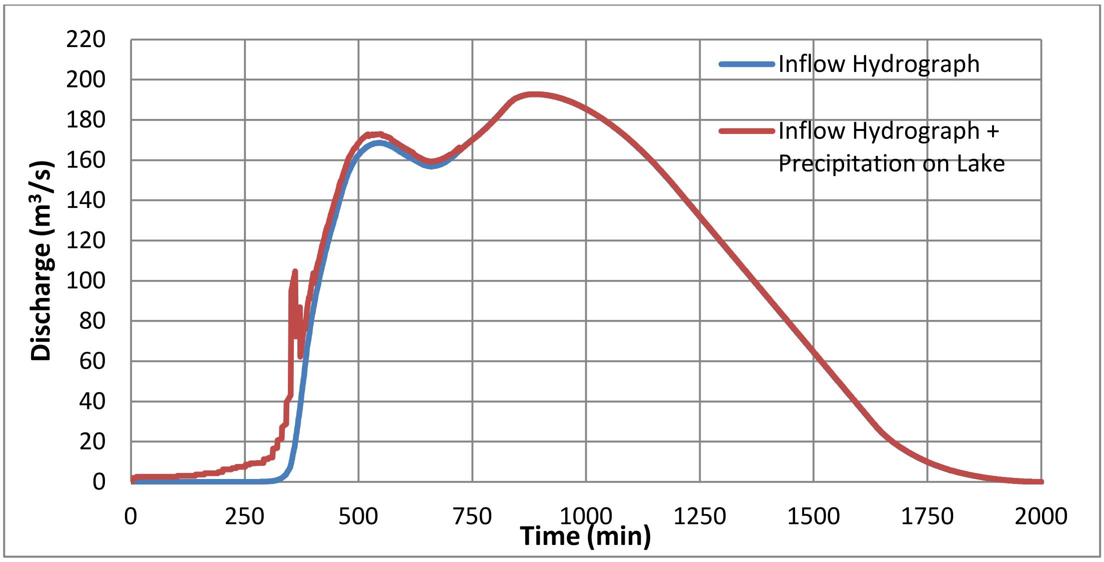



**Figure 3.17** Hydrograph of Lake Mogan Subbasin (Tr = 50 year)

**Table 3.24** Results of Hydrograph Analysis of Lake Mogan Subbasins (Tr = 100 year)

| NAME of the SUBBASIN | AREA ($km^2$) | $T_r$ = 100 year | | |
|---|---|---|---|---|
| | | PEAK DISCHARGE ($m^3/s$) | TIME TO PEAK (min) | BASE TIME (min) |
| SUKESEN CREEK | 32.54 | 31.05 | 531 | 1057 |
| KEPİR CREEK | 8.39 | 10.86 | 470 | 948 |
| İĞDELİ CREEK | 17.91 | 21.35 | 505 | 1017 |
| BAĞIRSAK CREEK | 9.73 | 13.40 | 469 | 948 |
| GÖLCÜK CREEK | 22.75 | 42.89 | 490 | 1004 |
| TATLIM CREEK | 14.14 | 10.95 | 536 | 1045 |
| BURCUPINAR CREEK | 12.59 | 17.13 | 499 | 1002 |
| INTERMEDIATE ZONES | 19.61 | 48.80 | 397 | 808 |
| UPSTREAM OF LAKE MOGAN | 791.43 | 247.64 | 933 | 2000 |
| DESIGN HYDROGRAPH | 929.09 | 253.80 | 883 | 2000 |
| TOTAL FLOOD VOLUME | 14.20 $hm^3$ | | | |

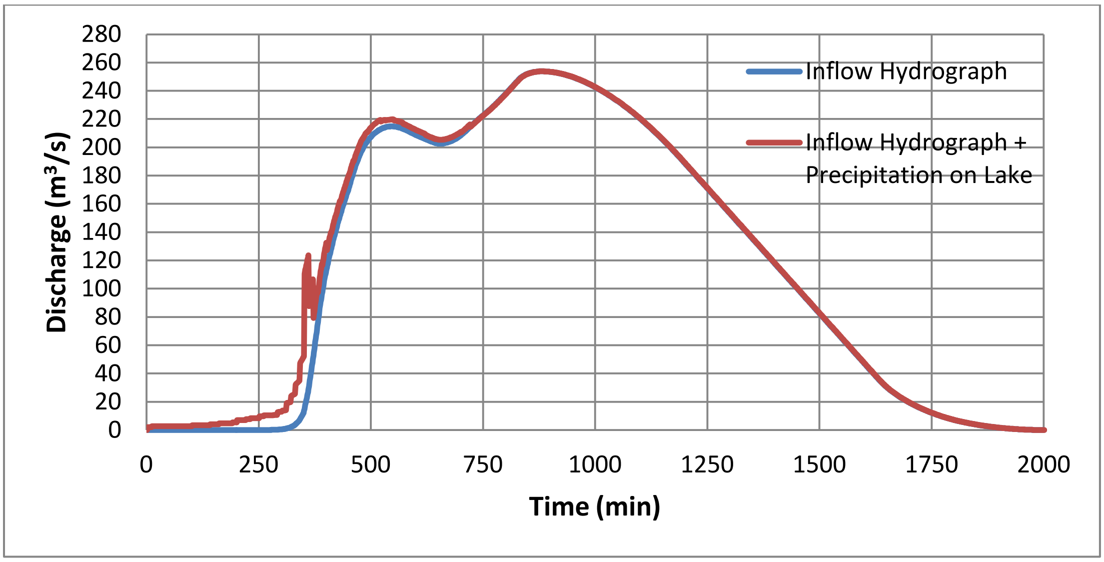



**Figure 3.18** Hydrograph of Lake Mogan Subbasin (Tr = 100 year)

**Table 3.25** Results of Hydrograph Analysis of Lake Mogan Subbasins (Tr = 500 year)

| NAME of the SUBBASIN | AREA ($km^2$) | $T_r$ = 500 year | | |
|---|---|---|---|---|
| | | PEAK DISCHARGE ($m^3/s$) | TIME TO PEAK (min) | BASE TIME (min) |
| SUKESEN CREEK | 32.54 | 49.78 | 520 | 1057 |
| KEPİR CREEK | 8.39 | 17.33 | 469 | 948 |
| İĞDELİ CREEK | 17.91 | 33.35 | 496 | 1017 |
| BAĞIRSAK CREEK | 9.73 | 24.58 | 459 | 948 |
| GÖLCÜK CREEK | 22.75 | 61.79 | 481 | 1004 |
| TATLIM CREEK | 14.14 | 18.35 | 526 | 1045 |
| BURCUPINAR CREEK | 12.59 | 26.28 | 490 | 1002 |
| INTERMEDIATE ZONES | 19.61 | 76.62 | 397 | 808 |
| UPSTREAM OF LAKE MOGAN | 791.43 | 402.12 | 914 | 2000 |
| DESIGN HYDROGRAPH | 929.09 | 412.92 | 873 | 2000 |
| TOTAL FLOOD VOLUME | 22.60 $hm^3$ | | | |

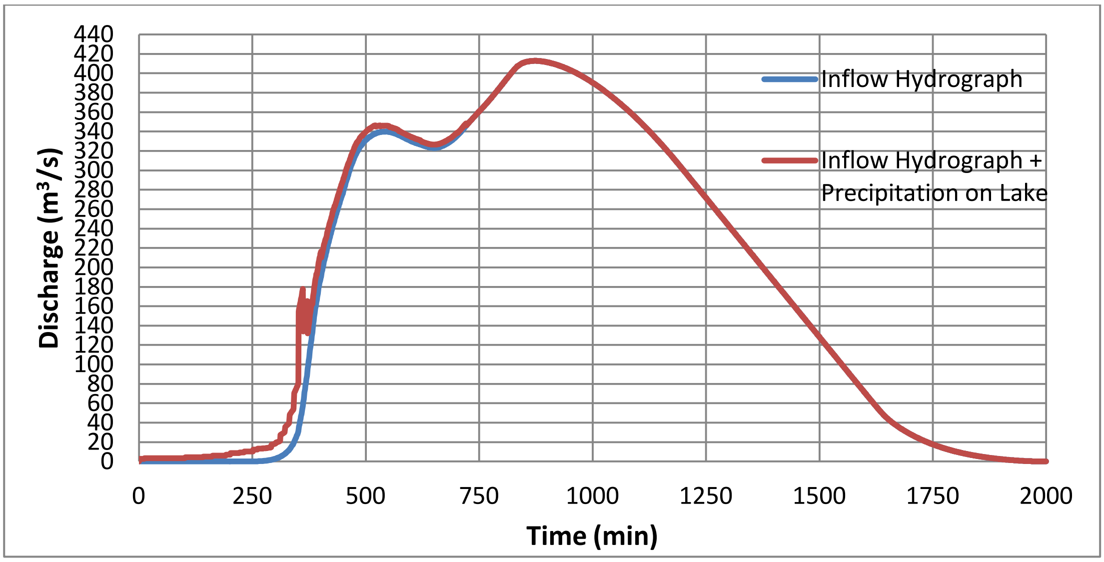



**Figure 3.19** Hydrograph of Lake Mogan Subbasin (Tr = 500 year)

### 3.5.2 Lake Eymir Subbasin

Obtained hydrographs for Lake Eymir subbasin is given in Table 3.26 – 3.28 and Figure 3.20-3.22.

**Table 3.26** Results of Hydrograph Analysis of Lake Eymir Subbasin (Tr = 50 year)

| NAME of the SUBBASIN | AREA ($km^2$) | $T_r$ = 50 year | | |
|---|---|---|---|---|
| | | PEAK DISCHARGE ($m^3/s$) | TIME TO PEAK (min) | BASE TIME (min) |
| LAKE EYMİR | 42.49 | 32.07 | 530 | 1057 |
| TOTAL FLOOD VOLUME | 0.63 $hm^3$ | | | |

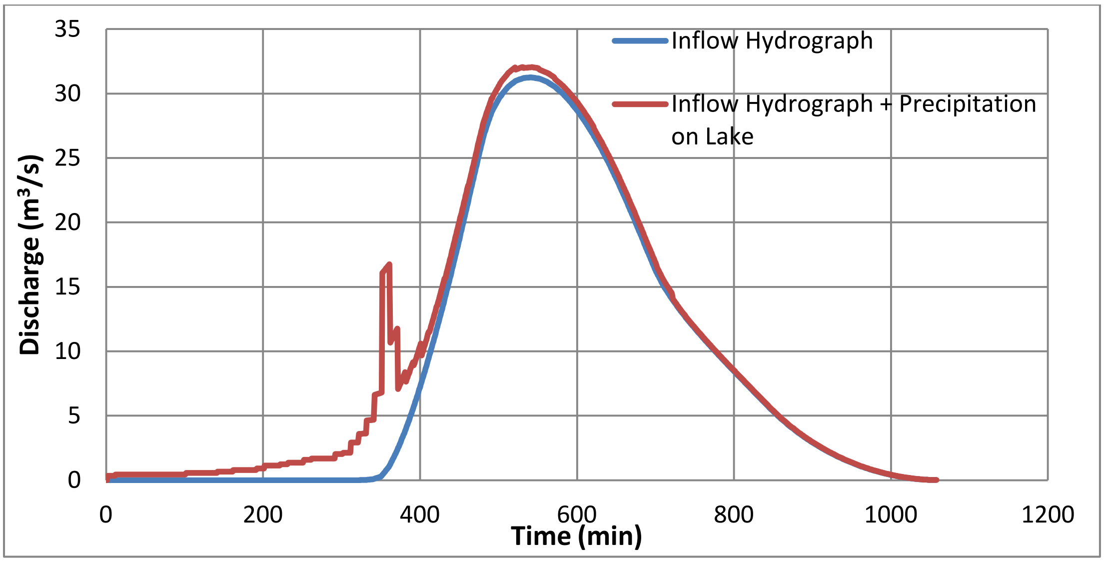



**Figure 3.20** Hydrograph of Lake Eymir Subbasin (Tr = 50 year)

**Table 3.27** Results of Hydrograph Analysis of Lake Eymir Subbasin (Tr = 100 year)

| NAME of the SUBBASIN | AREA ($km^2$) | $T_r$ = 100 year | | |
|---|---|---|---|---|
| | | PEAK DISCHARGE ($m^3/s$) | TIME TO PEAK (min) | BASE TIME (min) |
| LAKE EYMİR | 42.49 | 41.73 | 520 | 1057 |
| TOTAL FLOOD VOLUME | 0.79 $hm^3$ | | | |

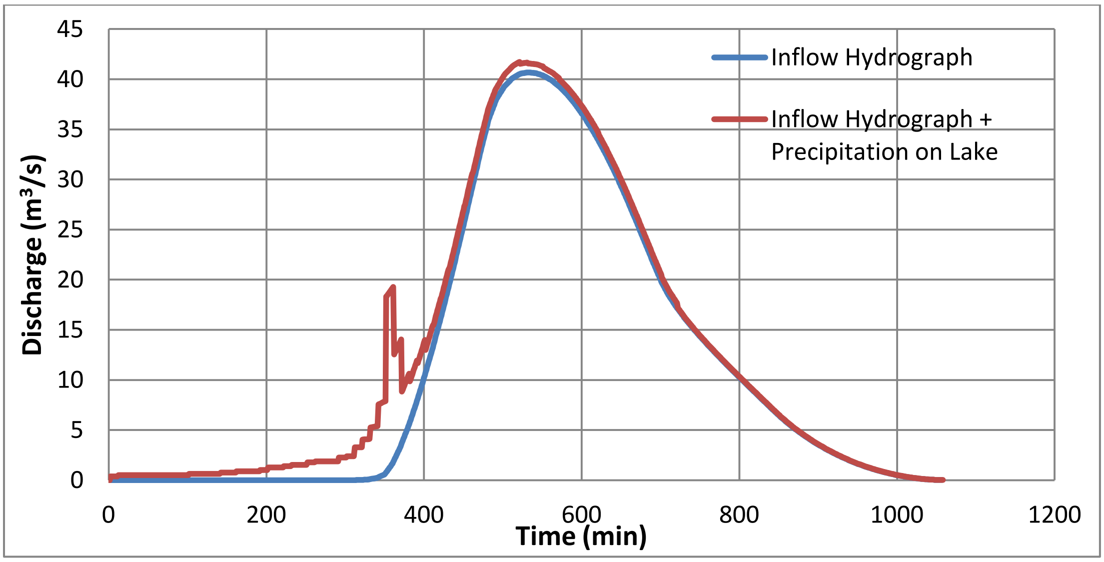



**Figure 3.21** Hydrograph of Lake Eymir Subbasin (Tr = 100 year)

**Table 3.28** Results of Hydrograph Analysis of Lake Eymir Subbasin (Tr = 500 year)

| NAME of the SUBBASIN | AREA ($km^2$) | $T_r$ = 500 year | | |
|---|---|---|---|---|
| | | PEAK DISCHARGE ($m^3/s$) | TIME TO PEAK (min) | BASE TIME (min) |
| LAKE EYMİR | 42.49 | 66.65 | 521 | 1057 |
| TOTAL FLOOD VOLUME | 1.22 $hm^3$ | | | |

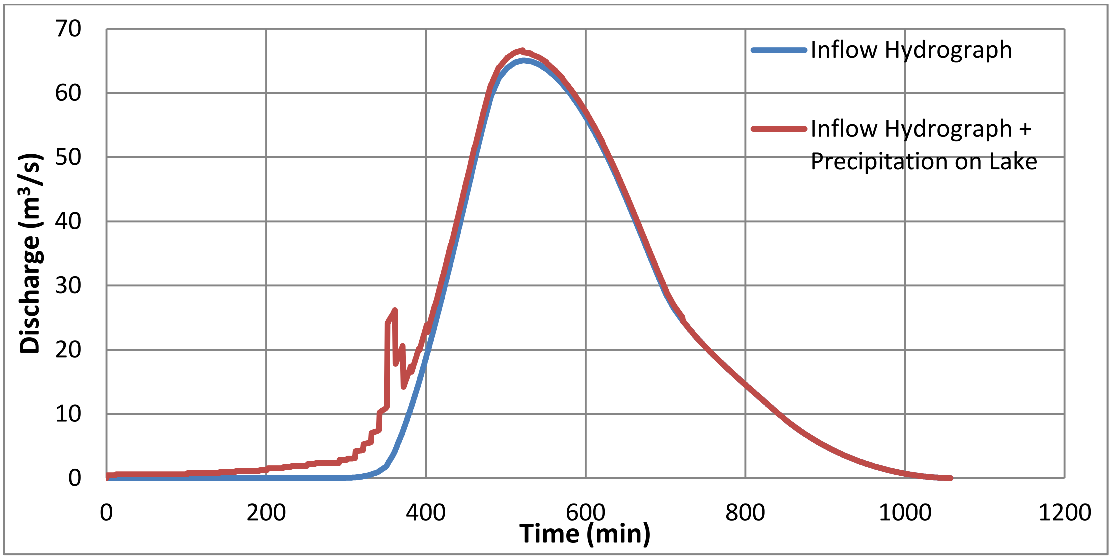



**Figure 3.22** Hydrograph of Lake Eymir Subbasin (Tr = 500 year)

### 3.5.3 İncesu Detention Pond Subbasin

**Table 3.29** Results of Hydrograph Analysis of İncesu Detention Pond Subbasin (Tr = 50 year)

| NAME of the SUBBASIN | AREA ($km^2$) | $T_r$ = 50 year | | |
|---|---|---|---|---|
| | | PEAK DISCHARGE ($m^3/s$) | TIME TO PEAK (min) | BASE TIME (min) |
| İNCESU DETENTION POND | 98.12 | 48.95 | 606 | 1178 |
| TOTAL FLOOD VOLUME | 1.06 $hm^3$ | | | |

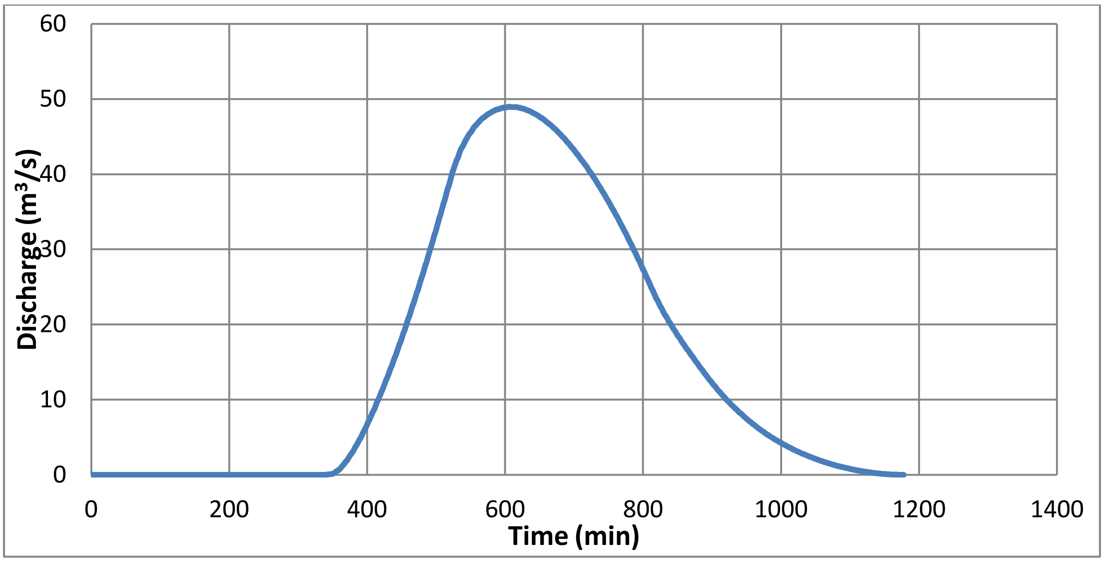



**Figure 3.23** Hydrograph of İncesu Detention Pond Subbasin (Tr = 50 year)

**Table 3.30** Results of Hydrograph Analysis of İncesu Detention Pond Subbasin (Tr = 100 year)

| NAME of the SUBBASIN | AREA ($km^2$) | $T_r$ = 100 year | | |
|---|---|---|---|---|
| | | PEAK DISCHARGE ($m^3/s$) | TIME TO PEAK (min) | BASE TIME (min) |
| İNCESU DETENTION POND | 98.12 | 64.8 | 596 | 1178 |
| TOTAL FLOOD VOLUME | 1.39 $hm^3$ | | | |

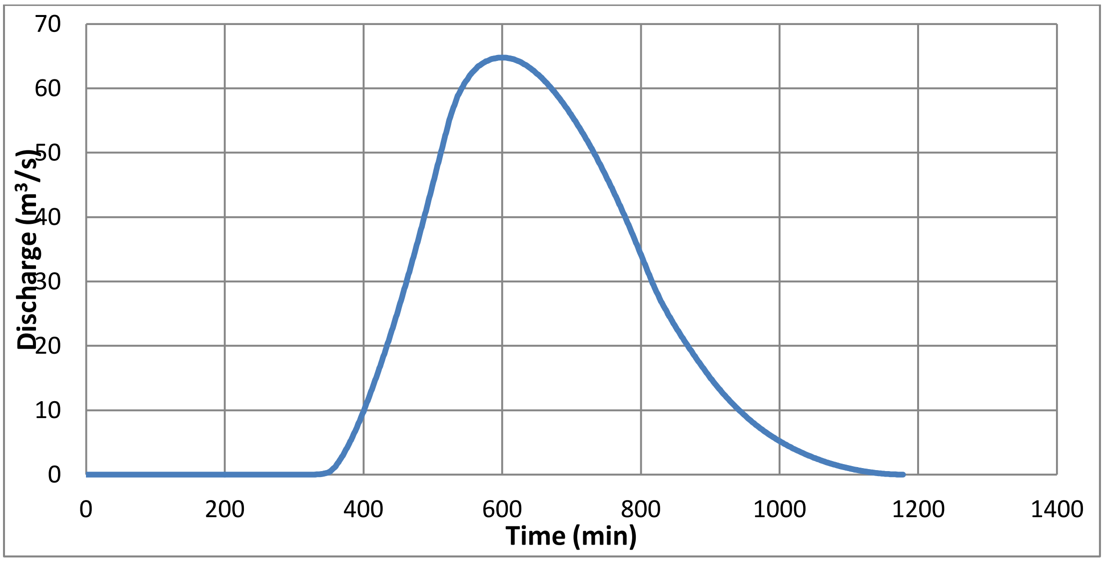



**Figure 3.24** Hydrograph of İncesu Detention Pond Subbasin (Tr = 100 year)

**Table 3.31** Results of Hydrograph Analysis of İncesu Detention Pond Basin (Tr = 500 year)

| NAME of the SUBBASIN | AREA ($km^2$) | $T_r$ = 500 year | | |
|---|---|---|---|---|
| | | PEAK DISCHARGE ($m^3/s$) | TIME TO PEAK (min) | BASE TIME (min) |
| İNCESU DETENTION POND | 98.12 | 106.52 | 586 | 1178 |
| TOTAL FLOOD VOLUME | 2.24 $hm^3$ | | | |

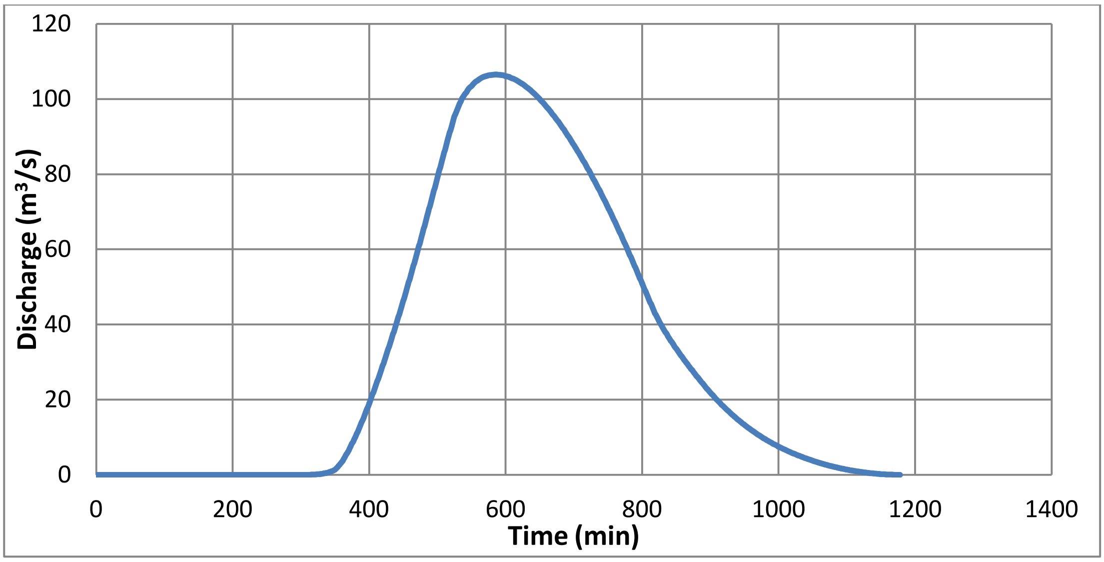



**Figure 3.25** Hydrograph of İncesu Detention Pond Subbasin (Tr = 500 year)

## 3.6 Reservoir Routing and Operation Studies

Elevation – storage relationships of Mogan and Eymir lakes which are used in this thesis study are taken from *Gölbaşı Mogan-Eymir Gölleri için Su Kaynakları ve Çevre Yönetimi Projesi Kesin Rapor (1995).* In this report, it is stated that considerable sedimentation had occurred at the bottom of the lake in the last 25 years. Annual average sedimentation accumulation was calculated as 18,264 $m^3$ in Lake Eymir and 236,667 $m^3$ in Lake Mogan. After that time there have not been done any sedimentation measurement. In order to obtain more precise results, bathymetric maps of both lakes should be reproduced. In operation analysis, it is assumed that gates of water control structures of Mogan and Eymir lakes will be opened whenever the specified storm begins to fall. Schematic representation of water control structures in study area can be seen in Figure 3.26.

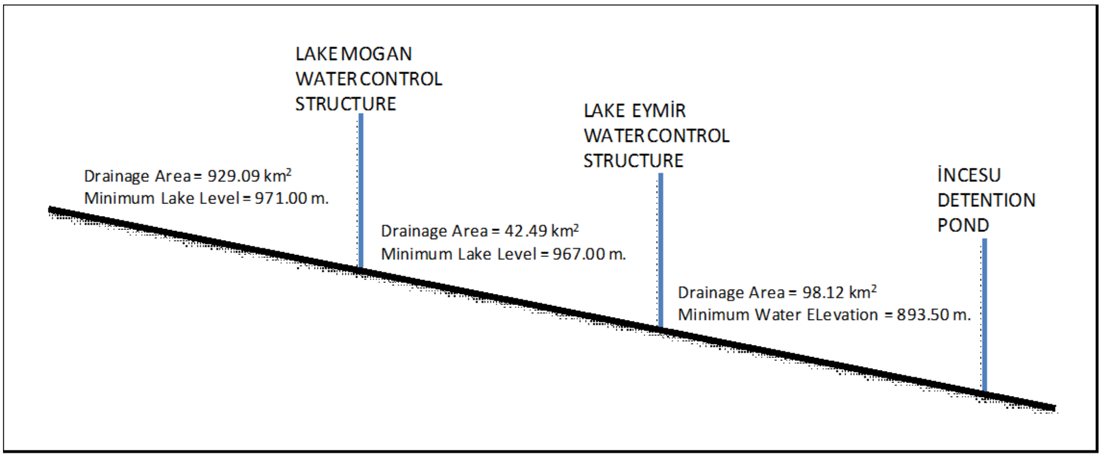



**Figure 3.26** Schematic Representation of Water Control Structures in Study Area

### 3.6.1 Lake Mogan Reservoir Routing and Operation Studies

As seen from hydrograph results main and most important facility in study area is Mogan Lake water control structure. Most of the drainage area remains in upstream part of Mogan Lake. So Mogan Lake water control structure has a key role to prevent the flood damages in this basin.

Water control structure is composed of two vertical sluice gates of each has 3.25 m. width and sill elevation is 971.00 m. Elevation – storage relationship of lake and profile of water control structure at exit of lake are given in Table 3.32 and Figure 3.27 respectively. Discharge values through the gates are estimated by using equations 3.3 and 3.4.

$$Q = \mathrm{C_d w}\sqrt{\mathrm{2gE}} \quad (3.3)$$

$$C_d = \sqrt{\frac{C_c}{1 + C_c\left(\frac{w}{E}\right)}} \quad (3.4)$$

where

E: upstream water depth

w: gate opening

$C_d$: discharge coefficient

$C_c$: contraction coefficient, taken as 0.60

**Table 3.32** Elevation – Storage Relationship of Lake Mogan (Altınbilek, 1995)

| | Elevation (m) | Volume ($hm^3$) |
|---|---|---|
| 1 | 971.00 | 6.2 |
| 2 | 972.00 | 11.63 |
| 3 | 972.50 | 14.82 |
| 4 | 973.00 | 18.32 |
| 5 | 973.25 | 20.19 |
| 6 | 973.50 | 22.16 |
| 7 | 973.75 | 24.24 |
| 8 | 974.00 | 26.43 |
| 9 | 974.25 | 28.70 |
| 10 | 974.50 | 31.06 |

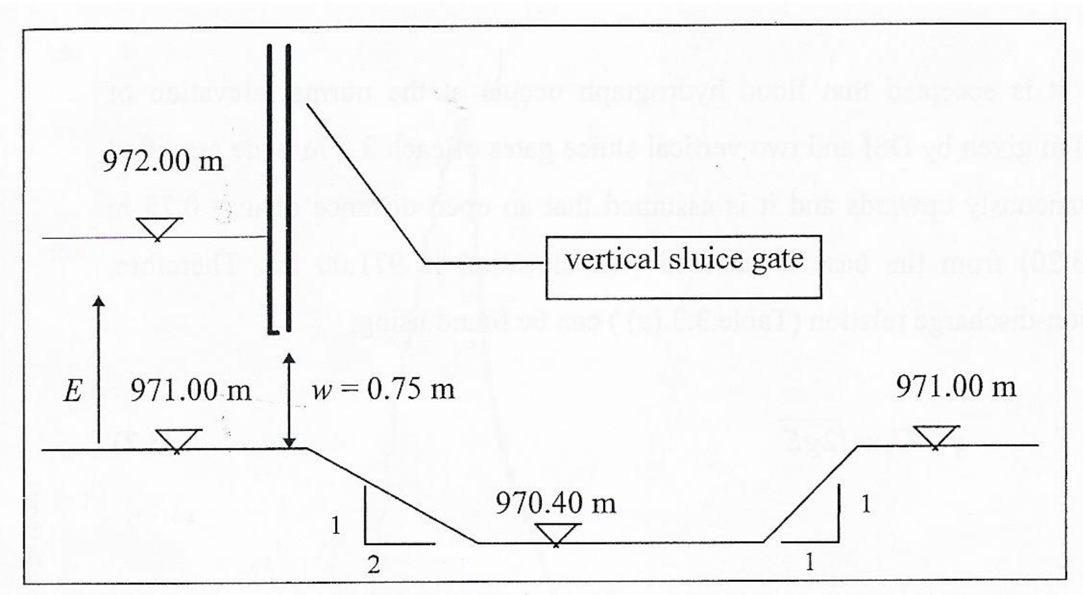



**Figure 3.27** Profile of water control structure (Aktaş, 1996)

Ankara Metropolitan Municipality has the responsibility of the operation of water control structure. However, since municipality does not have enough equipment and staff, State Hydraulic Works (DSİ) plays an organizer role in operation studies. Furthermore, General Directorate of Protection of Natural Assets (GDPNA) keep the environmental protection zone under observation and level of Lake Mogan is measured every first day of months by them.

In order to sustain a healthy ecological life at Lake Mogan, GDPNA does not want to keep lake level below 973.00 m in start of summer and 972.50 in winter times. Since accumulated mud creates problems for fish life, they cannot find enough oxygen when the lake level is below the specified elevations in those times. In addition, keeping water elevation in high levels is also important for recreation purposes. There are various cafes and teagardens around the Lake Mogan and fishery can also be done in lake although it is not very preferable activity anymore.

Lake level measurements which are made by GDPNA and State Hydraulic Works can be seen in Figure 3.28, Figure 3.29 and Table C 1 – C 10. As seen from Figure 3.30 lake level is above the 972.50 m. in nearly 75% of the time between 1997 and 2011 years although normal operation level is defined as 972.00 m in past reports of DSİ.

On the other hand, main factor that affect the operation processes in real situation is the capacity of the lined canal between the Mogan and Eymir lakes. According to past reports, canal was designed to convey 30 $m^3/s$ discharges. However, it is claimed by DSI and municipality officers that capacity of canal is reduced to 7-10 $m^3/s$ because of the culvert that passes Ankara-Konya road. Furthermore, storm sewer systems of Gölbaşı Municipality Social Facilites (Gölbaşı Stadium and Youth Center) are connected to that canal. Since their and surrounding other buildings sill elevation are under the canal banquette elevation, those facilities are flooded when the canal is in fully-flow stage. General view of canal can be seen in Figure 3.31.

These conditions led not to use conveyance canal effectively and to happen flooding damages in recent years. In 2011 and 2012 social facilities around the Lake Mogan were flooded for almost two weeks. Lake level reached the 973.97 m level. Pictures which were taken on those times are given in Figure 3.32 – 3.35. As can be seen from pictures facilities on both part of the lake affected intensively.

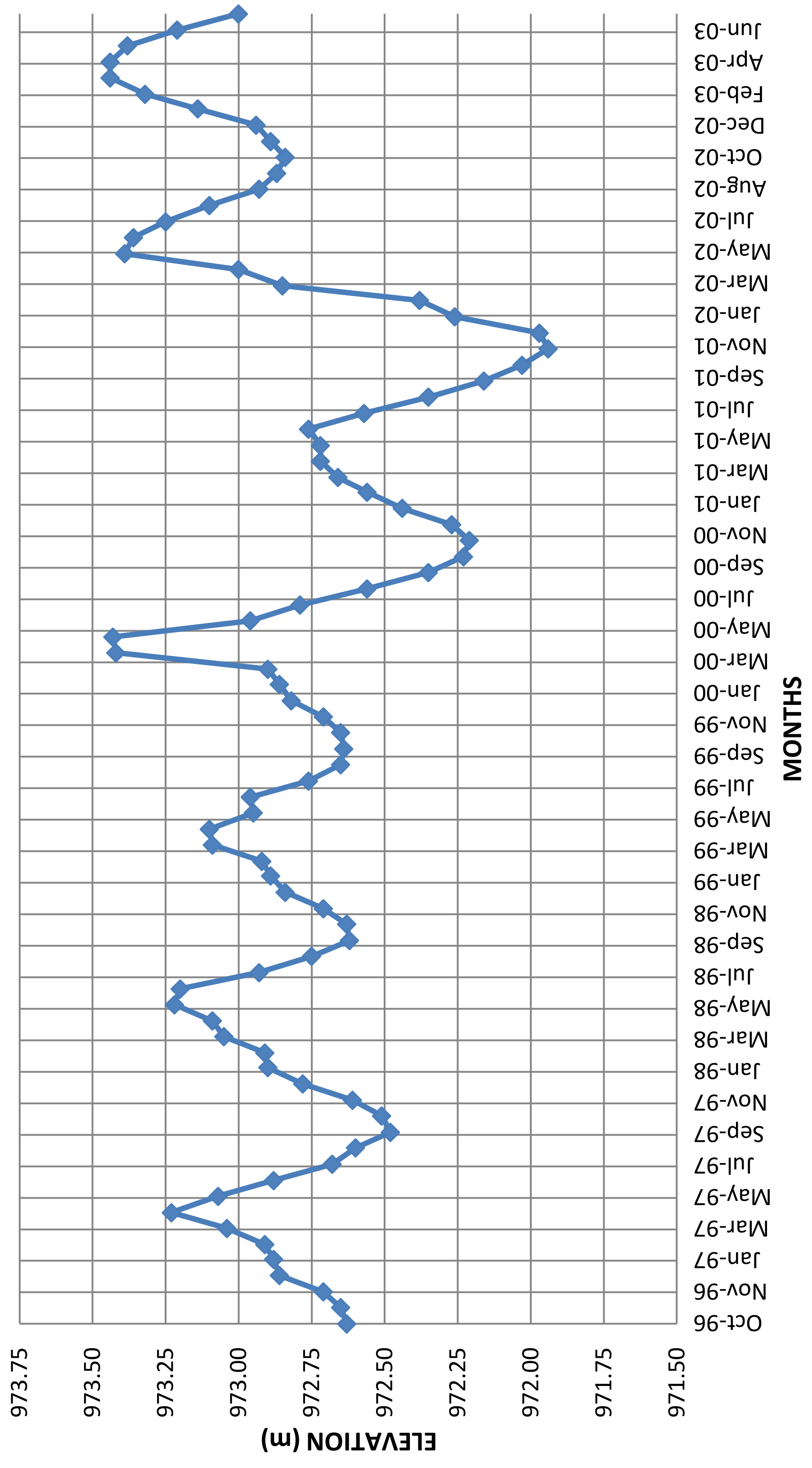
In this thesis study, different scenarios are generated to observe the performance of the overall system in different circumstances. Scenarios are created on the basis of four basic parameters. These parameters are return period of storm, lake level when the storm starts, canal capacity and weight factor for upstream and downstream part of the control structure. As mentioned before, three different return periods is considered in calculations. These are 50, 100 and 500 year return periods. Three different lake level values are taken into accounts which are 972.00, 972.50 and 973.00 m. Capacity of canal between Mogan and Eymir lakes are taken as 7, 15 and 30 $m^3/s$.

Weight factor is the weakest parameter that is used in scenarios. When flooding damages are considered, basically two types of damages may occur around Lake Mogan. First type is the damage that occurs on the upstream part of water control structure. In this situation, social facilities around the lake are subject to flooding damage. On the other hand, second type is the damage that occurs on the downstream part of the lake. This type of damage is due to lack of capacity of the conveyance canal. Importance of these two kind of damages is obviously different. Since upstream part of control structure is a parking area, more importance can be given to downstream part. Gölbaşı Sport Center, youth center of municipality, two stadiums and one technical high school are located on the downstream part, in flooding area. Weight is given according to flooding volume of water. Damages on upstream and downstream parts are assumed to be equalized by giving weight to the excess water volume on the two sides. Excess water of downstream part is multiplied by a weight factor in order to give more importance. 5, 10 and 20 are the three different weight factors that is used in analyses. Totally 81 (34) different scenarios are established for Lake Mogan Basin.

The social facilities around Lake Mogan are mostly above 973.75 m. elevation. This elevation is defined as the damage level. Failure level is taken as 974.25 m. which is the upper elevation of Lake Mogan levee.

In order to equalize damage levels of upstream and downstream part of Lake Mogan a simple theoretical algorithm is developed. Flowchart of this algorithm is given in Figure 3.36. In the algorithm, gate opening is changed according to current situation and excess volume that occurs in upstream part of the lake in a specific time interval is overflowed from canal according to weight factor. If the time interval is selected as infinitesimal, weighted damage on both sides will be equal. However, since it is not the case in manual operations, resultant weight factor will be different than the predefined one. This phenomenon is tried to be showed in Figure 3.37.

**Figure 3.28** Water Elevations of Lake Mogan (1997 – 2003)



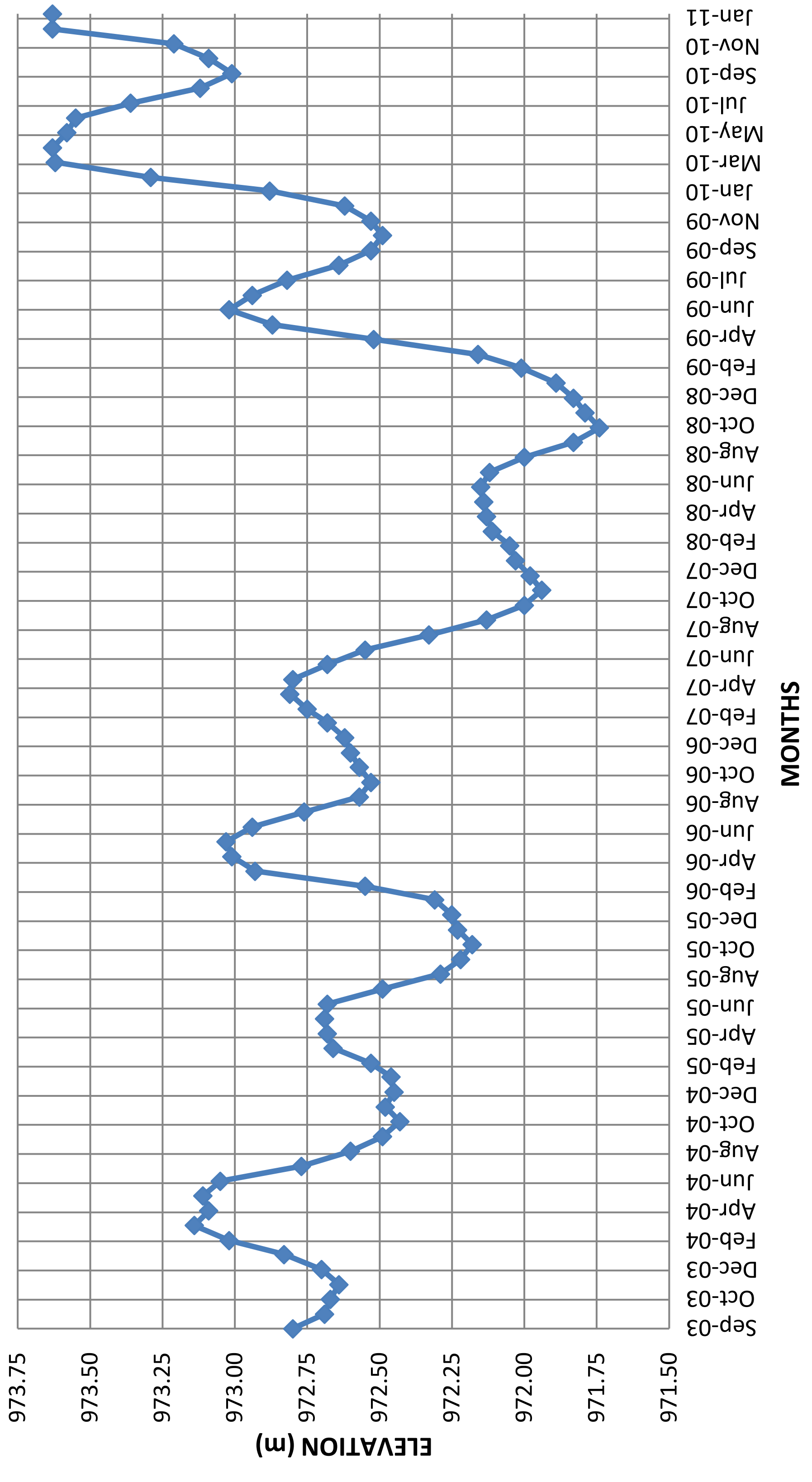



**Figure** 3.29 Water Elevations of Lake Mogan (2003 – 2011)

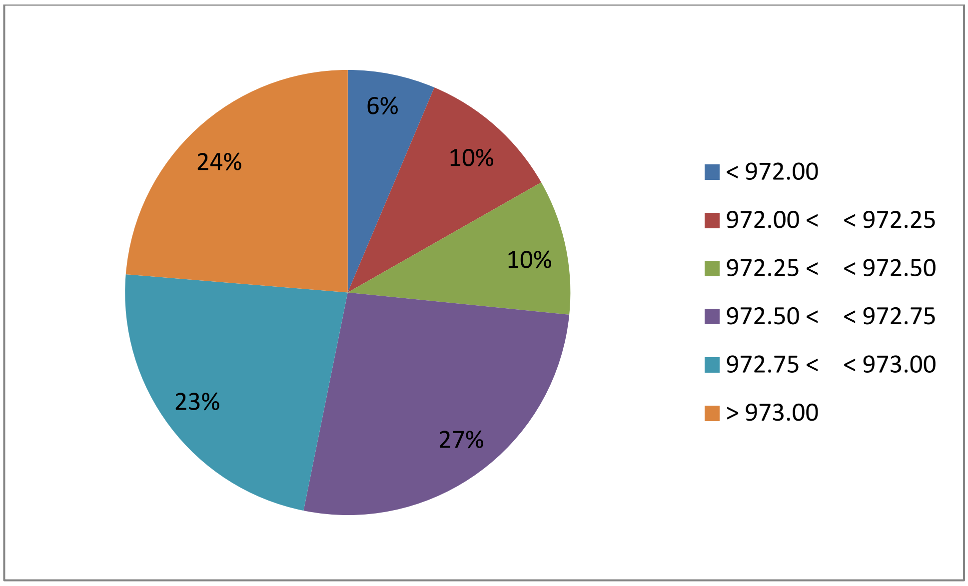



**Figure 3.30** Operation Levels of Lake Mogan (1997 – 2011)

**Figure 3.31** General View of Lined Canal between Mogan and Eymir Lakes

**Figure 3.32** Flooding Areas around Lake Mogan (23.03.2011)

**Figure 3.33** Flooding Areas at the Downstream of Lake Mogan (20.03.2012)

**Figure 3.34** Flooding Areas around Lake Mogan (20.03.2012)

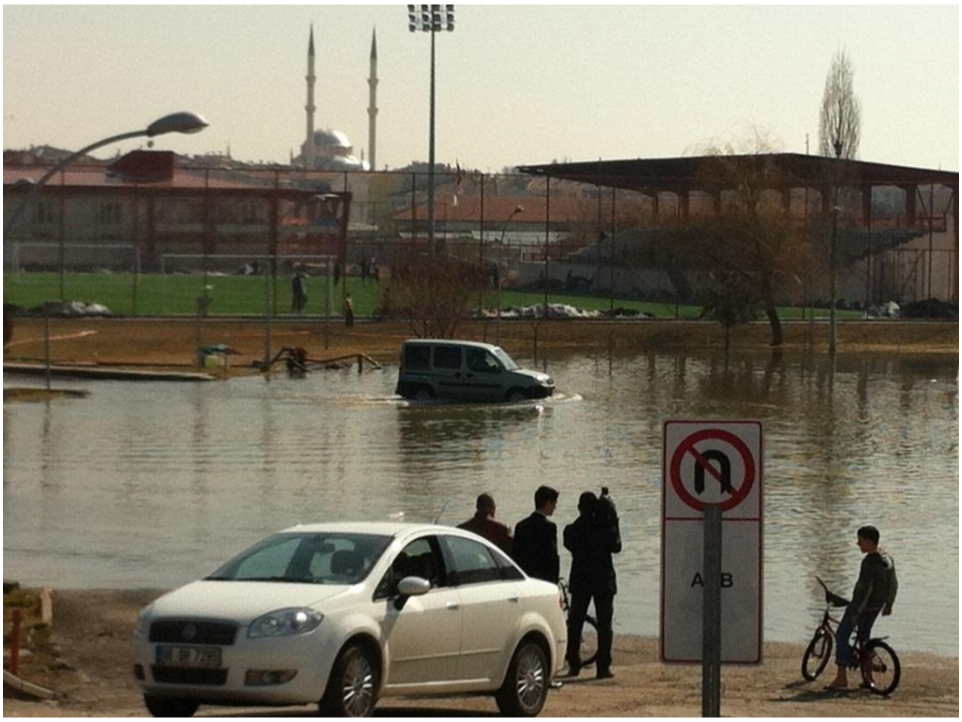
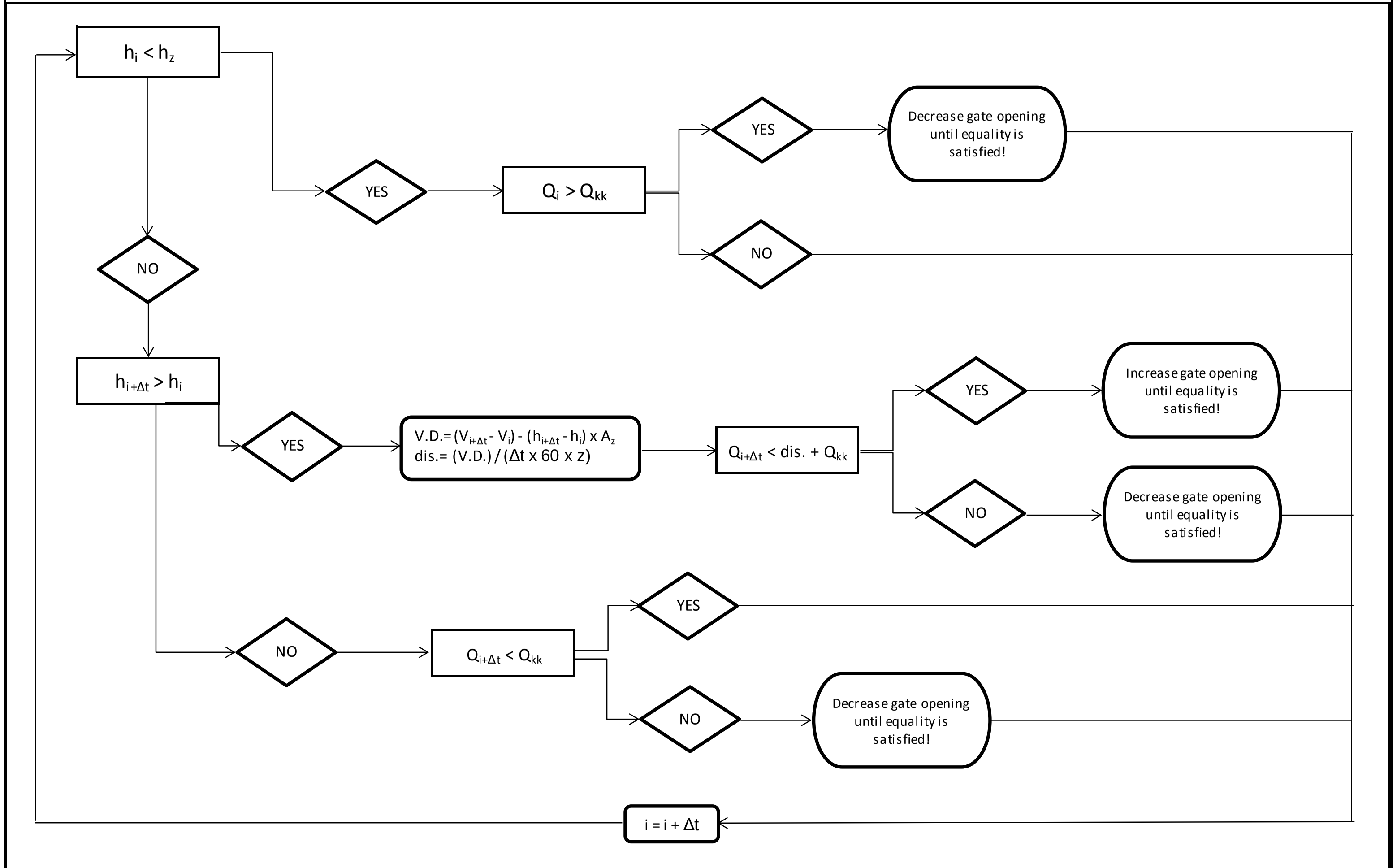


**Figure 3.35** Flooding Areas around Lake Mogan (20.03.2012)

**Figure 3.36** Flow Chart of Damage Equality Process




$h_i$: instantaneous lake level
$h_z$: damage level

$Q_i$: instantaneous discharge
$Q_{kk}$: canal capacity

V.D. = excess volume difference between two lake level
dis.= excess discharge which is required to equalize damage between upstream and downstream
z= weight factor of downstream

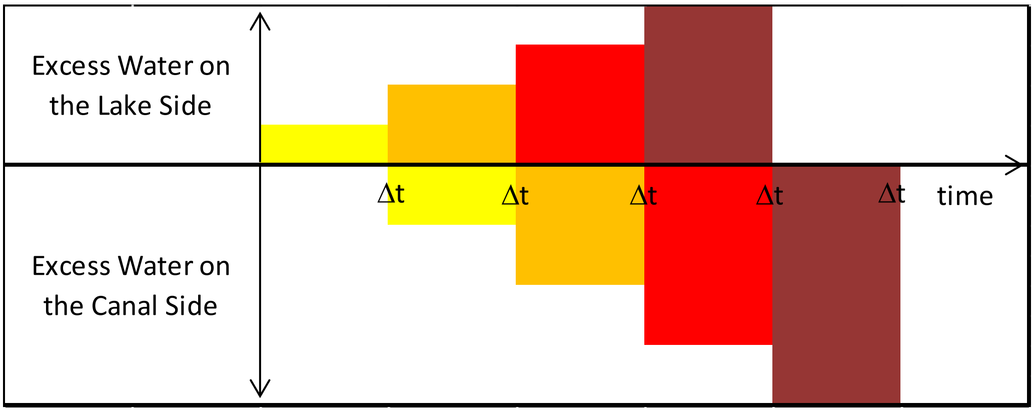



**Figure 3.37** Comparisons of Excess Water Volumes

As seen in Figure 3.37, in order to equalize damage on both side of the lake, excess water on the lake side is estimated in a specified time interval Δt. After that, gate openings of water control structure are adjusted in order to make overflowing from the canal in following Δt time by considering weight factor. However, since water level continues to increase, discharged water from gate openings also increase. As a result, excess water on both side of the lake cannot be equalized with previously desired weight factor.

Results of different scenarios are given in Table 3.33. When these results are analyzed it is seen that only 21 scenarios have no flooding damage. In 24 scenarios damage occur and it is shared between upstream and downstream parts. In the rest of the scenarios (36 ones) maximum water elevation exceed the upper elevation of the levees which means the failure of the system.

According to the results, 50 year storm will not cause any damage when the lake level is 972.00 at the beginning of the storm while canal capacity is 7 $m^3$/s. If canal capacity is increased to 15 $m^3$/s, same storm will not cause damage while lake level is 972.50 m initially. In order not to have any damage because of the 100 year storm, lake level should be 972.00 m and canal capacity should be 15 $m^3$/s at least.

In case of occurrence of 500 year storm, all the scenarios result with the failure of the system. A 100 year storm is also cause a failure when the lake level is 973.00 m. at the beginning of the storm.

In other scenarios damage is shared between upstream and downstream part of the lake. As seen from Table 3.33, specified weight factors do not lead to change maximum lake level. This is because area of lake surface is so large and volume which overflow from the canal does not affect the lake level very much.

**Table 3.33** Results of Operation Studies of Lake Mogan Water Control Structure

| Lake Level: | 973.75 m. | 974.25 m. |
|---|---|---|
| NO DAMAGE | DAMAGE IS SHARED | FAILURE |

| Canal Capacity ($m^3/s$) | Return Period (yr) | Lake Level (m) | Weight Factor | Maximum Water Elevation (m) | $Q_{max}$ ($m^3/s$) | Upstream Excess Volume ($m^3$) | Downstream Excess Volume ($m^3$) |
|---|---|---|---|---|---|---|---|
| 7 | 50 | 972.00 | 5 | 973.460 | 7.00 | 0 | 0 |
| 7 | 50 | 972.00 | 10 | 973.460 | 7.00 | 0 | 0 |
| 7 | 50 | 972.00 | 20 | 973.460 | 7.00 | 0 | 0 |
| 7 | 50 | 972.50 | 5 | 973.841 | 7.67 | 20972 | 3619 |
| 7 | 50 | 972.50 | 10 | 973.842 | 7.35 | 21006 | 2334 |
| 7 | 50 | 972.50 | 20 | 973.842 | 7.13 | 21005 | 1335 |
| 7 | 50 | 973.00 | 5 | 974.228 | 8.53 | 182661 | 41296 |
| 7 | 50 | 973.00 | 10 | 974.230 | 7.81 | 183793 | 20530 |
| 7 | 50 | 973.00 | 20 | 974.232 | 7.42 | 183348 | 10345 |
| 7 | 100 | 972.00 | 5 | 973.842 | 7.47 | 21131 | 8857 |
| 7 | 100 | 972.00 | 10 | 973.843 | 7.22 | 21297 | 3908 |
| 7 | 100 | 972.00 | 20 | 973.843 | 7.11 | 21334 | 1626 |
| 7 | 100 | 972.50 | 5 | 974.197 | 8.86 | 165433 | 29553 |
| 7 | 100 | 972.50 | 10 | 974.198 | 8.06 | 166163 | 17465 |
| 7 | 100 | 972.50 | 20 | 974.199 | 7.38 | 166599 | 9675 |
| 7 | 100 | 973.00 | 5 | 974.561 | 10.45 | 475684 | 107002 |
| 7 | 100 | 973.00 | 10 | 974.566 | 8.81 | 480103 | 59706 |
| 7 | 100 | 973.00 | 20 | 974.569 | 8.10 | 482337 | 35791 |
| 7 | 500 | 972.00 | 5 | 974.741 | 12.01 | 633381 | 123716 |
| 7 | 500 | 972.00 | 10 | 974.747 | 9.79 | 639071 | 62829 |
| 7 | 500 | 972.00 | 20 | 974.750 | 8.59 | 641609 | 36322 |
| 7 | 500 | 972.50 | 5 | 975.088 | 14.16 | 828517 | 161041 |
| 7 | 500 | 972.50 | 10 | 975.096 | 10.60 | 833148 | 84738 |
| 7 | 500 | 972.50 | 20 | 975.101 | 9.00 | 835729 | 43323 |
| 7 | 500 | 973.00 | 5 | 975.468 | 14.88 | 1037726 | 206546 |
| 7 | 500 | 973.00 | 10 | 975.479 | 11.01 | 1043904 | 106294 |
| 7 | 500 | 973.00 | 20 | 975.485 | 9.01 | 1047250 | 51071 |
| 15 | 50 | 972.00 | 5 | 973.430 | 11.35 | 0 | 0 |
| 15 | 50 | 972.00 | 10 | 973.430 | 11.35 | 0 | 0 |
| 15 | 50 | 972.00 | 20 | 973.430 | 11.35 | 0 | 0 |
| 15 | 50 | 972.50 | 5 | 973.746 | 15.00 | 0 | 0 |
| 15 | 50 | 972.50 | 10 | 973.746 | 15.00 | 0 | 0 |
| 15 | 50 | 972.50 | 20 | 973.746 | 15.00 | 0 | 0 |
| 15 | 50 | 973.00 | 5 | 974.137 | 16.11 | 132392 | 37951 |
| 15 | 50 | 973.00 | 10 | 974.138 | 15.59 | 133250 | 18474 |
| 15 | 50 | 973.00 | 20 | 974.139 | 15.36 | 133657 | 9775 |
| 15 | 100 | 972.00 | 5 | 973.748 | 15.00 | 0 | 0 |
| 15 | 100 | 972.00 | 10 | 973.748 | 15.00 | 0 | 0 |
| 15 | 100 | 972.00 | 20 | 973.748 | 15.00 | 0 | 0 |

**Table 3.33** (continued)

| Canal Capacity ($m^3/s$) | Return Period (yr) | Lake Level (m) | Weight Factor | Maximum Water Elevation (m) | $Q_{max}$ ($m^3/s$) | Upstream Excess Volume ($m^3$) | Downstream Excess Volume ($m^3$) |
|---|---|---|---|---|---|---|---|
| 15 | 100 | 972.50 | 5 | 974.104 | 16.48 | 114513 | 22588 |
| 15 | 100 | 972.50 | 10 | 974.105 | 15.97 | 115051 | 13684 |
| 15 | 100 | 972.50 | 20 | 974.106 | 15.62 | 115517 | 7164 |
| 15 | 100 | 973.00 | 5 | 974.474 | 18.22 | 398114 | 94085 |
| 15 | 100 | 973.00 | 10 | 974.479 | 16.28 | 402475 | 42420 |
| 15 | 100 | 973.00 | 20 | 974.485 | 16.00 | 408401 | 30574 |
| 15 | 500 | 972.00 | 5 | 974.651 | 20.22 | 554760 | 110579 |
| 15 | 500 | 972.00 | 10 | 974.657 | 17.93 | 559579 | 58998 |
| 15 | 500 | 972.00 | 20 | 974.660 | 16.40 | 562394 | 29176 |
| 15 | 500 | 972.50 | 5 | 974.993 | 21.44 | 776312 | 155405 |
| 15 | 500 | 972.50 | 10 | 975.001 | 18.39 | 780962 | 79041 |
| 15 | 500 | 972.50 | 20 | 975.005 | 16.85 | 783167 | 43451 |
| 15 | 500 | 973.00 | 5 | 975.373 | 22.35 | 985930 | 197498 |
| 15 | 500 | 973.00 | 10 | 975.384 | 18.84 | 991835 | 99838 |
| 15 | 500 | 973.00 | 20 | 975.389 | 16.90 | 994684 | 52717 |
| 30 | 50 | 972.00 | 5 | 973.296 | 24.58 | 0 | 0 |
| 30 | 50 | 972.00 | 10 | 973.296 | 24.58 | 0 | 0 |
| 30 | 50 | 972.00 | 20 | 973.296 | 24.58 | 0 | 0 |
| 30 | 50 | 972.50 | 5 | 973.652 | 26.73 | 0 | 0 |
| 30 | 50 | 972.50 | 10 | 973.652 | 26.73 | 0 | 0 |
| 30 | 50 | 972.50 | 20 | 973.652 | 26.73 | 0 | 0 |
| 30 | 50 | 973.00 | 5 | 974.017 | 31.11 | 66615 | 12410 |
| 30 | 50 | 973.00 | 10 | 974.018 | 30.79 | 66892 | 7854 |
| 30 | 50 | 973.00 | 20 | 974.018 | 30.79 | 67034 | 5835 |
| 30 | 100 | 972.00 | 5 | 973.674 | 26.87 | 0 | 0 |
| 30 | 100 | 972.00 | 10 | 973.674 | 26.87 | 0 | 0 |
| 30 | 100 | 972.00 | 20 | 973.674 | 26.87 | 0 | 0 |
| 30 | 100 | 972.50 | 5 | 974.002 | 31.17 | 58531 | 10732 |
| 30 | 100 | 972.50 | 10 | 974.003 | 30.85 | 58809 | 6373 |
| 30 | 100 | 972.50 | 20 | 974.003 | 30.53 | 58946 | 4399 |
| 30 | 100 | 973.00 | 5 | 974.352 | 32.87 | 286804 | 60281 |
| 30 | 100 | 973.00 | 10 | 974.355 | 31.52 | 289496 | 32313 |
| 30 | 100 | 973.00 | 20 | 974.356 | 31.18 | 291164 | 15544 |
| 30 | 500 | 972.00 | 5 | 974.558 | 34.70 | 473172 | 96590 |
| 30 | 500 | 972.00 | 10 | 974.563 | 32.58 | 477397 | 51355 |
| 30 | 500 | 972.00 | 20 | 974.566 | 31.48 | 479528 | 28550 |
| 30 | 500 | 972.50 | 5 | 974.873 | 36.21 | 709905 | 145755 |
| 30 | 500 | 972.50 | 10 | 974.881 | 33.49 | 714201 | 76107 |
| 30 | 500 | 972.50 | 20 | 974.885 | 31.85 | 716238 | 42465 |
| 30 | 500 | 973.00 | 5 | 975.234 | 37.30 | 909207 | 188491 |
| 30 | 500 | 973.00 | 10 | 975.244 | 34.01 | 914744 | 97303 |
| 30 | 500 | 973.00 | 20 | 975.249 | 32.23 | 917408 | 53961 |

### 3.6.2 Lake Eymir Reservoir Routing and Operation Studies

Similar to Lake Mogan, there is also one water control structure at the exit of Lake Eymir (Figure 3.38). It is composed of two vertical sluice gates of each has 1.00 wide and sill elevation is 966.65 m. Elevation – storage relationship of lake is given in Table 3.34. Discharge passing through the gates can be calculated by using the same equations which are used for also Lake Mogan water control structure.

**Figure 3.38** Water Control Structure of Lake Eymir (DSİ, 2008)

**Table 3.34** Elevation – Storage Relationship of Lake Eymir

| | Elevation (m) | Volume ($hm^3$) |
|---|---|---|
| 1 | 966.00 | 1.184 |
| 2 | 966.50 | 1.651 |
| 3 | 967.00 | 2.156 |
| 4 | 967.50 | 2.698 |
| 5 | 968.00 | 3.273 |
| 6 | 968.50 | 3.883 |
| 7 | 969.00 | 4.524 |
| 8 | 969.50 | 5.199 |
| 9 | 970.00 | 5.910 |

Middle East Technical University has the responsibility of the operation of water control structure. However, operation studies are conducted by cooperation with State Hydraulic Works and Ankara Metropolitan Municipality. Daily lake level measurements were done between 1998 and 2006 water years. These data can be seen in Figure 3.39 and Table C 11-19.

When these values are analyzed it is seen that lake level is under the 968.50 m in nearly 75% of the time and above the 969.00 m in nearly 5% of the time. Periods that lake level is above the normal operation level is generally spring seasons which can be acceptable in these ratios. However situation has changed in recent years and operation level is increased to 969.00 m. for recreation purposes. It is assumed that elevation of social facilities around Lake Eymir starts at 969.75 m. and failure level is taken as 970.25 m.

As seen from elevation – storage relationship Lake Eymir has an active storage volume of 1.32 $hm^3$ between 968.50 meter and 969.50 meter levels. That much amount of storage capacity is enough to store 500 year flood volume which is coming from Lake Eymir basin. However since storage capacity is not high as Lake Mogan, extra flood volume which is conveyed from Lake Mogan via canal should not be accumulated in Lake Eymir. In other words, what comes to Lake Eymir through the lined canal between Mogan and Eymir lakes must be discharged from Lake Eymir water control structure. Otherwise social facilities around Lake Eymir are going to be under the threat of flooding damage. In these circumstances, it would be necessary to have integrated operation scheme when the high return period storms are occurred in the basin and capacity of Lake Eymir water control structure should be equal to Lake Mogan water control structure at least.

In order to see the operation performance of Lake Eymir water control structure in quantitative manner, 6 different scenarios are established. In these scenarios, discharges coming from Lake Mogan are added to inflow hydrograph of Lake Eymir directly since travel time between Mogan and Eymir lakes are assumed to be zero. Operation level of Lake Eymir is taken as 969.00 when the storm starts which is a conservative approach.

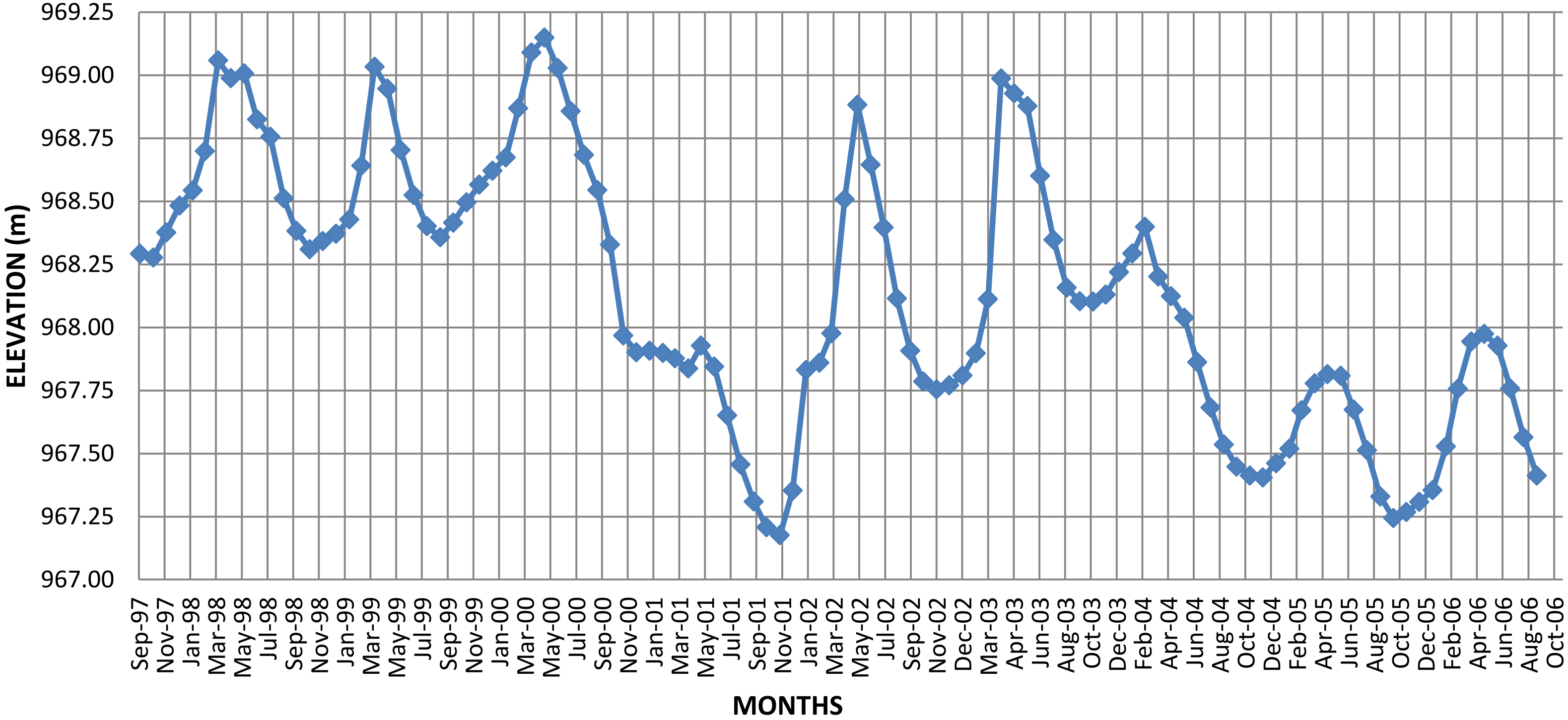
Although Lake Eymir has enough storage capacity to store 500 year storm, that storm pattern is not used in operation studies. This is because in case of 500 year storm, water height in Lake Mogan exceeds the upper elevation of the levees which means failure of the system. In those circumstances, it is hard to presume or model propagation of flood waves. Characteristics of chosen scenarios are given below in Table 3.35.

**Table 3.35** Operation Scenarios for Lake Eymir Water Control Structure

| | Return Period | Canal Capacity | Mogan Lake Level |
|---|---|---|---|
| | (year) | ($m^3$/s) | (m) |
| Case 1 | 50 | 7 | 973.00 |
| Case 2 | 100 | 7 | 972.50 |
| Case 3 | 50 | 15 | 973.00 |
| Case 4 | 100 | 15 | 972.50 |
| Case 5 | 50 | 30 | 973.00 |
| Case 6 | 100 | 30 | 972.50 |

Gate openings for these inflow hydrographs are chosen by considering incoming discharge from Lake Mogan water control structure. Rating curves for different gate openings in 969.00 level are given in Figure 3.40. Obtained results are given in Figure B 34 – B 39.

**Figure 3.39** Water Elevations of Lake Eymir (1998 – 2006)



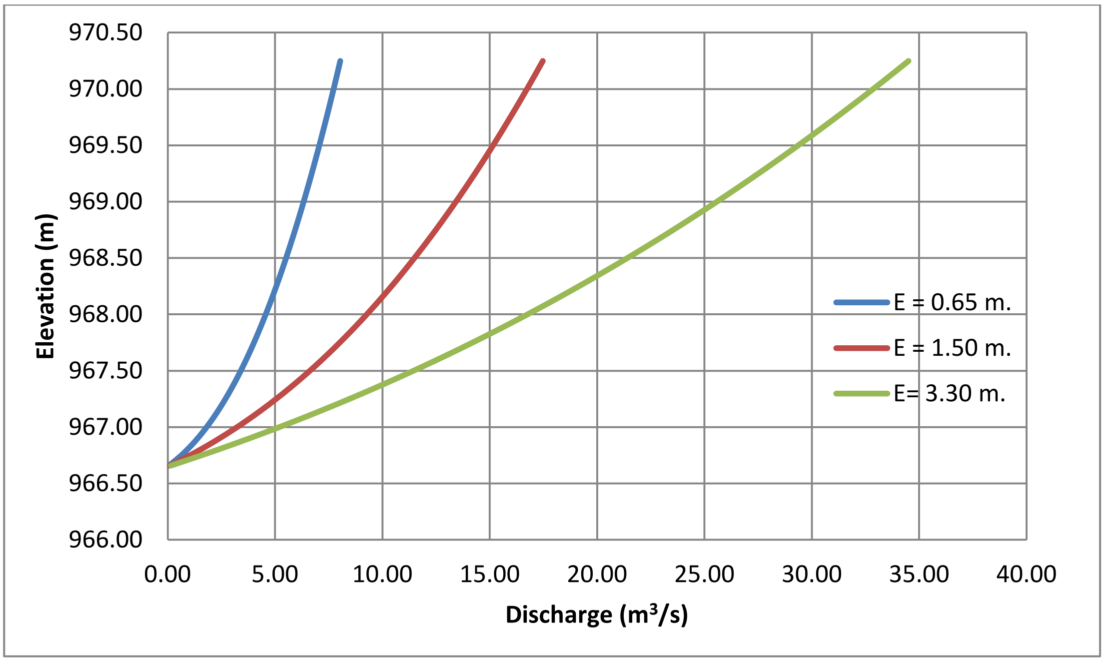



**Figure 3.40** Rating Curves of Lake Eymir Water Control Structure

### 3.6.3 İncesu Detention Pond Basin (İmrahor Basin) Operation Studies

General characteristics of İncesu detention pond were given in section 3.1. This structure is the last component of flood protection system of İncesu Creek. Storm waters are conveyed to city sewer system from this point via closed conduit. In DSI report which is prepared in 2008 it is claimed that capacity of conduit system at the exit of detention pond is reduced to 48 - 94 $m^3/s$. Capacity of the sluiceway is also reduced to 10 $m^3/s$. In order to know the real capacity of the conduit, detailed studies should be carried out and accumulated sedimentation and other deposits should be removed from the conduit. In this study, it is assumed that storm water which is discharged from the spillway and sluiceway of detention pond can be collected and transmitted with this box system. Spillway and closed conduit can be seen in Figure 3.41 and 3.42. Elevation – storage relationship of detention pond is given in Table 3.36.

**Table 3.36** Elevation – Storage Relationship of İncesu Detention Pond

| | Elevation (m) | Volume ($m^3$) |
|---|---|---|
| 1 | 894.00 | 0 |
| 2 | 896.00 | 32,566 |
| 3 | 898.00 | 143,064 |
| 4 | 900.00 | 335,306 |
| 5 | 902.00 | 694,416 |
| 6 | 904.00 | 1,311,373 |

**Figure 3.41** Spillway of İncesu Detention Pond (DSİ, 2008)

**Figure 3.42** Closed Conduit at the exit of İncesu Detention Pond (DSİ, 2008)

In order to find stage – discharge relationship of the detention pond, sluiceway and spillway discharge values according to water height are calculated separately and superposed to get final stage-discharge relationship of the pond by using procedure which is explained by Sungur, 1978.

Both pressurized and open channel flow are occurred in the sluiceway. By assuming that flow will be open channel flow until conduit reaches the fully flow state, open channel conditions are estimated using below equations (Sungur, 1978).

Reservoir water elevation = Conduit entrance elevation + entrance loss + water depth at pipe + velocity head (3.5)

Entrance loss, $h_a = \mathrm{f}\, h_v$ (3.6)

$\mathrm{f} = 0.22$

velocity head, $h_v = \dfrac{v^2}{2g}$ (3.7)

Control section is the downstream part in pressurized flow state. To get the discharge curve of pressurized flow below equalities are used.

Reservoir water elevation = Downstream exit elevation + mD + Total head losses (3.8)

mD: piezometric height for pressurized flow at downstream end

total head losses = entrance loss + transition loss + friction loss + curve loss + velocity head

Spillway discharge values are calculated by using below equation

$Q_0 = C_0 L H_0^{1.5}$ (3.9)

where

$Q_0$= design discharge

$C_0$= spillway discharge coefficient

L= effective crest length

$H_0$= total head over the spillway

Maximum water elevation is taken as 903.00 m and approach velocity head over the spillway is neglected. Since there is no gate or other structure over the spillway, crest length is taken as 120 m. $C_0$ and correction factor for varying heads are calculated by using equations which is given by Yanmaz, 2006. Calculations for spillway discharge values can be seen in Table 3.37.

**Table 3.37** Calculations of Spillway Discharge Values of İncesu Detention Pond

| Water Elevation (m) | Effective Crest Length, L (m) | $H_e$ (m) | $H_e/H_0$ | $C_{me}$ | Discharge ($m^3/s$) |
|---|---|---|---|---|---|
| 902.00 | 120.00 | 0.00 | | | 0.00 |
| 902.25 | 119.95 | 0.25 | 0.25 | 1.87 | 28.05 |
| 902.50 | 119.90 | 0.50 | 0.50 | 1.99 | 84.54 |
| 902.75 | 119.85 | 0.75 | 0.75 | 2.09 | 162.88 |
| 903.00 | 119.80 | 1.00 | 1.00 | 2.17 | 260.05 |
| 903.10 | 119.78 | 1.10 | 1.10 | 2.20 | 303.73 |
| 903.35 | 119.73 | 1.35 | 1.35 | 2.26 | 424.24 |

Stage – discharge relationship of detention pond are found by making superposition of stage-discharge values of sluiceway and spillway. Resulted relationship can be seen in Figure 3.43.

Flood hydrographs of İncesu Detention Pond basin are calculated and given in section 3.5. Operation performance of detention pond are tried to be measured by using 50 and 100 year flood hydrographs and outflow hydrographs of Lake Eymir which are obtained for six different scenarios previously. 500 year storm is not used in analysis due to the same reason which is explained for Lake Eymir water control structure. Length of creek between Lake Eymir and detention pond is approximately 11 km. By considering this length, travel time of discharged water from Lake Eymir to detention pond is assumed to be 4 hours. Obtained results are given in Figure B 40 - 45.

As seen from results incoming hydrograph can be discharged from the detention pond without creating any problem by assuming that conduit at exit of pond can convey the discharged water without problem.

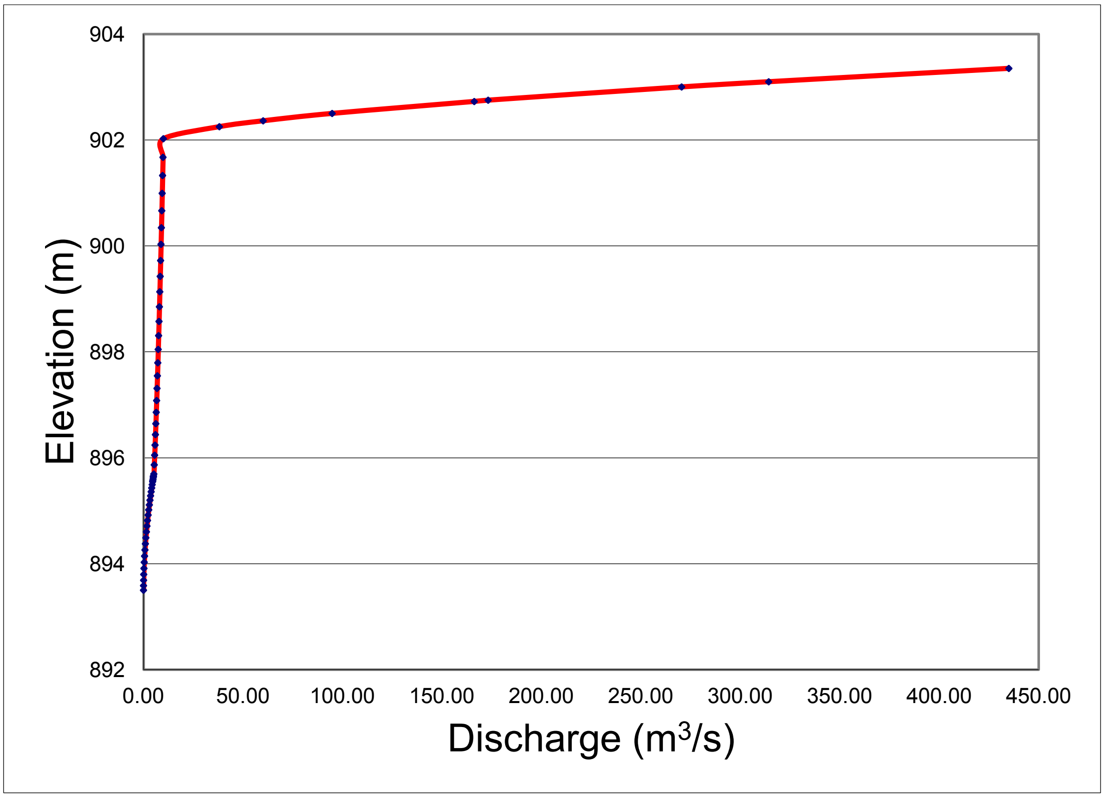



**Figure 3.43** Stage – Discharge Relationship of İncesu Detention Pond

### 3.7 Discussion of Results

Curve numbers and flood hydrographs for 50, 100 and 500 year return periods of 12 hour storms are obtained for Lake Mogan, Lake Eymir and İncesu Detention Pond subbasins. Curve numbers of Lake Mogan, Lake Eymir and Incesu Detention Pond subbasins are found as 76, 78 and 76 respectively. Computed peak discharges and flood volumes are given in Table 3.38.

**Table 3.38** Peak Discharges and Flood Volumes of Subbasins

| NAME of the SUBBASIN | $T_r$ = 50 year | | $T_r$ = 100 year | | $T_r$ = 500 year | |
|---|---|---|---|---|---|---|
| | PEAK DISCHARGE ($m^3/s$) | TOTAL FLOOD VOLUME ($hm^3$) | PEAK DISCHARGE ($m^3/s$) | TOTAL FLOOD VOLUME ($hm^3$) | PEAK DISCHARGE ($m^3/s$) | TOTAL FLOOD VOLUME ($hm^3$) |
| LAKE MOGAN | 192.77 | 10.99 | 253.80 | 14.20 | 412.92 | 22.60 |
| LAKE EYMİR | 32.07 | 0.63 | 41.73 | 0.79 | 66.65 | 1.22 |
| INCESU DETENTION POND | 48.95 | 1.06 | 64.80 | 1.39 | 106.52 | 2.24 |

Operation performances of control structures are investigated and operation requirements for different damage levels are obtained for different scenarios. Results of a sample scenario are given in Table 3.39. In that case, return period is 50 year, canal capacity between Lake Mogan and Lake Eymir is 7 $m^3$/s, lake levels at the beginning of the storm are 973.00 m and 969.00 m. for Lake Mogan and Lake Eymir respectively. Other scenarios are tried to be summarized below also.

For Lake Mogan basin 81 different operation cases are examined and it is seen that 50 year storm will not cause any damage while operation level of the lake is 972.00 m and canal capacity is 7 $m^3$/s. If elevation of the lake is maintained at 972.50 m level; in order not to have any damage because of 50 year storm, canal capacity should be increased to 15 $m^3$/s. 100 year storm would also cause no damage while lake level is 972.00 m at the beginning of the storm and canal capacity is 15 $m^3$/s at least. In case of occurrence of 500 year storm, all the scenarios result with the failure of the system. A 100 year storm is also cause a failure when the lake level is 973.00 m. at the beginning of the storm. In other scenarios damage is shared between upstream and downstream part of the lake.

Contribution of Dikilitaş and İkizce ponds are neglected by considering their limited storage capacity and by assuming that storms will occur when reservoir levels are at the maximum operation level.

Lake Eymir subbasin is modeled by a lumped way of modelling for the sake of simplicity and by considering its relatively small catchment area. It is seen that flood hydrographs of Lake Eymir will not cause any damage to social facilities around the lake if extra flood volume which is conveyed from Lake Mogan via canal is not stored in Lake Eymir. In other words discharge capacity of Lake Eymir water control structure should not be less than Lake Mogan water control structure.

Obtained peak discharges for İncesu Detention Pond subbasin can be discharged from the detention pond without creating any problem by assuming that conduit at the exit of pond can convey the discharged water. Travel time between Lake Eymir and İncesu Detention Pond is taken as 4 hours by considering 11 km creek length between lake and detention pond. In order to make more precise estimations, Imrahor Valley should be studied in more detail. There are various small depressions on river route. These depressions cause difficulty in modeling process. In this study, they are not taken into account. Similar to Lake Eymir subbasin, lumped way of modeling is used in analysis.

Incesu Detention Pond has a limited storage capacity. That much capacity is not enough to route flood volume when high return period storms come into picture. In those storms, water height reach crest elevation of spillway in a very short time and huge discharge passed over the spillway. On other hand, conduit at the exit of pond may not convey the spilled water because of the accumulated particles in it. That may cause big problems for the urbanized areas on the downstream part of detention pond.

**Table 3.39 Results of a Sample Scenario**

| Time (min) | Inflow to Lake Mogan ($m^3/s$) | Outflow from Lake Mogan ($m^3/s$) | Lake Level (m) | Inflow to Lake Eymir ($m^3/s$) | Outflow from Lake Eymir ($m^3/s$) | Lake Level (m) | Inflow to İncesu ($m^3/s$) | Outflow from İncesu ($m^3/s$) | Water Level (m) |
|---|---|---|---|---|---|---|---|---|---|
| 0 | 0.000 | 0.000 | 973.000 | 0.000 | 0.000 | 969.000 | 0.000 | 0.000 | 893.500 |
| 30 | 2.472 | 6.718 | 972.999 | 7.168 | 6.334 | 969.001 | 0.000 | 0.000 | 893.500 |
| 60 | 2.472 | 6.716 | 972.998 | 7.166 | 6.336 | 969.002 | 0.000 | 0.000 | 893.500 |
| 90 | 2.472 | 6.715 | 972.997 | 7.164 | 6.337 | 969.003 | 0.000 | 0.000 | 893.500 |
| 120 | 3.090 | 6.713 | 972.996 | 7.275 | 6.339 | 969.004 | 0.000 | 0.000 | 893.500 |
| 150 | 3.709 | 6.711 | 972.995 | 7.386 | 6.341 | 969.006 | 0.000 | 0.000 | 893.500 |
| 180 | 4.327 | 6.710 | 972.994 | 7.497 | 6.343 | 969.007 | 0.000 | 0.000 | 893.500 |
| 210 | 6.181 | 6.709 | 972.994 | 7.834 | 6.346 | 969.009 | 0.000 | 0.000 | 893.500 |
| 240 | 7.417 | 6.709 | 972.994 | 8.059 | 6.349 | 969.011 | 0.000 | 0.000 | 893.500 |
| 270 | 9.290 | 6.710 | 972.994 | 8.397 | 6.353 | 969.014 | 6.334 | 0.099 | 893.751 |
| 300 | 11.323 | 6.711 | 972.995 | 8.736 | 6.358 | 969.016 | 6.336 | 0.502 | 894.114 |
| 330 | 21.404 | 6.716 | 972.997 | 10.328 | 6.364 | 969.021 | 6.337 | 1.110 | 894.447 |
| 360 | 104.115 | 6.736 | 973.009 | 23.482 | 6.383 | 969.033 | 7.077 | 1.855 | 894.752 |
| 390 | 91.140 | 6.767 | 973.026 | 15.927 | 6.403 | 969.046 | 11.178 | 3.077 | 895.147 |
| 420 | 117.829 | 6.809 | 973.050 | 20.261 | 6.426 | 969.061 | 17.200 | 5.261 | 895.746 |
| 450 | 141.605 | 6.861 | 973.079 | 27.208 | 6.460 | 969.084 | 24.492 | 5.919 | 896.358 |
| 480 | 161.971 | 6.921 | 973.114 | 34.749 | 6.509 | 969.116 | 32.880 | 6.609 | 897.090 |
| 510 | 171.019 | 6.988 | 973.153 | 38.477 | 6.570 | 969.157 | 42.178 | 7.389 | 898.032 |
| 540 | 172.733 | 6.744 | 973.193 | 38.781 | 6.633 | 969.200 | 50.350 | 7.745 | 898.501 |
| 570 | 170.792 | 6.808 | 973.232 | 38.076 | 6.695 | 969.242 | 53.982 | 8.130 | 899.034 |
| 600 | 166.062 | 6.868 | 973.270 | 36.133 | 6.754 | 969.283 | 55.252 | 8.512 | 899.591 |
| 630 | 161.654 | 6.925 | 973.306 | 33.188 | 6.808 | 969.320 | 54.984 | 8.877 | 900.150 |
| 660 | 159.297 | 6.980 | 973.341 | 29.484 | 6.855 | 969.353 | 53.395 | 9.217 | 900.692 |
| 690 | 161.297 | 6.708 | 973.376 | 24.890 | 6.893 | 969.380 | 50.746 | 9.527 | 901.205 |
| 720 | 166.165 | 6.761 | 973.412 | 21.251 | 6.923 | 969.401 | 47.231 | 9.803 | 901.678 |
| 750 | 170.111 | 6.815 | 973.449 | 18.594 | 6.947 | 969.418 | 42.893 | 20.145 | 902.105 |
| 780 | 175.931 | 6.870 | 973.486 | 16.605 | 6.967 | 969.432 | 37.799 | 38.116 | 902.250 |
| 810 | 182.885 | 6.924 | 973.525 | 14.746 | 6.984 | 969.444 | 32.016 | 34.458 | 902.220 |
| 840 | 189.869 | 6.980 | 973.563 | 12.926 | 6.996 | 969.453 | 26.782 | 29.030 | 902.177 |
| 870 | 192.464 | 6.692 | 973.603 | 10.938 | 7.005 | 969.459 | 22.715 | 24.541 | 902.140 |
| 900 | 192.648 | 6.746 | 973.644 | 9.671 | 7.012 | 969.464 | 19.084 | 20.707 | 902.109 |
| 930 | 191.600 | 6.799 | 973.684 | 8.696 | 7.016 | 969.467 | 16.055 | 17.396 | 902.083 |
| 960 | 189.533 | 6.851 | 973.723 | 7.964 | 7.018 | 969.468 | 13.631 | 14.706 | 902.061 |
| 990 | 186.574 | 6.901 | 973.762 | 7.455 | 7.019 | 969.469 | 11.729 | 12.571 | 902.044 |

**Table 3.39 (cont.) Results of a Sample Scenario**

| Time (min) | Inflow to Lake Mogan ($m^3/s$) | Outflow from Lake Mogan ($m^3/s$) | Lake Level (m) | Inflow to Lake Eymir ($m^3/s$) | Outflow from Lake Eymir ($m^3/s$) | Lake Level (m) | Inflow to İncesu ($m^3/s$) | Outflow from İncesu ($m^3/s$) | Water Level (m) |
|---|---|---|---|---|---|---|---|---|---|
| 1020 | 182.803 | 6.948 | 973.799 | 7.137 | 7.020 | 969.469 | 10.255 | 10.910 | 902.031 |
| 1050 | 178.294 | 8.074 | 973.834 | 8.093 | 7.020 | 969.470 | 9.107 | 9.997 | 902.018 |
| 1080 | 173.082 | 8.125 | 973.869 | 8.125 | 7.022 | 969.471 | 8.234 | 9.985 | 901.996 |
| 1110 | 167.118 | 7.810 | 973.902 | 7.810 | 7.024 | 969.473 | 7.612 | 9.970 | 901.971 |
| 1140 | 160.496 | 7.855 | 973.934 | 7.855 | 7.026 | 969.474 | 7.211 | 9.953 | 901.941 |
| 1170 | 153.241 | 7.529 | 973.965 | 7.529 | 7.027 | 969.475 | 7.033 | 9.934 | 901.907 |
| 1200 | 145.385 | 7.567 | 973.994 | 7.567 | 7.028 | 969.476 | 7.018 | 9.914 | 901.872 |
| 1230 | 137.297 | 7.975 | 974.021 | 7.975 | 7.029 | 969.476 | 7.019 | 9.894 | 901.837 |
| 1260 | 129.208 | 8.009 | 974.045 | 8.009 | 7.031 | 969.478 | 7.020 | 9.874 | 901.803 |
| 1290 | 121.120 | 8.790 | 974.069 | 8.790 | 7.034 | 969.479 | 7.020 | 9.855 | 901.769 |
| 1320 | 113.031 | 8.822 | 974.090 | 8.822 | 7.037 | 969.482 | 7.022 | 9.836 | 901.735 |
| 1350 | 104.943 | 8.097 | 974.110 | 8.097 | 7.040 | 969.484 | 7.024 | 9.816 | 901.701 |
| 1380 | 96.854 | 8.121 | 974.128 | 8.121 | 7.042 | 969.485 | 7.026 | 9.797 | 901.668 |
| 1410 | 88.766 | 7.763 | 974.145 | 7.763 | 7.043 | 969.487 | 7.027 | 9.778 | 901.635 |
| 1440 | 80.678 | 7.783 | 974.160 | 7.783 | 7.045 | 969.487 | 7.028 | 9.759 | 901.602 |
| 1470 | 72.589 | 8.183 | 974.174 | 8.183 | 7.046 | 969.489 | 7.029 | 9.740 | 901.569 |
| 1500 | 64.501 | 8.199 | 974.186 | 8.199 | 7.049 | 969.490 | 7.031 | 9.721 | 901.537 |
| 1530 | 56.412 | 7.444 | 974.196 | 7.444 | 7.050 | 969.491 | 7.034 | 9.702 | 901.505 |
| 1560 | 48.324 | 7.455 | 974.205 | 7.455 | 7.051 | 969.492 | 7.037 | 9.684 | 901.473 |
| 1590 | 40.235 | 7.849 | 974.213 | 7.849 | 7.052 | 969.493 | 7.040 | 9.665 | 901.441 |
| 1620 | 32.147 | 7.856 | 974.218 | 7.856 | 7.053 | 969.494 | 7.042 | 9.647 | 901.410 |
| 1650 | 24.459 | 7.088 | 974.222 | 7.088 | 7.054 | 969.494 | 7.043 | 9.629 | 901.378 |
| 1680 | 18.847 | 7.091 | 974.225 | 7.091 | 7.055 | 969.494 | 7.045 | 9.611 | 901.348 |
| 1710 | 14.488 | 6.705 | 974.227 | 6.705 | 7.054 | 969.494 | 7.046 | 9.593 | 901.317 |
| 1740 | 10.944 | 6.707 | 974.228 | 6.707 | 7.054 | 969.494 | 7.049 | 9.575 | 901.286 |
| 1770 | 8.097 | 6.707 | 974.229 | 6.707 | 7.053 | 969.493 | 7.050 | 9.557 | 901.256 |
| 1800 | 5.836 | 6.707 | 974.229 | 6.707 | 7.052 | 969.493 | 7.051 | 9.539 | 901.226 |
| 1830 | 4.086 | 6.707 | 974.228 | 6.707 | 7.052 | 969.493 | 7.052 | 9.521 | 901.197 |
| 1860 | 2.720 | 6.706 | 974.228 | 6.706 | 7.051 | 969.492 | 7.053 | 9.504 | 901.167 |
| 1890 | 1.663 | 6.705 | 974.227 | 6.705 | 7.051 | 969.492 | 7.054 | 9.486 | 901.138 |
| 1920 | 0.891 | 6.704 | 974.226 | 6.704 | 7.050 | 969.491 | 7.055 | 9.469 | 901.109 |
| 1950 | 0.362 | 6.703 | 974.225 | 6.703 | 7.049 | 969.491 | 7.054 | 9.452 | 901.080 |
| 1980 | 0.070 | 6.701 | 974.223 | 6.701 | 7.049 | 969.490 | 7.054 | 9.435 | 901.051 |
| 2000 | 0.003 | 6.701 | 974.222 | 6.701 | 7.048 | 969.490 | 7.053 | 9.418 | 901.023 |

# CHAPTER 4

## CONCLUSIONS AND RECOMMENDATIONS

DSI (State Hydraulic Works) recommends strongly to take a return period of 500 years for designing external water control structures in order to hinder human losses. It would be more rational to design and operate them by considering 100 year storms. Not to allow construction on floodplains is also very important for preventing loss of life and property.

Real time operation of water control structures is also very important on flood protection studies. However, rain gage equipments should be installed on catchment area.

Flood protection facilities should be considered in an integrated manner. Even only one weak section on the system may cause collapse of the entire flood protection system. In this study, the most vulnerable section has been found as the Lake Mogan water control structure. Storm sewer systems in urban areas should transmit the peak discharges which are transmitted from external systems in addition to precipitation on rural areas.

Elevation – storage relationships of Mogan and Eymir lakes should be renewed by updating bathymetric maps of both lakes although operation studies would not be changed deeply according to new values.

In order to have more precise results, catchment area would be divided into more subbasins. However, channel routing procedure should be employed in that case which is not an easy task due to lack of information on K and X parameters.

Elevation of social facilities around Lake Mogan should be determined in high accuracy. The road which connects the Gölbaşı – Haymana Road and Ankara – Konya Road acts as an artificial barrier in the basin. In order to see the effect of this barrier as a water control structure, elevation -storage relationship should be determined. By knowing those values more reliable operation studies would be done.

Lake Mogan water control structure has a key role to prevent the flood damages in this basin. However, operation levels of lake are relatively high in recent years. Remaining storage volume and discharge capacity of control structure become insufficient in those operation levels.

It is seen that 500 year storm cannot be stored in Lake Mogan while operation levels are above the 972.00 m level. If necessary operations studies are done and precautions are taken, 100 year storm would not cause damages. However if it is not possible to decrease the current operation level of Lake Mogan because of several reasons, commercial enterprises should be informed about possible flood risks.

In operation studies, gate openings are adjusted dynamically by assuming that flexible operation can be maintained whenever it is required. However, it is not possible with current operation capability. Heavy construction equipments are required to lift the gates. Automated gate mechanism is compulsory in order to have a good flood protection operation system.

Decision makers should decide on major purpose of Lake Mogan. It is seen that lake cannot serve for recreation and flood control purposes at the same time in full confidence. Biological life of the lake is also an important factor affecting the normal operation level. However, lake level would be decreased up to some range in flood seasons without creating serious problems to ecological life. Canal capacity between Mogan and Eymir lakes and elevation of Lake Mogan levees may be increased to prevent flooding damages. Removing bottom mud of the lake would also be an alternative effective solution for flood control purpose.

DSI had prepared flood protection report in 2008. In that report, it is advised to build one more detention pond at the upstream side of Lake Mogan. Planned detention pond has a 1.5 km long crest length. Furthermore, location of pond is chosen on environmental protection zone on which it is forbidden to make any construction due to ecological concerns and biological life. On the other hand, total investment cost was estimated as 66,721,400 TL according to 2008 DSI unit prices whereas cost of flood damage due to 500 year storm was calculated as 212,377,940 TL. 70% of that value is estimated due to damage on switchyard which is located between the Mogan and Eymir lakes (DSİ, 2008). However, flooding in this area is almost impossible due to its relatively high altitude. Rehabilitation of existing water control structures and performed well organized operation scheme may give more economical and environment friendly solutions. Public institutions should act more carefully while giving decision about this kind of multidimensional subjects.

## REFERENCES


- Aktaş, M. T., 1996, *Determination of Inundation Maps By GIS: A Case Study,* M. Sc. Thesis, METU, Dept. of Civil Eng., Ankara.
- Altınbilek, D., et al., 1995, *Gölbaşı Mogan-Eymir Gölleri için Su Kaynakları ve Çevre Yönetimi Projesi*, Kesin Rapor, ASKİ, Ankara.
- Atalay, İ., 2004, *Doğa Bilimleri Sözlüğü*, Meta Press, İzmir.
- Ateş, T., 1985, *Ankara Kenti Yeşil Alan Planlamasında Mogan Gölü-Akköprü Arasındaki Göl-Akarsu Sistemi Çevresine İlişkin Potansiyel Ağırlığın Saptanması ve Değerlendirilmesi Üzerine bir Arşatırma*, Ph. D Thesis, Ankara University, Ankara.
- Batukan, İ., 1968, *Ankara Taşkın Projesi Tatbikatı*, DSİ Publication, Ankara.
- Cantek, F. Ş., 2006, *Sanki Viran Ankara*, İletişim Press, İstanbul.
- Chow, V. T., Maidment, D. R., Mays, L. W., 1988, *Applied Hydrology*, McGraw-Hill, New York.
- Cook, H. L., 1946, *The Infiltration Approach to the Calculation of Surface Runoff*, Trans. Am. Geophys. Union, vol. 27, no. 5, pp. 726-747
- Çevre Kirliliğini Önleme ve Kontrol Genel Müdürlüğü, 2003, *Mogan ve Eymir Gölleri ve Çevresi Su Kirliliği İnceleme Raporu.*
- DSİ, 1963, *Ankara Taşkın Projesi Planlama Raporu,* Ankara
- DSİ, 1993, *Mogan Gölü Limnolojik Etüt Raporu,* Ankara.
- DSİ, 1994, *Mogan Gölü Kurtarma Projesi Planlama Raporu,* Ankara.
- DSİ, 2008, *Ankara Mogan ve Eymir Gölleri Havza Taşkın Planlama Mühendislik Hizmetleri İşi Planlama Raporu,* Ankara.
- Eagleson, P. S., 1970, *Dynamic Hydrology*, McGraw-Hill.
- EİE, 2005, *Mogan ve Eymir Göllerinin Hidrometeorolojik Özellikleri.*
- Gölbaşı Municipality, 1988, *Mogan Gölü Islah Projesi ve İnceleme Raporu.*
- Gölbaşı Municipality, 1995, *Mogan ve Eymir Gölleri 1. Çevre Kurultayı.*

- Green, W. H., Ampt, G. A., 1911, Studies on Soil Physics, part I, *The Flow of Air and Water through Soils*, J. Agric. Sci., vol. 4, no. 1, pp. 1-24.
- Hillel, D., 1980, *Application of Soil Physics*, Academic Press, Orlando, Fla.
- Hoggan, D. H., 1989, Computer-*Assisted Floodplain Hydrology and Hydraulics*, McGraw-Hill, USA.
- Horton, R. E., 1933, *The Role of Infiltration in the Hydrologic Cycle*, Trans. Am. Geophys. Union, vol. 14, pp. 446-460.
- Horton, R. E., 1939, *Analysis of Runoff Plant Experiments with Varying Infiltration Capacity*, Trans. Am. Geophys. Union, vol. 20, pp. 693-711.
- İzbırak, R., 1978, *Hidroğrafya, Akarsular ve Göller*, DTC Fak.Yay. No: 123, Ankara
- Kızılkaya, T., 1988, *Sulama ve Drenaj*, DSİ Publication, Ankara.
- McCarthy, G.T., 1938, *The Unit Hydrograph and Flood Routing*, Conf., North Atl. Div., U.S. Corps Eng.
- Özdemir, H., 1978, *Uygulamalı Taşkın Hidrolojisi*, DSİ Publication, Ankara.
- Pekin, U., 2007, *Kentsel Akarsu Koridorlarının Geliştirilmesi ve Kavramsal Yeşil Yol Planı*, Ph.D Thesis, Ankara University, Dept. of Landscape Architecture, Ankara.
- Philip, J. R., 1957, *The Theory of Infiltration: 1. The infiltration equation and its solution,* Soil Sci, vol. 83 no. 5, pp. 345-357.
- Philip, J. R., 1969, *Theory of Infiltration,* Advances in Hydroscince, ed. By V. T. Chow, vol. 5, pp. 215-296.
- Prasad, R., 1967, A Nonlinear Hydrologic System Response Model, J. Hydraulic Div., ASCE, Vol. 93, pp. 201-222.
- Raudviki, A. J., 1979, *Hydrology*, Pergamon Press, Oxford.
- Richards, L. A., 1931, *Capillary Conduction of Liquids through Porous Mediums*, Physics, vol. 1, pp. 318-333.
- Sherman, L. K., 1932, *Streamflow from Rainfall by the Unit-Graph Method*, Eng. News Record, 108, pp. 501-505.

- Soil Conservation Service, 1972, *National Engineering Handbook, section 4, Hydrology*, U. S. Dept. of Agriculture, Washington, D. C.

- Sungur, T., 1989, *Su Yapıları Cilt 1 Barajlar ve Göletler (Su Biriktirme Yapıları)*, DSİ Publication, Ankara.

- Usul, N., 2005, *Engineering Hydrology*, Metu Press, Ankara.

- U. S. Weather Bureau, 1958, *Technical Paper 29*.

- Web 1, http://asterweb.jpl.nasa.gov/index.asp

- Web 2, Ministry of Forestry and Waterworks, 1 / 25000 Ölçekli Ulusal Toprak Veri Tabanı http://aris.cob.gov.tr/sites/default/files/lejant.pdf

- Web 3, Ministry of Environment and Forestry, GMES Arazi İzleme Sistemi: http://corine.cevreorman.gov.tr/?q=node/1

- WMO (World Meteorological Organization), 1974, Guide to Hydrometeorological Practices, 3rd ed., WMO No: 168, Tech. Pap. 82, pp. 3.8-3.10, Geneva.

- Yanmaz, A. M., 2006, *Applied Water Resources Engineering*, METU Press, Ankara.

## APPENDIX A

**Table A 1** Design Hyetograph of Kepir Creek Subbasin (Tr = 50 yr)

| duration (min) | duration / total duration | depth / total depth | cumulative depth (cm) | incremental depth (cm) | ordered depth (cm) | cumulative ordered depth (cm) | cum. initial abstriction, Ia (cm) | cumulative abstriction, Fa (cm) | cumulative excess depth, Pe (cm) | excess depth (cm) |
|---|---|---|---|---|---|---|---|---|---|---|
| 10 | 0.014 | 0.140 | 0.727 | 0.727 | 0.016 | 0.016 | 0.016 | 0.000 | 0.000 | 0.000 |
| 20 | 0.028 | 0.225 | 1.168 | 0.441 | 0.021 | 0.036 | 0.036 | 0.000 | 0.000 | 0.000 |
| 30 | 0.042 | 0.283 | 1.469 | 0.301 | 0.021 | 0.057 | 0.057 | 0.000 | 0.000 | 0.000 |
| 40 | 0.056 | 0.325 | 1.687 | 0.218 | 0.021 | 0.078 | 0.078 | 0.000 | 0.000 | 0.000 |
| 50 | 0.070 | 0.366 | 1.900 | 0.213 | 0.021 | 0.099 | 0.099 | 0.000 | 0.000 | 0.000 |
| 60 | 0.084 | 0.400 | 2.076 | 0.176 | 0.021 | 0.119 | 0.119 | 0.000 | 0.000 | 0.000 |
| 70 | 0.097 | 0.432 | 2.242 | 0.166 | 0.021 | 0.140 | 0.140 | 0.000 | 0.000 | 0.000 |
| 80 | 0.111 | 0.462 | 2.398 | 0.156 | 0.021 | 0.161 | 0.161 | 0.000 | 0.000 | 0.000 |
| 90 | 0.125 | 0.488 | 2.533 | 0.135 | 0.021 | 0.182 | 0.182 | 0.000 | 0.000 | 0.000 |
| 100 | 0.139 | 0.508 | 2.637 | 0.104 | 0.021 | 0.202 | 0.202 | 0.000 | 0.000 | 0.000 |
| 110 | 0.153 | 0.527 | 2.735 | 0.099 | 0.026 | 0.228 | 0.228 | 0.000 | 0.000 | 0.000 |
| 120 | 0.167 | 0.545 | 2.829 | 0.093 | 0.026 | 0.254 | 0.254 | 0.000 | 0.000 | 0.000 |
| 130 | 0.181 | 0.563 | 2.922 | 0.093 | 0.026 | 0.280 | 0.280 | 0.000 | 0.000 | 0.000 |
| 140 | 0.195 | 0.580 | 3.010 | 0.088 | 0.026 | 0.306 | 0.306 | 0.000 | 0.000 | 0.000 |
| 150 | 0.209 | 0.595 | 3.088 | 0.078 | 0.031 | 0.337 | 0.337 | 0.000 | 0.000 | 0.000 |
| 160 | 0.222 | 0.610 | 3.166 | 0.078 | 0.031 | 0.368 | 0.368 | 0.000 | 0.000 | 0.000 |
| 170 | 0.236 | 0.625 | 3.244 | 0.078 | 0.036 | 0.405 | 0.405 | 0.000 | 0.000 | 0.000 |
| 180 | 0.250 | 0.640 | 3.322 | 0.078 | 0.036 | 0.441 | 0.441 | 0.000 | 0.000 | 0.000 |
| 190 | 0.264 | 0.655 | 3.399 | 0.078 | 0.036 | 0.477 | 0.477 | 0.000 | 0.000 | 0.000 |
| 200 | 0.278 | 0.669 | 3.472 | 0.073 | 0.042 | 0.519 | 0.519 | 0.000 | 0.000 | 0.000 |
| 210 | 0.292 | 0.683 | 3.545 | 0.073 | 0.052 | 0.571 | 0.571 | 0.000 | 0.000 | 0.000 |
| 220 | 0.306 | 0.695 | 3.607 | 0.062 | 0.052 | 0.623 | 0.623 | 0.000 | 0.000 | 0.000 |
| 230 | 0.320 | 0.707 | 3.669 | 0.062 | 0.057 | 0.680 | 0.680 | 0.000 | 0.000 | 0.000 |
| 240 | 0.334 | 0.719 | 3.732 | 0.062 | 0.062 | 0.742 | 0.742 | 0.000 | 0.000 | 0.000 |
| 250 | 0.347 | 0.731 | 3.794 | 0.062 | 0.062 | 0.804 | 0.804 | 0.000 | 0.000 | 0.000 |
| 260 | 0.361 | 0.742 | 3.851 | 0.057 | 0.073 | 0.877 | 0.877 | 0.000 | 0.000 | 0.000 |
| 270 | 0.375 | 0.753 | 3.908 | 0.057 | 0.078 | 0.955 | 0.955 | 0.000 | 0.000 | 0.000 |
| 280 | 0.389 | 0.763 | 3.960 | 0.052 | 0.078 | 1.033 | 1.033 | 0.000 | 0.000 | 0.000 |
| 290 | 0.403 | 0.773 | 4.012 | 0.052 | 0.078 | 1.111 | 1.111 | 0.000 | 0.000 | 0.000 |
| 300 | 0.417 | 0.783 | 4.064 | 0.052 | 0.093 | 1.204 | 1.204 | 0.000 | 0.000 | 0.000 |
| 310 | 0.431 | 0.793 | 4.116 | 0.052 | 0.099 | 1.303 | 1.303 | 0.000 | 0.000 | 0.000 |
| 320 | 0.445 | 0.803 | 4.168 | 0.052 | 0.135 | 1.438 | 1.350 | 0.086 | 0.001 | 0.001 |
| 330 | 0.459 | 0.811 | 4.209 | 0.042 | 0.166 | 1.604 | 1.350 | 0.244 | 0.009 | 0.008 |
| 340 | 0.472 | 0.819 | 4.251 | 0.042 | 0.213 | 1.817 | 1.350 | 0.436 | 0.030 | 0.021 |
| 350 | 0.486 | 0.826 | 4.287 | 0.036 | 0.301 | 2.118 | 1.350 | 0.689 | 0.078 | 0.048 |
| 360 | 0.500 | 0.833 | 4.323 | 0.036 | 0.727 | 2.844 | 1.350 | 1.223 | 0.271 | 0.192 |

**Table A 1** (continued)

| duration (min) | duration / total duration | depth / total depth | cumulative depth (cm) | incremental depth (cm) | ordered depth (cm) | cumulative ordered depth (cm) | cum. initial abstriction, Ia (cm) | cumulative abstriction, Fa (cm) | cumulative excess depth, Pe (cm) | excess depth (cm) |
|---|---|---|---|---|---|---|---|---|---|---|
| 370 | 0.514 | 0.840 | 4.360 | 0.036 | 0.441 | 3.285 | 1.350 | 1.504 | 0.431 | 0.160 |
| 380 | 0.528 | 0.847 | 4.396 | 0.036 | 0.218 | 3.503 | 1.350 | 1.632 | 0.520 | 0.090 |
| 390 | 0.542 | 0.854 | 4.432 | 0.036 | 0.176 | 3.680 | 1.350 | 1.732 | 0.597 | 0.077 |
| 400 | 0.556 | 0.860 | 4.463 | 0.031 | 0.156 | 3.835 | 1.350 | 1.816 | 0.669 | 0.071 |
| 410 | 0.569 | 0.866 | 4.495 | 0.031 | 0.104 | 3.939 | 1.350 | 1.871 | 0.718 | 0.049 |
| 420 | 0.583 | 0.872 | 4.526 | 0.031 | 0.093 | 4.033 | 1.350 | 1.920 | 0.763 | 0.045 |
| 430 | 0.597 | 0.878 | 4.557 | 0.031 | 0.088 | 4.121 | 1.350 | 1.964 | 0.806 | 0.043 |
| 440 | 0.611 | 0.883 | 4.583 | 0.026 | 0.078 | 4.199 | 1.350 | 2.003 | 0.845 | 0.039 |
| 450 | 0.625 | 0.888 | 4.609 | 0.026 | 0.078 | 4.277 | 1.350 | 2.041 | 0.885 | 0.040 |
| 460 | 0.639 | 0.893 | 4.635 | 0.026 | 0.073 | 4.349 | 1.350 | 2.077 | 0.922 | 0.038 |
| 470 | 0.653 | 0.898 | 4.661 | 0.026 | 0.062 | 4.412 | 1.350 | 2.106 | 0.955 | 0.033 |
| 480 | 0.667 | 0.903 | 4.687 | 0.026 | 0.062 | 4.474 | 1.350 | 2.136 | 0.988 | 0.033 |
| 490 | 0.681 | 0.908 | 4.713 | 0.026 | 0.057 | 4.531 | 1.350 | 2.162 | 1.018 | 0.031 |
| 500 | 0.694 | 0.913 | 4.738 | 0.026 | 0.052 | 4.583 | 1.350 | 2.186 | 1.046 | 0.028 |
| 510 | 0.708 | 0.918 | 4.764 | 0.026 | 0.052 | 4.635 | 1.350 | 2.210 | 1.075 | 0.028 |
| 520 | 0.722 | 0.923 | 4.790 | 0.026 | 0.052 | 4.687 | 1.350 | 2.233 | 1.103 | 0.029 |
| 530 | 0.736 | 0.927 | 4.811 | 0.021 | 0.042 | 4.728 | 1.350 | 2.251 | 1.126 | 0.023 |
| 540 | 0.750 | 0.931 | 4.832 | 0.021 | 0.036 | 4.764 | 1.350 | 2.267 | 1.147 | 0.020 |
| 550 | 0.764 | 0.935 | 4.853 | 0.021 | 0.036 | 4.801 | 1.350 | 2.283 | 1.167 | 0.020 |
| 560 | 0.778 | 0.939 | 4.873 | 0.021 | 0.031 | 4.832 | 1.350 | 2.297 | 1.184 | 0.018 |
| 570 | 0.792 | 0.943 | 4.894 | 0.021 | 0.031 | 4.863 | 1.350 | 2.311 | 1.202 | 0.018 |
| 580 | 0.806 | 0.947 | 4.915 | 0.021 | 0.026 | 4.889 | 1.350 | 2.322 | 1.217 | 0.015 |
| 590 | 0.819 | 0.951 | 4.936 | 0.021 | 0.026 | 4.915 | 1.350 | 2.333 | 1.232 | 0.015 |
| 600 | 0.833 | 0.955 | 4.956 | 0.021 | 0.026 | 4.941 | 1.350 | 2.344 | 1.246 | 0.015 |
| 610 | 0.847 | 0.959 | 4.977 | 0.021 | 0.026 | 4.967 | 1.350 | 2.355 | 1.261 | 0.015 |
| 620 | 0.861 | 0.963 | 4.998 | 0.021 | 0.026 | 4.993 | 1.350 | 2.366 | 1.276 | 0.015 |
| 630 | 0.875 | 0.967 | 5.019 | 0.021 | 0.021 | 5.014 | 1.350 | 2.375 | 1.288 | 0.012 |
| 640 | 0.889 | 0.971 | 5.039 | 0.021 | 0.021 | 5.034 | 1.350 | 2.383 | 1.300 | 0.012 |
| 650 | 0.903 | 0.975 | 5.060 | 0.021 | 0.021 | 5.055 | 1.350 | 2.392 | 1.313 | 0.012 |
| 660 | 0.917 | 0.979 | 5.081 | 0.021 | 0.021 | 5.076 | 1.350 | 2.401 | 1.325 | 0.012 |
| 670 | 0.931 | 0.983 | 5.102 | 0.021 | 0.021 | 5.097 | 1.350 | 2.409 | 1.337 | 0.012 |
| 680 | 0.944 | 0.987 | 5.123 | 0.021 | 0.021 | 5.117 | 1.350 | 2.418 | 1.349 | 0.012 |
| 690 | 0.958 | 0.991 | 5.143 | 0.021 | 0.021 | 5.138 | 1.350 | 2.426 | 1.361 | 0.012 |
| 700 | 0.972 | 0.994 | 5.159 | 0.016 | 0.021 | 5.159 | 1.350 | 2.435 | 1.373 | 0.012 |
| 710 | 0.986 | 0.997 | 5.174 | 0.016 | 0.016 | 5.174 | 1.350 | 2.441 | 1.383 | 0.009 |
| 720 | 1.000 | 1.000 | 5.190 | 0.016 | 0.016 | 5.190 | 1.350 | 2.448 | 1.392 | 0.009 |

**Table A 2** Design Hyetograph of Kepir Creek Subbasin (Tr = 100 yr)

| duration (min) | duration / total duration | depth / total depth | cumulative depth (cm) | incremental depth (cm) | ordered depth (cm) | cumulative ordered depth (cm) | cum. initial abstriction, Ia (cm) | cumulative abstriction, Fa (cm) | cumulative excess depth, Pe (cm) | excess depth (cm) |
|---|---|---|---|---|---|---|---|---|---|---|
| 10 | 0.014 | 0.140 | 0.814 | 0.814 | 0.017 | 0.017 | 0.017 | 0.000 | 0.000 | 0.000 |
| 20 | 0.028 | 0.225 | 1.308 | 0.494 | 0.023 | 0.041 | 0.041 | 0.000 | 0.000 | 0.000 |
| 30 | 0.042 | 0.283 | 1.645 | 0.337 | 0.023 | 0.064 | 0.064 | 0.000 | 0.000 | 0.000 |
| 40 | 0.056 | 0.325 | 1.889 | 0.244 | 0.023 | 0.087 | 0.087 | 0.000 | 0.000 | 0.000 |
| 50 | 0.070 | 0.366 | 2.127 | 0.238 | 0.023 | 0.110 | 0.110 | 0.000 | 0.000 | 0.000 |
| 60 | 0.084 | 0.400 | 2.325 | 0.198 | 0.023 | 0.134 | 0.134 | 0.000 | 0.000 | 0.000 |
| 70 | 0.097 | 0.432 | 2.511 | 0.186 | 0.023 | 0.157 | 0.157 | 0.000 | 0.000 | 0.000 |
| 80 | 0.111 | 0.462 | 2.686 | 0.174 | 0.023 | 0.180 | 0.180 | 0.000 | 0.000 | 0.000 |
| 90 | 0.125 | 0.488 | 2.837 | 0.151 | 0.023 | 0.203 | 0.203 | 0.000 | 0.000 | 0.000 |
| 100 | 0.139 | 0.508 | 2.953 | 0.116 | 0.023 | 0.227 | 0.227 | 0.000 | 0.000 | 0.000 |
| 110 | 0.153 | 0.527 | 3.063 | 0.110 | 0.029 | 0.256 | 0.256 | 0.000 | 0.000 | 0.000 |
| 120 | 0.167 | 0.545 | 3.168 | 0.105 | 0.029 | 0.285 | 0.285 | 0.000 | 0.000 | 0.000 |
| 130 | 0.181 | 0.563 | 3.273 | 0.105 | 0.029 | 0.314 | 0.314 | 0.000 | 0.000 | 0.000 |
| 140 | 0.195 | 0.580 | 3.371 | 0.099 | 0.029 | 0.343 | 0.343 | 0.000 | 0.000 | 0.000 |
| 150 | 0.209 | 0.595 | 3.459 | 0.087 | 0.035 | 0.378 | 0.378 | 0.000 | 0.000 | 0.000 |
| 160 | 0.222 | 0.610 | 3.546 | 0.087 | 0.035 | 0.413 | 0.413 | 0.000 | 0.000 | 0.000 |
| 170 | 0.236 | 0.625 | 3.633 | 0.087 | 0.041 | 0.453 | 0.453 | 0.000 | 0.000 | 0.000 |
| 180 | 0.250 | 0.640 | 3.720 | 0.087 | 0.041 | 0.494 | 0.494 | 0.000 | 0.000 | 0.000 |
| 190 | 0.264 | 0.655 | 3.807 | 0.087 | 0.041 | 0.535 | 0.535 | 0.000 | 0.000 | 0.000 |
| 200 | 0.278 | 0.669 | 3.889 | 0.081 | 0.047 | 0.581 | 0.581 | 0.000 | 0.000 | 0.000 |
| 210 | 0.292 | 0.683 | 3.970 | 0.081 | 0.058 | 0.639 | 0.639 | 0.000 | 0.000 | 0.000 |
| 220 | 0.306 | 0.695 | 4.040 | 0.070 | 0.058 | 0.698 | 0.698 | 0.000 | 0.000 | 0.000 |
| 230 | 0.320 | 0.707 | 4.110 | 0.070 | 0.064 | 0.761 | 0.761 | 0.000 | 0.000 | 0.000 |
| 240 | 0.334 | 0.719 | 4.179 | 0.070 | 0.070 | 0.831 | 0.831 | 0.000 | 0.000 | 0.000 |
| 250 | 0.347 | 0.731 | 4.249 | 0.070 | 0.070 | 0.901 | 0.901 | 0.000 | 0.000 | 0.000 |
| 260 | 0.361 | 0.742 | 4.313 | 0.064 | 0.081 | 0.982 | 0.982 | 0.000 | 0.000 | 0.000 |
| 270 | 0.375 | 0.753 | 4.377 | 0.064 | 0.087 | 1.070 | 1.070 | 0.000 | 0.000 | 0.000 |
| 280 | 0.389 | 0.763 | 4.435 | 0.058 | 0.087 | 1.157 | 1.157 | 0.000 | 0.000 | 0.000 |
| 290 | 0.403 | 0.773 | 4.493 | 0.058 | 0.087 | 1.244 | 1.244 | 0.000 | 0.000 | 0.000 |
| 300 | 0.417 | 0.783 | 4.551 | 0.058 | 0.105 | 1.349 | 1.349 | 0.000 | 0.000 | 0.000 |
| 310 | 0.431 | 0.793 | 4.610 | 0.058 | 0.110 | 1.459 | 1.350 | 0.107 | 0.002 | 0.002 |
| 320 | 0.445 | 0.803 | 4.668 | 0.058 | 0.151 | 1.610 | 1.350 | 0.250 | 0.010 | 0.008 |
| 330 | 0.459 | 0.811 | 4.714 | 0.047 | 0.186 | 1.796 | 1.350 | 0.418 | 0.028 | 0.018 |
| 340 | 0.472 | 0.819 | 4.761 | 0.047 | 0.238 | 2.034 | 1.350 | 0.621 | 0.063 | 0.035 |
| 350 | 0.486 | 0.826 | 4.801 | 0.041 | 0.337 | 2.372 | 1.350 | 0.887 | 0.134 | 0.071 |
| 360 | 0.500 | 0.833 | 4.842 | 0.041 | 0.814 | 3.185 | 1.350 | 1.443 | 0.392 | 0.258 |

**Table A 2** (continued)

| duration (min) | duration / total duration | depth / total depth | cumulative depth (cm) | incremental depth (cm) | ordered depth (cm) | cumulative ordered depth (cm) | cum. initial abstriction, Ia (cm) | cumulative abstriction, Fa (cm) | cumulative excess depth, Pe (cm) | excess depth (cm) |
|---|---|---|---|---|---|---|---|---|---|---|
| 370 | 0.514 | 0.840 | 4.883 | 0.041 | 0.494 | 3.680 | 1.350 | 1.732 | 0.597 | 0.205 |
| 380 | 0.528 | 0.847 | 4.923 | 0.041 | 0.244 | 3.924 | 1.350 | 1.863 | 0.710 | 0.113 |
| 390 | 0.542 | 0.854 | 4.964 | 0.041 | 0.198 | 4.121 | 1.350 | 1.965 | 0.806 | 0.096 |
| 400 | 0.556 | 0.860 | 4.999 | 0.035 | 0.174 | 4.296 | 1.350 | 2.051 | 0.895 | 0.088 |
| 410 | 0.569 | 0.866 | 5.034 | 0.035 | 0.116 | 4.412 | 1.350 | 2.106 | 0.955 | 0.061 |
| 420 | 0.583 | 0.872 | 5.069 | 0.035 | 0.105 | 4.517 | 1.350 | 2.155 | 1.011 | 0.056 |
| 430 | 0.597 | 0.878 | 5.104 | 0.035 | 0.099 | 4.615 | 1.350 | 2.201 | 1.064 | 0.053 |
| 440 | 0.611 | 0.883 | 5.133 | 0.029 | 0.087 | 4.703 | 1.350 | 2.240 | 1.112 | 0.048 |
| 450 | 0.625 | 0.888 | 5.162 | 0.029 | 0.087 | 4.790 | 1.350 | 2.279 | 1.161 | 0.049 |
| 460 | 0.639 | 0.893 | 5.191 | 0.029 | 0.081 | 4.871 | 1.350 | 2.314 | 1.207 | 0.046 |
| 470 | 0.653 | 0.898 | 5.220 | 0.029 | 0.070 | 4.941 | 1.350 | 2.344 | 1.246 | 0.040 |
| 480 | 0.667 | 0.903 | 5.249 | 0.029 | 0.070 | 5.011 | 1.350 | 2.374 | 1.287 | 0.040 |
| 490 | 0.681 | 0.908 | 5.278 | 0.029 | 0.064 | 5.075 | 1.350 | 2.400 | 1.324 | 0.037 |
| 500 | 0.694 | 0.913 | 5.307 | 0.029 | 0.058 | 5.133 | 1.350 | 2.424 | 1.358 | 0.034 |
| 510 | 0.708 | 0.918 | 5.336 | 0.029 | 0.058 | 5.191 | 1.350 | 2.448 | 1.392 | 0.034 |
| 520 | 0.722 | 0.923 | 5.365 | 0.029 | 0.058 | 5.249 | 1.350 | 2.472 | 1.427 | 0.035 |
| 530 | 0.736 | 0.927 | 5.388 | 0.023 | 0.047 | 5.295 | 1.350 | 2.490 | 1.455 | 0.028 |
| 540 | 0.750 | 0.931 | 5.412 | 0.023 | 0.041 | 5.336 | 1.350 | 2.506 | 1.479 | 0.025 |
| 550 | 0.764 | 0.935 | 5.435 | 0.023 | 0.041 | 5.377 | 1.350 | 2.522 | 1.504 | 0.025 |
| 560 | 0.778 | 0.939 | 5.458 | 0.023 | 0.035 | 5.412 | 1.350 | 2.536 | 1.525 | 0.021 |
| 570 | 0.792 | 0.943 | 5.481 | 0.023 | 0.035 | 5.447 | 1.350 | 2.549 | 1.547 | 0.021 |
| 580 | 0.806 | 0.947 | 5.505 | 0.023 | 0.029 | 5.476 | 1.350 | 2.561 | 1.565 | 0.018 |
| 590 | 0.819 | 0.951 | 5.528 | 0.023 | 0.029 | 5.505 | 1.350 | 2.572 | 1.582 | 0.018 |
| 600 | 0.833 | 0.955 | 5.551 | 0.023 | 0.029 | 5.534 | 1.350 | 2.583 | 1.600 | 0.018 |
| 610 | 0.847 | 0.959 | 5.574 | 0.023 | 0.029 | 5.563 | 1.350 | 2.594 | 1.618 | 0.018 |
| 620 | 0.861 | 0.963 | 5.598 | 0.023 | 0.029 | 5.592 | 1.350 | 2.605 | 1.636 | 0.018 |
| 630 | 0.875 | 0.967 | 5.621 | 0.023 | 0.023 | 5.615 | 1.350 | 2.614 | 1.651 | 0.014 |
| 640 | 0.889 | 0.971 | 5.644 | 0.023 | 0.023 | 5.638 | 1.350 | 2.623 | 1.666 | 0.015 |
| 650 | 0.903 | 0.975 | 5.667 | 0.023 | 0.023 | 5.662 | 1.350 | 2.631 | 1.680 | 0.015 |
| 660 | 0.917 | 0.979 | 5.691 | 0.023 | 0.023 | 5.685 | 1.350 | 2.640 | 1.695 | 0.015 |
| 670 | 0.931 | 0.983 | 5.714 | 0.023 | 0.023 | 5.708 | 1.350 | 2.648 | 1.709 | 0.015 |
| 680 | 0.944 | 0.987 | 5.737 | 0.023 | 0.023 | 5.731 | 1.350 | 2.657 | 1.724 | 0.015 |
| 690 | 0.958 | 0.991 | 5.760 | 0.023 | 0.023 | 5.755 | 1.350 | 2.666 | 1.739 | 0.015 |
| 700 | 0.972 | 0.994 | 5.778 | 0.017 | 0.023 | 5.778 | 1.350 | 2.674 | 1.753 | 0.015 |
| 710 | 0.986 | 0.997 | 5.795 | 0.017 | 0.017 | 5.795 | 1.350 | 2.680 | 1.765 | 0.011 |
| 720 | 1.000 | 1.000 | 5.813 | 0.017 | 0.017 | 5.813 | 1.350 | 2.687 | 1.776 | 0.011 |

**Table A 3** Design Hyetograph of Kepir Creek Subbasin (Tr = 500 yr)

| duration (min) | duration / total duration | depth / total depth | cumulative depth (cm) | incremental depth (cm) | ordered depth (cm) | cumulative ordered depth (cm) | cum. initial abstriction, Ia (cm) | cumulative abstriction, Fa (cm) | cumulative excess depth, Pe (cm) | excess depth (cm) |
|---|---|---|---|---|---|---|---|---|---|---|
| 10 | 0.014 | 0.140 | 1.014 | 1.014 | 0.022 | 0.022 | 0.022 | 0.000 | 0.000 | 0.000 |
| 20 | 0.028 | 0.225 | 1.630 | 0.616 | 0.029 | 0.051 | 0.051 | 0.000 | 0.000 | 0.000 |
| 30 | 0.042 | 0.283 | 2.050 | 0.420 | 0.029 | 0.080 | 0.080 | 0.000 | 0.000 | 0.000 |
| 40 | 0.056 | 0.325 | 2.355 | 0.304 | 0.029 | 0.109 | 0.109 | 0.000 | 0.000 | 0.000 |
| 50 | 0.070 | 0.366 | 2.652 | 0.297 | 0.029 | 0.138 | 0.138 | 0.000 | 0.000 | 0.000 |
| 60 | 0.084 | 0.400 | 2.898 | 0.246 | 0.029 | 0.167 | 0.167 | 0.000 | 0.000 | 0.000 |
| 70 | 0.097 | 0.432 | 3.130 | 0.232 | 0.029 | 0.196 | 0.196 | 0.000 | 0.000 | 0.000 |
| 80 | 0.111 | 0.462 | 3.347 | 0.217 | 0.029 | 0.225 | 0.225 | 0.000 | 0.000 | 0.000 |
| 90 | 0.125 | 0.488 | 3.536 | 0.188 | 0.029 | 0.254 | 0.254 | 0.000 | 0.000 | 0.000 |
| 100 | 0.139 | 0.508 | 3.681 | 0.145 | 0.029 | 0.283 | 0.283 | 0.000 | 0.000 | 0.000 |
| 110 | 0.153 | 0.527 | 3.818 | 0.138 | 0.036 | 0.319 | 0.319 | 0.000 | 0.000 | 0.000 |
| 120 | 0.167 | 0.545 | 3.949 | 0.130 | 0.036 | 0.355 | 0.355 | 0.000 | 0.000 | 0.000 |
| 130 | 0.181 | 0.563 | 4.079 | 0.130 | 0.036 | 0.391 | 0.391 | 0.000 | 0.000 | 0.000 |
| 140 | 0.195 | 0.580 | 4.202 | 0.123 | 0.036 | 0.427 | 0.427 | 0.000 | 0.000 | 0.000 |
| 150 | 0.209 | 0.595 | 4.311 | 0.109 | 0.043 | 0.471 | 0.471 | 0.000 | 0.000 | 0.000 |
| 160 | 0.222 | 0.610 | 4.420 | 0.109 | 0.043 | 0.514 | 0.514 | 0.000 | 0.000 | 0.000 |
| 170 | 0.236 | 0.625 | 4.528 | 0.109 | 0.051 | 0.565 | 0.565 | 0.000 | 0.000 | 0.000 |
| 180 | 0.250 | 0.640 | 4.637 | 0.109 | 0.051 | 0.616 | 0.616 | 0.000 | 0.000 | 0.000 |
| 190 | 0.264 | 0.655 | 4.746 | 0.109 | 0.051 | 0.667 | 0.667 | 0.000 | 0.000 | 0.000 |
| 200 | 0.278 | 0.669 | 4.847 | 0.101 | 0.058 | 0.725 | 0.725 | 0.000 | 0.000 | 0.000 |
| 210 | 0.292 | 0.683 | 4.948 | 0.101 | 0.072 | 0.797 | 0.797 | 0.000 | 0.000 | 0.000 |
| 220 | 0.306 | 0.695 | 5.035 | 0.087 | 0.072 | 0.869 | 0.869 | 0.000 | 0.000 | 0.000 |
| 230 | 0.320 | 0.707 | 5.122 | 0.087 | 0.080 | 0.949 | 0.949 | 0.000 | 0.000 | 0.000 |
| 240 | 0.334 | 0.719 | 5.209 | 0.087 | 0.087 | 1.036 | 1.036 | 0.000 | 0.000 | 0.000 |
| 250 | 0.347 | 0.731 | 5.296 | 0.087 | 0.087 | 1.123 | 1.123 | 0.000 | 0.000 | 0.000 |
| 260 | 0.361 | 0.742 | 5.376 | 0.080 | 0.101 | 1.224 | 1.224 | 0.000 | 0.000 | 0.000 |
| 270 | 0.375 | 0.753 | 5.456 | 0.080 | 0.109 | 1.333 | 1.333 | 0.000 | 0.000 | 0.000 |
| 280 | 0.389 | 0.763 | 5.528 | 0.072 | 0.109 | 1.442 | 1.350 | 0.090 | 0.001 | 0.001 |
| 290 | 0.403 | 0.773 | 5.601 | 0.072 | 0.109 | 1.550 | 1.350 | 0.194 | 0.006 | 0.005 |
| 300 | 0.417 | 0.783 | 5.673 | 0.072 | 0.130 | 1.681 | 1.350 | 0.315 | 0.015 | 0.010 |
| 310 | 0.431 | 0.793 | 5.745 | 0.072 | 0.138 | 1.819 | 1.350 | 0.438 | 0.030 | 0.015 |
| 320 | 0.445 | 0.803 | 5.818 | 0.072 | 0.188 | 2.007 | 1.350 | 0.598 | 0.058 | 0.028 |
| 330 | 0.459 | 0.811 | 5.876 | 0.058 | 0.232 | 2.239 | 1.350 | 0.785 | 0.103 | 0.045 |
| 340 | 0.472 | 0.819 | 5.934 | 0.058 | 0.297 | 2.536 | 1.350 | 1.008 | 0.177 | 0.074 |
| 350 | 0.486 | 0.826 | 5.985 | 0.051 | 0.420 | 2.956 | 1.350 | 1.297 | 0.308 | 0.131 |
| 360 | 0.500 | 0.833 | 6.035 | 0.051 | 1.014 | 3.970 | 1.350 | 1.888 | 0.732 | 0.424 |

**Table A 3** (continued)

| duration (min) | duration / total duration | depth / total depth | cumulative depth (cm) | incremental depth (cm) | ordered depth (cm) | cumulative ordered depth (cm) | cum. initial abstriction, Ia (cm) | cumulative abstriction, Fa (cm) | cumulative excess depth, Pe (cm) | excess depth (cm) |
|---|---|---|---|---|---|---|---|---|---|---|
| 370 | 0.514 | 0.840 | 6.086 | 0.051 | 0.616 | 4.586 | 1.350 | 2.187 | 1.048 | 0.316 |
| 380 | 0.528 | 0.847 | 6.137 | 0.051 | 0.304 | 4.891 | 1.350 | 2.322 | 1.218 | 0.169 |
| 390 | 0.542 | 0.854 | 6.187 | 0.051 | 0.246 | 5.137 | 1.350 | 2.426 | 1.360 | 0.143 |
| 400 | 0.556 | 0.860 | 6.231 | 0.043 | 0.217 | 5.354 | 1.350 | 2.513 | 1.490 | 0.130 |
| 410 | 0.569 | 0.866 | 6.274 | 0.043 | 0.145 | 5.499 | 1.350 | 2.570 | 1.579 | 0.089 |
| 420 | 0.583 | 0.872 | 6.318 | 0.043 | 0.130 | 5.630 | 1.350 | 2.619 | 1.660 | 0.081 |
| 430 | 0.597 | 0.878 | 6.361 | 0.043 | 0.123 | 5.753 | 1.350 | 2.665 | 1.738 | 0.078 |
| 440 | 0.611 | 0.883 | 6.398 | 0.036 | 0.109 | 5.861 | 1.350 | 2.704 | 1.807 | 0.069 |
| 450 | 0.625 | 0.888 | 6.434 | 0.036 | 0.109 | 5.970 | 1.350 | 2.743 | 1.877 | 0.070 |
| 460 | 0.639 | 0.893 | 6.470 | 0.036 | 0.101 | 6.072 | 1.350 | 2.778 | 1.943 | 0.066 |
| 470 | 0.653 | 0.898 | 6.506 | 0.036 | 0.087 | 6.158 | 1.350 | 2.808 | 2.000 | 0.057 |
| 480 | 0.667 | 0.903 | 6.542 | 0.036 | 0.087 | 6.245 | 1.350 | 2.838 | 2.057 | 0.058 |
| 490 | 0.681 | 0.908 | 6.579 | 0.036 | 0.080 | 6.325 | 1.350 | 2.864 | 2.110 | 0.053 |
| 500 | 0.694 | 0.913 | 6.615 | 0.036 | 0.072 | 6.398 | 1.350 | 2.888 | 2.159 | 0.049 |
| 510 | 0.708 | 0.918 | 6.651 | 0.036 | 0.072 | 6.470 | 1.350 | 2.912 | 2.208 | 0.049 |
| 520 | 0.722 | 0.923 | 6.687 | 0.036 | 0.072 | 6.542 | 1.350 | 2.935 | 2.257 | 0.049 |
| 530 | 0.736 | 0.927 | 6.716 | 0.029 | 0.058 | 6.600 | 1.350 | 2.953 | 2.297 | 0.040 |
| 540 | 0.750 | 0.931 | 6.745 | 0.029 | 0.051 | 6.651 | 1.350 | 2.969 | 2.331 | 0.035 |
| 550 | 0.764 | 0.935 | 6.774 | 0.029 | 0.051 | 6.702 | 1.350 | 2.985 | 2.366 | 0.035 |
| 560 | 0.778 | 0.939 | 6.803 | 0.029 | 0.043 | 6.745 | 1.350 | 2.999 | 2.396 | 0.030 |
| 570 | 0.792 | 0.943 | 6.832 | 0.029 | 0.043 | 6.789 | 1.350 | 3.012 | 2.426 | 0.030 |
| 580 | 0.806 | 0.947 | 6.861 | 0.029 | 0.036 | 6.825 | 1.350 | 3.023 | 2.451 | 0.025 |
| 590 | 0.819 | 0.951 | 6.890 | 0.029 | 0.036 | 6.861 | 1.350 | 3.034 | 2.477 | 0.025 |
| 600 | 0.833 | 0.955 | 6.919 | 0.029 | 0.036 | 6.897 | 1.350 | 3.045 | 2.502 | 0.025 |
| 610 | 0.847 | 0.959 | 6.948 | 0.029 | 0.036 | 6.934 | 1.350 | 3.056 | 2.527 | 0.025 |
| 620 | 0.861 | 0.963 | 6.977 | 0.029 | 0.036 | 6.970 | 1.350 | 3.067 | 2.553 | 0.025 |
| 630 | 0.875 | 0.967 | 7.006 | 0.029 | 0.029 | 6.999 | 1.350 | 3.076 | 2.573 | 0.020 |
| 640 | 0.889 | 0.971 | 7.035 | 0.029 | 0.029 | 7.028 | 1.350 | 3.084 | 2.593 | 0.020 |
| 650 | 0.903 | 0.975 | 7.064 | 0.029 | 0.029 | 7.057 | 1.350 | 3.093 | 2.614 | 0.020 |
| 660 | 0.917 | 0.979 | 7.093 | 0.029 | 0.029 | 7.086 | 1.350 | 3.101 | 2.634 | 0.020 |
| 670 | 0.931 | 0.983 | 7.122 | 0.029 | 0.029 | 7.115 | 1.350 | 3.110 | 2.655 | 0.021 |
| 680 | 0.944 | 0.987 | 7.151 | 0.029 | 0.029 | 7.144 | 1.350 | 3.118 | 2.675 | 0.021 |
| 690 | 0.958 | 0.991 | 7.180 | 0.029 | 0.029 | 7.173 | 1.350 | 3.126 | 2.696 | 0.021 |
| 700 | 0.972 | 0.994 | 7.202 | 0.022 | 0.029 | 7.202 | 1.350 | 3.135 | 2.717 | 0.021 |
| 710 | 0.986 | 0.997 | 7.224 | 0.022 | 0.022 | 7.224 | 1.350 | 3.141 | 2.732 | 0.016 |
| 720 | 1.000 | 1.000 | 7.245 | 0.022 | 0.022 | 7.245 | 1.350 | 3.147 | 2.748 | 0.016 |

**Table A 4** Design Hyetograph of İğdeli Creek Subbasin (Tr = 50 yr)

| duration (min) | duration / total duration | depth / total depth | cumulative depth (cm) | incremental depth (cm) | ordered depth (cm) | cumulative ordered depth (cm) | cum. initial abstriction, Ia (cm) | cumulative abstriction, Fa (cm) | cumulative excess depth, Pe (cm) | excess depth (cm) |
|---|---|---|---|---|---|---|---|---|---|---|
| 10 | 0.014 | 0.140 | 0.727 | 0.727 | 0.016 | 0.016 | 0.016 | 0.000 | 0.000 | 0.000 |
| 20 | 0.028 | 0.225 | 1.168 | 0.441 | 0.021 | 0.036 | 0.036 | 0.000 | 0.000 | 0.000 |
| 30 | 0.042 | 0.283 | 1.469 | 0.301 | 0.021 | 0.057 | 0.057 | 0.000 | 0.000 | 0.000 |
| 40 | 0.056 | 0.325 | 1.687 | 0.218 | 0.021 | 0.078 | 0.078 | 0.000 | 0.000 | 0.000 |
| 50 | 0.070 | 0.366 | 1.900 | 0.213 | 0.021 | 0.099 | 0.099 | 0.000 | 0.000 | 0.000 |
| 60 | 0.084 | 0.400 | 2.076 | 0.176 | 0.021 | 0.119 | 0.119 | 0.000 | 0.000 | 0.000 |
| 70 | 0.097 | 0.432 | 2.242 | 0.166 | 0.021 | 0.140 | 0.140 | 0.000 | 0.000 | 0.000 |
| 80 | 0.111 | 0.462 | 2.398 | 0.156 | 0.021 | 0.161 | 0.161 | 0.000 | 0.000 | 0.000 |
| 90 | 0.125 | 0.488 | 2.533 | 0.135 | 0.021 | 0.182 | 0.182 | 0.000 | 0.000 | 0.000 |
| 100 | 0.139 | 0.508 | 2.637 | 0.104 | 0.021 | 0.202 | 0.202 | 0.000 | 0.000 | 0.000 |
| 110 | 0.153 | 0.527 | 2.735 | 0.099 | 0.026 | 0.228 | 0.228 | 0.000 | 0.000 | 0.000 |
| 120 | 0.167 | 0.545 | 2.829 | 0.093 | 0.026 | 0.254 | 0.254 | 0.000 | 0.000 | 0.000 |
| 130 | 0.181 | 0.563 | 2.922 | 0.093 | 0.026 | 0.280 | 0.280 | 0.000 | 0.000 | 0.000 |
| 140 | 0.195 | 0.580 | 3.010 | 0.088 | 0.026 | 0.306 | 0.306 | 0.000 | 0.000 | 0.000 |
| 150 | 0.209 | 0.595 | 3.088 | 0.078 | 0.031 | 0.337 | 0.337 | 0.000 | 0.000 | 0.000 |
| 160 | 0.222 | 0.610 | 3.166 | 0.078 | 0.031 | 0.368 | 0.368 | 0.000 | 0.000 | 0.000 |
| 170 | 0.236 | 0.625 | 3.244 | 0.078 | 0.036 | 0.405 | 0.405 | 0.000 | 0.000 | 0.000 |
| 180 | 0.250 | 0.640 | 3.322 | 0.078 | 0.036 | 0.441 | 0.441 | 0.000 | 0.000 | 0.000 |
| 190 | 0.264 | 0.655 | 3.399 | 0.078 | 0.036 | 0.477 | 0.477 | 0.000 | 0.000 | 0.000 |
| 200 | 0.278 | 0.669 | 3.472 | 0.073 | 0.042 | 0.519 | 0.519 | 0.000 | 0.000 | 0.000 |
| 210 | 0.292 | 0.683 | 3.545 | 0.073 | 0.052 | 0.571 | 0.571 | 0.000 | 0.000 | 0.000 |
| 220 | 0.306 | 0.695 | 3.607 | 0.062 | 0.052 | 0.623 | 0.623 | 0.000 | 0.000 | 0.000 |
| 230 | 0.320 | 0.707 | 3.669 | 0.062 | 0.057 | 0.680 | 0.680 | 0.000 | 0.000 | 0.000 |
| 240 | 0.334 | 0.719 | 3.732 | 0.062 | 0.062 | 0.742 | 0.742 | 0.000 | 0.000 | 0.000 |
| 250 | 0.347 | 0.731 | 3.794 | 0.062 | 0.062 | 0.804 | 0.804 | 0.000 | 0.000 | 0.000 |
| 260 | 0.361 | 0.742 | 3.851 | 0.057 | 0.073 | 0.877 | 0.877 | 0.000 | 0.000 | 0.000 |
| 270 | 0.375 | 0.753 | 3.908 | 0.057 | 0.078 | 0.955 | 0.955 | 0.000 | 0.000 | 0.000 |
| 280 | 0.389 | 0.763 | 3.960 | 0.052 | 0.078 | 1.033 | 1.033 | 0.000 | 0.000 | 0.000 |
| 290 | 0.403 | 0.773 | 4.012 | 0.052 | 0.078 | 1.111 | 1.111 | 0.000 | 0.000 | 0.000 |
| 300 | 0.417 | 0.783 | 4.064 | 0.052 | 0.093 | 1.204 | 1.204 | 0.000 | 0.000 | 0.000 |
| 310 | 0.431 | 0.793 | 4.116 | 0.052 | 0.099 | 1.303 | 1.270 | 0.033 | 0.000 | 0.000 |
| 320 | 0.445 | 0.803 | 4.168 | 0.052 | 0.135 | 1.438 | 1.270 | 0.163 | 0.004 | 0.004 |
| 330 | 0.459 | 0.811 | 4.209 | 0.042 | 0.166 | 1.604 | 1.270 | 0.317 | 0.017 | 0.012 |
| 340 | 0.472 | 0.819 | 4.251 | 0.042 | 0.213 | 1.817 | 1.270 | 0.503 | 0.043 | 0.027 |
| 350 | 0.486 | 0.826 | 4.287 | 0.036 | 0.301 | 2.118 | 1.270 | 0.748 | 0.100 | 0.056 |
| 360 | 0.500 | 0.833 | 4.323 | 0.036 | 0.727 | 2.844 | 1.270 | 1.261 | 0.313 | 0.213 |

**Table A 4** (continued)

| duration (min) | duration / total duration | depth / total depth | cumulative depth (cm) | incremental depth (cm) | ordered depth (cm) | cumulative ordered depth (cm) | cum. initial abstriction, Ia (cm) | cumulative abstriction, Fa (cm) | cumulative excess depth, Pe (cm) | excess depth (cm) |
|---|---|---|---|---|---|---|---|---|---|---|
| 370 | 0.514 | 0.840 | 4.360 | 0.036 | 0.441 | 3.285 | 1.270 | 1.530 | 0.485 | 0.173 |
| 380 | 0.528 | 0.847 | 4.396 | 0.036 | 0.218 | 3.503 | 1.270 | 1.652 | 0.581 | 0.096 |
| 390 | 0.542 | 0.854 | 4.432 | 0.036 | 0.176 | 3.680 | 1.270 | 1.747 | 0.663 | 0.082 |
| 400 | 0.556 | 0.860 | 4.463 | 0.031 | 0.156 | 3.835 | 1.270 | 1.827 | 0.738 | 0.075 |
| 410 | 0.569 | 0.866 | 4.495 | 0.031 | 0.104 | 3.939 | 1.270 | 1.879 | 0.790 | 0.052 |
| 420 | 0.583 | 0.872 | 4.526 | 0.031 | 0.093 | 4.033 | 1.270 | 1.925 | 0.838 | 0.048 |
| 430 | 0.597 | 0.878 | 4.557 | 0.031 | 0.088 | 4.121 | 1.270 | 1.968 | 0.883 | 0.046 |
| 440 | 0.611 | 0.883 | 4.583 | 0.026 | 0.078 | 4.199 | 1.270 | 2.004 | 0.924 | 0.041 |
| 450 | 0.625 | 0.888 | 4.609 | 0.026 | 0.078 | 4.277 | 1.270 | 2.040 | 0.966 | 0.042 |
| 460 | 0.639 | 0.893 | 4.635 | 0.026 | 0.073 | 4.349 | 1.270 | 2.074 | 1.006 | 0.039 |
| 470 | 0.653 | 0.898 | 4.661 | 0.026 | 0.062 | 4.412 | 1.270 | 2.102 | 1.040 | 0.034 |
| 480 | 0.667 | 0.903 | 4.687 | 0.026 | 0.062 | 4.474 | 1.270 | 2.129 | 1.074 | 0.035 |
| 490 | 0.681 | 0.908 | 4.713 | 0.026 | 0.057 | 4.531 | 1.270 | 2.154 | 1.106 | 0.032 |
| 500 | 0.694 | 0.913 | 4.738 | 0.026 | 0.052 | 4.583 | 1.270 | 2.177 | 1.136 | 0.029 |
| 510 | 0.708 | 0.918 | 4.764 | 0.026 | 0.052 | 4.635 | 1.270 | 2.199 | 1.165 | 0.030 |
| 520 | 0.722 | 0.923 | 4.790 | 0.026 | 0.052 | 4.687 | 1.270 | 2.221 | 1.195 | 0.030 |
| 530 | 0.736 | 0.927 | 4.811 | 0.021 | 0.042 | 4.728 | 1.270 | 2.239 | 1.219 | 0.024 |
| 540 | 0.750 | 0.931 | 4.832 | 0.021 | 0.036 | 4.764 | 1.270 | 2.254 | 1.240 | 0.021 |
| 550 | 0.764 | 0.935 | 4.853 | 0.021 | 0.036 | 4.801 | 1.270 | 2.269 | 1.262 | 0.021 |
| 560 | 0.778 | 0.939 | 4.873 | 0.021 | 0.031 | 4.832 | 1.270 | 2.282 | 1.280 | 0.018 |
| 570 | 0.792 | 0.943 | 4.894 | 0.021 | 0.031 | 4.863 | 1.270 | 2.295 | 1.298 | 0.018 |
| 580 | 0.806 | 0.947 | 4.915 | 0.021 | 0.026 | 4.889 | 1.270 | 2.305 | 1.314 | 0.015 |
| 590 | 0.819 | 0.951 | 4.936 | 0.021 | 0.026 | 4.915 | 1.270 | 2.316 | 1.329 | 0.015 |
| 600 | 0.833 | 0.955 | 4.956 | 0.021 | 0.026 | 4.941 | 1.270 | 2.326 | 1.345 | 0.016 |
| 610 | 0.847 | 0.959 | 4.977 | 0.021 | 0.026 | 4.967 | 1.270 | 2.337 | 1.360 | 0.016 |
| 620 | 0.861 | 0.963 | 4.998 | 0.021 | 0.026 | 4.993 | 1.270 | 2.347 | 1.376 | 0.016 |
| 630 | 0.875 | 0.967 | 5.019 | 0.021 | 0.021 | 5.014 | 1.270 | 2.355 | 1.388 | 0.013 |
| 640 | 0.889 | 0.971 | 5.039 | 0.021 | 0.021 | 5.034 | 1.270 | 2.363 | 1.401 | 0.013 |
| 650 | 0.903 | 0.975 | 5.060 | 0.021 | 0.021 | 5.055 | 1.270 | 2.371 | 1.414 | 0.013 |
| 660 | 0.917 | 0.979 | 5.081 | 0.021 | 0.021 | 5.076 | 1.270 | 2.380 | 1.426 | 0.013 |
| 670 | 0.931 | 0.983 | 5.102 | 0.021 | 0.021 | 5.097 | 1.270 | 2.388 | 1.439 | 0.013 |
| 680 | 0.944 | 0.987 | 5.123 | 0.021 | 0.021 | 5.117 | 1.270 | 2.396 | 1.452 | 0.013 |
| 690 | 0.958 | 0.991 | 5.143 | 0.021 | 0.021 | 5.138 | 1.270 | 2.404 | 1.464 | 0.013 |
| 700 | 0.972 | 0.994 | 5.159 | 0.016 | 0.021 | 5.159 | 1.270 | 2.412 | 1.477 | 0.013 |
| 710 | 0.986 | 0.997 | 5.174 | 0.016 | 0.016 | 5.174 | 1.270 | 2.418 | 1.487 | 0.010 |
| 720 | 1.000 | 1.000 | 5.190 | 0.016 | 0.016 | 5.190 | 1.270 | 2.424 | 1.496 | 0.010 |

**Table A 5** Design Hyetograph of İğdeli Creek Subbasin (Tr = 100 yr)

| duration (min) | duration / total duration | depth / total depth | cumulative depth (cm) | incremental depth (cm) | ordered depth (cm) | cumulative ordered depth (cm) | cum. initial abstriction, Ia (cm) | cumulative abstriction, Fa (cm) | cumulative excess depth, Pe (cm) | excess depth (cm) |
|---|---|---|---|---|---|---|---|---|---|---|
| 10 | 0.014 | 0.140 | 0.814 | 0.814 | 0.017 | 0.017 | 0.017 | 0.000 | 0.000 | 0.000 |
| 20 | 0.028 | 0.225 | 1.308 | 0.494 | 0.023 | 0.041 | 0.041 | 0.000 | 0.000 | 0.000 |
| 30 | 0.042 | 0.283 | 1.645 | 0.337 | 0.023 | 0.064 | 0.064 | 0.000 | 0.000 | 0.000 |
| 40 | 0.056 | 0.325 | 1.889 | 0.244 | 0.023 | 0.087 | 0.087 | 0.000 | 0.000 | 0.000 |
| 50 | 0.070 | 0.366 | 2.127 | 0.238 | 0.023 | 0.110 | 0.110 | 0.000 | 0.000 | 0.000 |
| 60 | 0.084 | 0.400 | 2.325 | 0.198 | 0.023 | 0.134 | 0.134 | 0.000 | 0.000 | 0.000 |
| 70 | 0.097 | 0.432 | 2.511 | 0.186 | 0.023 | 0.157 | 0.157 | 0.000 | 0.000 | 0.000 |
| 80 | 0.111 | 0.462 | 2.686 | 0.174 | 0.023 | 0.180 | 0.180 | 0.000 | 0.000 | 0.000 |
| 90 | 0.125 | 0.488 | 2.837 | 0.151 | 0.023 | 0.203 | 0.203 | 0.000 | 0.000 | 0.000 |
| 100 | 0.139 | 0.508 | 2.953 | 0.116 | 0.023 | 0.227 | 0.227 | 0.000 | 0.000 | 0.000 |
| 110 | 0.153 | 0.527 | 3.063 | 0.110 | 0.029 | 0.256 | 0.256 | 0.000 | 0.000 | 0.000 |
| 120 | 0.167 | 0.545 | 3.168 | 0.105 | 0.029 | 0.285 | 0.285 | 0.000 | 0.000 | 0.000 |
| 130 | 0.181 | 0.563 | 3.273 | 0.105 | 0.029 | 0.314 | 0.314 | 0.000 | 0.000 | 0.000 |
| 140 | 0.195 | 0.580 | 3.371 | 0.099 | 0.029 | 0.343 | 0.343 | 0.000 | 0.000 | 0.000 |
| 150 | 0.209 | 0.595 | 3.459 | 0.087 | 0.035 | 0.378 | 0.378 | 0.000 | 0.000 | 0.000 |
| 160 | 0.222 | 0.610 | 3.546 | 0.087 | 0.035 | 0.413 | 0.413 | 0.000 | 0.000 | 0.000 |
| 170 | 0.236 | 0.625 | 3.633 | 0.087 | 0.041 | 0.453 | 0.453 | 0.000 | 0.000 | 0.000 |
| 180 | 0.250 | 0.640 | 3.720 | 0.087 | 0.041 | 0.494 | 0.494 | 0.000 | 0.000 | 0.000 |
| 190 | 0.264 | 0.655 | 3.807 | 0.087 | 0.041 | 0.535 | 0.535 | 0.000 | 0.000 | 0.000 |
| 200 | 0.278 | 0.669 | 3.889 | 0.081 | 0.047 | 0.581 | 0.581 | 0.000 | 0.000 | 0.000 |
| 210 | 0.292 | 0.683 | 3.970 | 0.081 | 0.058 | 0.639 | 0.639 | 0.000 | 0.000 | 0.000 |
| 220 | 0.306 | 0.695 | 4.040 | 0.070 | 0.058 | 0.698 | 0.698 | 0.000 | 0.000 | 0.000 |
| 230 | 0.320 | 0.707 | 4.110 | 0.070 | 0.064 | 0.761 | 0.761 | 0.000 | 0.000 | 0.000 |
| 240 | 0.334 | 0.719 | 4.179 | 0.070 | 0.070 | 0.831 | 0.831 | 0.000 | 0.000 | 0.000 |
| 250 | 0.347 | 0.731 | 4.249 | 0.070 | 0.070 | 0.901 | 0.901 | 0.000 | 0.000 | 0.000 |
| 260 | 0.361 | 0.742 | 4.313 | 0.064 | 0.081 | 0.982 | 0.982 | 0.000 | 0.000 | 0.000 |
| 270 | 0.375 | 0.753 | 4.377 | 0.064 | 0.087 | 1.070 | 1.070 | 0.000 | 0.000 | 0.000 |
| 280 | 0.389 | 0.763 | 4.435 | 0.058 | 0.087 | 1.157 | 1.157 | 0.000 | 0.000 | 0.000 |
| 290 | 0.403 | 0.773 | 4.493 | 0.058 | 0.087 | 1.244 | 1.244 | 0.000 | 0.000 | 0.000 |
| 300 | 0.417 | 0.783 | 4.551 | 0.058 | 0.105 | 1.349 | 1.270 | 0.078 | 0.001 | 0.001 |
| 310 | 0.431 | 0.793 | 4.610 | 0.058 | 0.110 | 1.459 | 1.270 | 0.184 | 0.005 | 0.005 |
| 320 | 0.445 | 0.803 | 4.668 | 0.058 | 0.151 | 1.610 | 1.270 | 0.323 | 0.017 | 0.012 |
| 330 | 0.459 | 0.811 | 4.714 | 0.047 | 0.186 | 1.796 | 1.270 | 0.486 | 0.040 | 0.023 |
| 340 | 0.472 | 0.819 | 4.761 | 0.047 | 0.238 | 2.034 | 1.270 | 0.682 | 0.082 | 0.042 |
| 350 | 0.486 | 0.826 | 4.801 | 0.041 | 0.337 | 2.372 | 1.270 | 0.939 | 0.163 | 0.081 |
| 360 | 0.500 | 0.833 | 4.842 | 0.041 | 0.814 | 3.185 | 1.270 | 1.472 | 0.444 | 0.281 |

**Table A 5** (continued)

| duration (min) | duration / total duration | depth / total depth | cumulative depth (cm) | incremental depth (cm) | ordered depth (cm) | cumulative ordered depth (cm) | cum. initial abstriction, Ia (cm) | cumulative abstriction, Fa (cm) | cumulative excess depth, Pe (cm) | excess depth (cm) |
|---|---|---|---|---|---|---|---|---|---|---|
| 370 | 0.514 | 0.840 | 4.883 | 0.041 | 0.494 | 3.680 | 1.270 | 1.747 | 0.663 | 0.219 |
| 380 | 0.528 | 0.847 | 4.923 | 0.041 | 0.244 | 3.924 | 1.270 | 1.872 | 0.782 | 0.119 |
| 390 | 0.542 | 0.854 | 4.964 | 0.041 | 0.198 | 4.121 | 1.270 | 1.968 | 0.884 | 0.101 |
| 400 | 0.556 | 0.860 | 4.999 | 0.035 | 0.174 | 4.296 | 1.270 | 2.049 | 0.976 | 0.093 |
| 410 | 0.569 | 0.866 | 5.034 | 0.035 | 0.116 | 4.412 | 1.270 | 2.102 | 1.040 | 0.064 |
| 420 | 0.583 | 0.872 | 5.069 | 0.035 | 0.105 | 4.517 | 1.270 | 2.148 | 1.098 | 0.058 |
| 430 | 0.597 | 0.878 | 5.104 | 0.035 | 0.099 | 4.615 | 1.270 | 2.191 | 1.154 | 0.056 |
| 440 | 0.611 | 0.883 | 5.133 | 0.029 | 0.087 | 4.703 | 1.270 | 2.228 | 1.204 | 0.050 |
| 450 | 0.625 | 0.888 | 5.162 | 0.029 | 0.087 | 4.790 | 1.270 | 2.265 | 1.255 | 0.051 |
| 460 | 0.639 | 0.893 | 5.191 | 0.029 | 0.081 | 4.871 | 1.270 | 2.298 | 1.303 | 0.048 |
| 470 | 0.653 | 0.898 | 5.220 | 0.029 | 0.070 | 4.941 | 1.270 | 2.326 | 1.345 | 0.042 |
| 480 | 0.667 | 0.903 | 5.249 | 0.029 | 0.070 | 5.011 | 1.270 | 2.354 | 1.387 | 0.042 |
| 490 | 0.681 | 0.908 | 5.278 | 0.029 | 0.064 | 5.075 | 1.270 | 2.379 | 1.425 | 0.039 |
| 500 | 0.694 | 0.913 | 5.307 | 0.029 | 0.058 | 5.133 | 1.270 | 2.402 | 1.461 | 0.036 |
| 510 | 0.708 | 0.918 | 5.336 | 0.029 | 0.058 | 5.191 | 1.270 | 2.424 | 1.497 | 0.036 |
| 520 | 0.722 | 0.923 | 5.365 | 0.029 | 0.058 | 5.249 | 1.270 | 2.446 | 1.533 | 0.036 |
| 530 | 0.736 | 0.927 | 5.388 | 0.023 | 0.047 | 5.295 | 1.270 | 2.464 | 1.562 | 0.029 |
| 540 | 0.750 | 0.931 | 5.412 | 0.023 | 0.041 | 5.336 | 1.270 | 2.479 | 1.587 | 0.026 |
| 550 | 0.764 | 0.935 | 5.435 | 0.023 | 0.041 | 5.377 | 1.270 | 2.494 | 1.613 | 0.026 |
| 560 | 0.778 | 0.939 | 5.458 | 0.023 | 0.035 | 5.412 | 1.270 | 2.507 | 1.635 | 0.022 |
| 570 | 0.792 | 0.943 | 5.481 | 0.023 | 0.035 | 5.447 | 1.270 | 2.519 | 1.657 | 0.022 |
| 580 | 0.806 | 0.947 | 5.505 | 0.023 | 0.029 | 5.476 | 1.270 | 2.530 | 1.676 | 0.019 |
| 590 | 0.819 | 0.951 | 5.528 | 0.023 | 0.029 | 5.505 | 1.270 | 2.540 | 1.694 | 0.019 |
| 600 | 0.833 | 0.955 | 5.551 | 0.023 | 0.029 | 5.534 | 1.270 | 2.551 | 1.713 | 0.019 |
| 610 | 0.847 | 0.959 | 5.574 | 0.023 | 0.029 | 5.563 | 1.270 | 2.561 | 1.732 | 0.019 |
| 620 | 0.861 | 0.963 | 5.598 | 0.023 | 0.029 | 5.592 | 1.270 | 2.572 | 1.750 | 0.019 |
| 630 | 0.875 | 0.967 | 5.621 | 0.023 | 0.023 | 5.615 | 1.270 | 2.580 | 1.765 | 0.015 |
| 640 | 0.889 | 0.971 | 5.644 | 0.023 | 0.023 | 5.638 | 1.270 | 2.588 | 1.780 | 0.015 |
| 650 | 0.903 | 0.975 | 5.667 | 0.023 | 0.023 | 5.662 | 1.270 | 2.596 | 1.795 | 0.015 |
| 660 | 0.917 | 0.979 | 5.691 | 0.023 | 0.023 | 5.685 | 1.270 | 2.604 | 1.811 | 0.015 |
| 670 | 0.931 | 0.983 | 5.714 | 0.023 | 0.023 | 5.708 | 1.270 | 2.612 | 1.826 | 0.015 |
| 680 | 0.944 | 0.987 | 5.737 | 0.023 | 0.023 | 5.731 | 1.270 | 2.620 | 1.841 | 0.015 |
| 690 | 0.958 | 0.991 | 5.760 | 0.023 | 0.023 | 5.755 | 1.270 | 2.628 | 1.856 | 0.015 |
| 700 | 0.972 | 0.994 | 5.778 | 0.017 | 0.023 | 5.778 | 1.270 | 2.636 | 1.872 | 0.015 |
| 710 | 0.986 | 0.997 | 5.795 | 0.017 | 0.017 | 5.795 | 1.270 | 2.642 | 1.883 | 0.011 |
| 720 | 1.000 | 1.000 | 5.813 | 0.017 | 0.017 | 5.813 | 1.270 | 2.648 | 1.895 | 0.012 |

**Table A 6** Design Hyetograph of İğdeli Creek Subbasin (Tr = 500 yr)

| duration (min) | duration / total duration | depth / total depth | cumulative depth (cm) | incremental depth (cm) | ordered depth (cm) | cumulative ordered depth (cm) | cum. initial abstriction, Ia (cm) | cumulative abstriction, Fa (cm) | cumulative excess depth, Pe (cm) | excess depth (cm) |
|---|---|---|---|---|---|---|---|---|---|---|
| 10 | 0.014 | 0.140 | 1.014 | 1.014 | 0.022 | 0.022 | 0.022 | 0.000 | 0.000 | 0.000 |
| 20 | 0.028 | 0.225 | 1.630 | 0.616 | 0.029 | 0.051 | 0.051 | 0.000 | 0.000 | 0.000 |
| 30 | 0.042 | 0.283 | 2.050 | 0.420 | 0.029 | 0.080 | 0.080 | 0.000 | 0.000 | 0.000 |
| 40 | 0.056 | 0.325 | 2.355 | 0.304 | 0.029 | 0.109 | 0.109 | 0.000 | 0.000 | 0.000 |
| 50 | 0.070 | 0.366 | 2.652 | 0.297 | 0.029 | 0.138 | 0.138 | 0.000 | 0.000 | 0.000 |
| 60 | 0.084 | 0.400 | 2.898 | 0.246 | 0.029 | 0.167 | 0.167 | 0.000 | 0.000 | 0.000 |
| 70 | 0.097 | 0.432 | 3.130 | 0.232 | 0.029 | 0.196 | 0.196 | 0.000 | 0.000 | 0.000 |
| 80 | 0.111 | 0.462 | 3.347 | 0.217 | 0.029 | 0.225 | 0.225 | 0.000 | 0.000 | 0.000 |
| 90 | 0.125 | 0.488 | 3.536 | 0.188 | 0.029 | 0.254 | 0.254 | 0.000 | 0.000 | 0.000 |
| 100 | 0.139 | 0.508 | 3.681 | 0.145 | 0.029 | 0.283 | 0.283 | 0.000 | 0.000 | 0.000 |
| 110 | 0.153 | 0.527 | 3.818 | 0.138 | 0.036 | 0.319 | 0.319 | 0.000 | 0.000 | 0.000 |
| 120 | 0.167 | 0.545 | 3.949 | 0.130 | 0.036 | 0.355 | 0.355 | 0.000 | 0.000 | 0.000 |
| 130 | 0.181 | 0.563 | 4.079 | 0.130 | 0.036 | 0.391 | 0.391 | 0.000 | 0.000 | 0.000 |
| 140 | 0.195 | 0.580 | 4.202 | 0.123 | 0.036 | 0.427 | 0.427 | 0.000 | 0.000 | 0.000 |
| 150 | 0.209 | 0.595 | 4.311 | 0.109 | 0.043 | 0.471 | 0.471 | 0.000 | 0.000 | 0.000 |
| 160 | 0.222 | 0.610 | 4.420 | 0.109 | 0.043 | 0.514 | 0.514 | 0.000 | 0.000 | 0.000 |
| 170 | 0.236 | 0.625 | 4.528 | 0.109 | 0.051 | 0.565 | 0.565 | 0.000 | 0.000 | 0.000 |
| 180 | 0.250 | 0.640 | 4.637 | 0.109 | 0.051 | 0.616 | 0.616 | 0.000 | 0.000 | 0.000 |
| 190 | 0.264 | 0.655 | 4.746 | 0.109 | 0.051 | 0.667 | 0.667 | 0.000 | 0.000 | 0.000 |
| 200 | 0.278 | 0.669 | 4.847 | 0.101 | 0.058 | 0.725 | 0.725 | 0.000 | 0.000 | 0.000 |
| 210 | 0.292 | 0.683 | 4.948 | 0.101 | 0.072 | 0.797 | 0.797 | 0.000 | 0.000 | 0.000 |
| 220 | 0.306 | 0.695 | 5.035 | 0.087 | 0.072 | 0.869 | 0.869 | 0.000 | 0.000 | 0.000 |
| 230 | 0.320 | 0.707 | 5.122 | 0.087 | 0.080 | 0.949 | 0.949 | 0.000 | 0.000 | 0.000 |
| 240 | 0.334 | 0.719 | 5.209 | 0.087 | 0.087 | 1.036 | 1.036 | 0.000 | 0.000 | 0.000 |
| 250 | 0.347 | 0.731 | 5.296 | 0.087 | 0.087 | 1.123 | 1.123 | 0.000 | 0.000 | 0.000 |
| 260 | 0.361 | 0.742 | 5.376 | 0.080 | 0.101 | 1.224 | 1.224 | 0.000 | 0.000 | 0.000 |
| 270 | 0.375 | 0.753 | 5.456 | 0.080 | 0.109 | 1.333 | 1.333 | 0.000 | 0.000 | 0.000 |
| 280 | 0.389 | 0.763 | 5.528 | 0.072 | 0.109 | 1.442 | 1.350 | 0.090 | 0.001 | 0.001 |
| 290 | 0.403 | 0.773 | 5.601 | 0.072 | 0.109 | 1.550 | 1.350 | 0.194 | 0.006 | 0.005 |
| 300 | 0.417 | 0.783 | 5.673 | 0.072 | 0.130 | 1.681 | 1.350 | 0.315 | 0.015 | 0.010 |
| 310 | 0.431 | 0.793 | 5.745 | 0.072 | 0.138 | 1.819 | 1.350 | 0.438 | 0.030 | 0.015 |
| 320 | 0.445 | 0.803 | 5.818 | 0.072 | 0.188 | 2.007 | 1.350 | 0.598 | 0.058 | 0.028 |
| 330 | 0.459 | 0.811 | 5.876 | 0.058 | 0.232 | 2.239 | 1.350 | 0.785 | 0.103 | 0.045 |
| 340 | 0.472 | 0.819 | 5.934 | 0.058 | 0.297 | 2.536 | 1.350 | 1.008 | 0.177 | 0.074 |
| 350 | 0.486 | 0.826 | 5.985 | 0.051 | 0.420 | 2.956 | 1.350 | 1.297 | 0.308 | 0.131 |
| 360 | 0.500 | 0.833 | 6.035 | 0.051 | 1.014 | 3.970 | 1.350 | 1.888 | 0.732 | 0.424 |

**Table A 6** (continued)

| duration (min) | duration / total duration | depth / total depth | cumulative depth (cm) | incremental depth (cm) | ordered depth (cm) | cumulative ordered depth (cm) | cum. initial abstriction, Ia (cm) | cumulative abstriction, Fa (cm) | cumulative excess depth, Pe (cm) | excess depth (cm) |
|---|---|---|---|---|---|---|---|---|---|---|
| 370 | 0.514 | 0.840 | 6.086 | 0.051 | 0.616 | 4.586 | 1.350 | 2.187 | 1.048 | 0.316 |
| 380 | 0.528 | 0.847 | 6.137 | 0.051 | 0.304 | 4.891 | 1.350 | 2.322 | 1.218 | 0.169 |
| 390 | 0.542 | 0.854 | 6.187 | 0.051 | 0.246 | 5.137 | 1.350 | 2.426 | 1.360 | 0.143 |
| 400 | 0.556 | 0.860 | 6.231 | 0.043 | 0.217 | 5.354 | 1.350 | 2.513 | 1.490 | 0.130 |
| 410 | 0.569 | 0.866 | 6.274 | 0.043 | 0.145 | 5.499 | 1.350 | 2.570 | 1.579 | 0.089 |
| 420 | 0.583 | 0.872 | 6.318 | 0.043 | 0.130 | 5.630 | 1.350 | 2.619 | 1.660 | 0.081 |
| 430 | 0.597 | 0.878 | 6.361 | 0.043 | 0.123 | 5.753 | 1.350 | 2.665 | 1.738 | 0.078 |
| 440 | 0.611 | 0.883 | 6.398 | 0.036 | 0.109 | 5.861 | 1.350 | 2.704 | 1.807 | 0.069 |
| 450 | 0.625 | 0.888 | 6.434 | 0.036 | 0.109 | 5.970 | 1.350 | 2.743 | 1.877 | 0.070 |
| 460 | 0.639 | 0.893 | 6.470 | 0.036 | 0.101 | 6.072 | 1.350 | 2.778 | 1.943 | 0.066 |
| 470 | 0.653 | 0.898 | 6.506 | 0.036 | 0.087 | 6.158 | 1.350 | 2.808 | 2.000 | 0.057 |
| 480 | 0.667 | 0.903 | 6.542 | 0.036 | 0.087 | 6.245 | 1.350 | 2.838 | 2.057 | 0.058 |
| 490 | 0.681 | 0.908 | 6.579 | 0.036 | 0.080 | 6.325 | 1.350 | 2.864 | 2.110 | 0.053 |
| 500 | 0.694 | 0.913 | 6.615 | 0.036 | 0.072 | 6.398 | 1.350 | 2.888 | 2.159 | 0.049 |
| 510 | 0.708 | 0.918 | 6.651 | 0.036 | 0.072 | 6.470 | 1.350 | 2.912 | 2.208 | 0.049 |
| 520 | 0.722 | 0.923 | 6.687 | 0.036 | 0.072 | 6.542 | 1.350 | 2.935 | 2.257 | 0.049 |
| 530 | 0.736 | 0.927 | 6.716 | 0.029 | 0.058 | 6.600 | 1.350 | 2.953 | 2.297 | 0.040 |
| 540 | 0.750 | 0.931 | 6.745 | 0.029 | 0.051 | 6.651 | 1.350 | 2.969 | 2.331 | 0.035 |
| 550 | 0.764 | 0.935 | 6.774 | 0.029 | 0.051 | 6.702 | 1.350 | 2.985 | 2.366 | 0.035 |
| 560 | 0.778 | 0.939 | 6.803 | 0.029 | 0.043 | 6.745 | 1.350 | 2.999 | 2.396 | 0.030 |
| 570 | 0.792 | 0.943 | 6.832 | 0.029 | 0.043 | 6.789 | 1.350 | 3.012 | 2.426 | 0.030 |
| 580 | 0.806 | 0.947 | 6.861 | 0.029 | 0.036 | 6.825 | 1.350 | 3.023 | 2.451 | 0.025 |
| 590 | 0.819 | 0.951 | 6.890 | 0.029 | 0.036 | 6.861 | 1.350 | 3.034 | 2.477 | 0.025 |
| 600 | 0.833 | 0.955 | 6.919 | 0.029 | 0.036 | 6.897 | 1.350 | 3.045 | 2.502 | 0.025 |
| 610 | 0.847 | 0.959 | 6.948 | 0.029 | 0.036 | 6.934 | 1.350 | 3.056 | 2.527 | 0.025 |
| 620 | 0.861 | 0.963 | 6.977 | 0.029 | 0.036 | 6.970 | 1.350 | 3.067 | 2.553 | 0.025 |
| 630 | 0.875 | 0.967 | 7.006 | 0.029 | 0.029 | 6.999 | 1.350 | 3.076 | 2.573 | 0.020 |
| 640 | 0.889 | 0.971 | 7.035 | 0.029 | 0.029 | 7.028 | 1.350 | 3.084 | 2.593 | 0.020 |
| 650 | 0.903 | 0.975 | 7.064 | 0.029 | 0.029 | 7.057 | 1.350 | 3.093 | 2.614 | 0.020 |
| 660 | 0.917 | 0.979 | 7.093 | 0.029 | 0.029 | 7.086 | 1.350 | 3.101 | 2.634 | 0.020 |
| 670 | 0.931 | 0.983 | 7.122 | 0.029 | 0.029 | 7.115 | 1.350 | 3.110 | 2.655 | 0.021 |
| 680 | 0.944 | 0.987 | 7.151 | 0.029 | 0.029 | 7.144 | 1.350 | 3.118 | 2.675 | 0.021 |
| 690 | 0.958 | 0.991 | 7.180 | 0.029 | 0.029 | 7.173 | 1.350 | 3.126 | 2.696 | 0.021 |
| 700 | 0.972 | 0.994 | 7.202 | 0.022 | 0.029 | 7.202 | 1.350 | 3.135 | 2.717 | 0.021 |
| 710 | 0.986 | 0.997 | 7.224 | 0.022 | 0.022 | 7.224 | 1.350 | 3.141 | 2.732 | 0.016 |
| 720 | 1.000 | 1.000 | 7.245 | 0.022 | 0.022 | 7.245 | 1.350 | 3.147 | 2.748 | 0.016 |

**Table A 7** Design Hyetograph of Bağırsak Creek Subbasin (Tr = 50 yr)

| duration (min) | duration / total duration | depth / total depth | cumulative depth (cm) | incremental depth (cm) | ordered depth (cm) | cumulative ordered depth (cm) | cum. initial abstriction, Ia (cm) | cumulative abstriction, Fa (cm) | cumulative excess depth, Pe (cm) | excess depth (cm) |
|---|---|---|---|---|---|---|---|---|---|---|
| 10 | 0.014 | 0.140 | 0.727 | 0.727 | 0.016 | 0.016 | 0.016 | 0.000 | 0.000 | 0.000 |
| 20 | 0.028 | 0.225 | 1.168 | 0.441 | 0.021 | 0.036 | 0.036 | 0.000 | 0.000 | 0.000 |
| 30 | 0.042 | 0.283 | 1.469 | 0.301 | 0.021 | 0.057 | 0.057 | 0.000 | 0.000 | 0.000 |
| 40 | 0.056 | 0.325 | 1.687 | 0.218 | 0.021 | 0.078 | 0.078 | 0.000 | 0.000 | 0.000 |
| 50 | 0.070 | 0.366 | 1.900 | 0.213 | 0.021 | 0.099 | 0.099 | 0.000 | 0.000 | 0.000 |
| 60 | 0.084 | 0.400 | 2.076 | 0.176 | 0.021 | 0.119 | 0.119 | 0.000 | 0.000 | 0.000 |
| 70 | 0.097 | 0.432 | 2.242 | 0.166 | 0.021 | 0.140 | 0.140 | 0.000 | 0.000 | 0.000 |
| 80 | 0.111 | 0.462 | 2.398 | 0.156 | 0.021 | 0.161 | 0.161 | 0.000 | 0.000 | 0.000 |
| 90 | 0.125 | 0.488 | 2.533 | 0.135 | 0.021 | 0.182 | 0.182 | 0.000 | 0.000 | 0.000 |
| 100 | 0.139 | 0.508 | 2.637 | 0.104 | 0.021 | 0.202 | 0.202 | 0.000 | 0.000 | 0.000 |
| 110 | 0.153 | 0.527 | 2.735 | 0.099 | 0.026 | 0.228 | 0.228 | 0.000 | 0.000 | 0.000 |
| 120 | 0.167 | 0.545 | 2.829 | 0.093 | 0.026 | 0.254 | 0.254 | 0.000 | 0.000 | 0.000 |
| 130 | 0.181 | 0.563 | 2.922 | 0.093 | 0.026 | 0.280 | 0.280 | 0.000 | 0.000 | 0.000 |
| 140 | 0.195 | 0.580 | 3.010 | 0.088 | 0.026 | 0.306 | 0.306 | 0.000 | 0.000 | 0.000 |
| 150 | 0.209 | 0.595 | 3.088 | 0.078 | 0.031 | 0.337 | 0.337 | 0.000 | 0.000 | 0.000 |
| 160 | 0.222 | 0.610 | 3.166 | 0.078 | 0.031 | 0.368 | 0.368 | 0.000 | 0.000 | 0.000 |
| 170 | 0.236 | 0.625 | 3.244 | 0.078 | 0.036 | 0.405 | 0.405 | 0.000 | 0.000 | 0.000 |
| 180 | 0.250 | 0.640 | 3.322 | 0.078 | 0.036 | 0.441 | 0.441 | 0.000 | 0.000 | 0.000 |
| 190 | 0.264 | 0.655 | 3.399 | 0.078 | 0.036 | 0.477 | 0.477 | 0.000 | 0.000 | 0.000 |
| 200 | 0.278 | 0.669 | 3.472 | 0.073 | 0.042 | 0.519 | 0.519 | 0.000 | 0.000 | 0.000 |
| 210 | 0.292 | 0.683 | 3.545 | 0.073 | 0.052 | 0.571 | 0.571 | 0.000 | 0.000 | 0.000 |
| 220 | 0.306 | 0.695 | 3.607 | 0.062 | 0.052 | 0.623 | 0.623 | 0.000 | 0.000 | 0.000 |
| 230 | 0.320 | 0.707 | 3.669 | 0.062 | 0.057 | 0.680 | 0.680 | 0.000 | 0.000 | 0.000 |
| 240 | 0.334 | 0.719 | 3.732 | 0.062 | 0.062 | 0.742 | 0.742 | 0.000 | 0.000 | 0.000 |
| 250 | 0.347 | 0.731 | 3.794 | 0.062 | 0.062 | 0.804 | 0.804 | 0.000 | 0.000 | 0.000 |
| 260 | 0.361 | 0.742 | 3.851 | 0.057 | 0.073 | 0.877 | 0.877 | 0.000 | 0.000 | 0.000 |
| 270 | 0.375 | 0.753 | 3.908 | 0.057 | 0.078 | 0.955 | 0.955 | 0.000 | 0.000 | 0.000 |
| 280 | 0.389 | 0.763 | 3.960 | 0.052 | 0.078 | 1.033 | 1.033 | 0.000 | 0.000 | 0.000 |
| 290 | 0.403 | 0.773 | 4.012 | 0.052 | 0.078 | 1.111 | 1.078 | 0.033 | 0.000 | 0.000 |
| 300 | 0.417 | 0.783 | 4.064 | 0.052 | 0.093 | 1.204 | 1.078 | 0.124 | 0.003 | 0.003 |
| 310 | 0.431 | 0.793 | 4.116 | 0.052 | 0.099 | 1.303 | 1.078 | 0.216 | 0.009 | 0.006 |
| 320 | 0.445 | 0.803 | 4.168 | 0.052 | 0.135 | 1.438 | 1.078 | 0.337 | 0.023 | 0.014 |
| 330 | 0.459 | 0.811 | 4.209 | 0.042 | 0.166 | 1.604 | 1.078 | 0.479 | 0.047 | 0.024 |
| 340 | 0.472 | 0.819 | 4.251 | 0.042 | 0.213 | 1.817 | 1.078 | 0.650 | 0.089 | 0.042 |
| 350 | 0.486 | 0.826 | 4.287 | 0.036 | 0.301 | 2.118 | 1.078 | 0.872 | 0.168 | 0.079 |
| 360 | 0.500 | 0.833 | 4.323 | 0.036 | 0.727 | 2.844 | 1.078 | 1.330 | 0.436 | 0.268 |

**Table A 7** (continued)

| duration (min) | duration / total duration | depth / total depth | cumulative depth (cm) | incremental depth (cm) | ordered depth (cm) | cumulative ordered depth (cm) | cum. initial abstriction, Ia (cm) | cumulative abstriction, Fa (cm) | cumulative excess depth, Pe (cm) | excess depth (cm) |
|---|---|---|---|---|---|---|---|---|---|---|
| 370 | 0.514 | 0.840 | 4.360 | 0.036 | 0.441 | 3.285 | 1.078 | 1.566 | 0.642 | 0.205 |
| 380 | 0.528 | 0.847 | 4.396 | 0.036 | 0.218 | 3.503 | 1.078 | 1.673 | 0.753 | 0.111 |
| 390 | 0.542 | 0.854 | 4.432 | 0.036 | 0.176 | 3.680 | 1.078 | 1.755 | 0.847 | 0.094 |
| 400 | 0.556 | 0.860 | 4.463 | 0.031 | 0.156 | 3.835 | 1.078 | 1.824 | 0.934 | 0.086 |
| 410 | 0.569 | 0.866 | 4.495 | 0.031 | 0.104 | 3.939 | 1.078 | 1.869 | 0.993 | 0.059 |
| 420 | 0.583 | 0.872 | 4.526 | 0.031 | 0.093 | 4.033 | 1.078 | 1.908 | 1.047 | 0.054 |
| 430 | 0.597 | 0.878 | 4.557 | 0.031 | 0.088 | 4.121 | 1.078 | 1.945 | 1.098 | 0.052 |
| 440 | 0.611 | 0.883 | 4.583 | 0.026 | 0.078 | 4.199 | 1.078 | 1.976 | 1.145 | 0.046 |
| 450 | 0.625 | 0.888 | 4.609 | 0.026 | 0.078 | 4.277 | 1.078 | 2.007 | 1.192 | 0.047 |
| 460 | 0.639 | 0.893 | 4.635 | 0.026 | 0.073 | 4.349 | 1.078 | 2.036 | 1.236 | 0.044 |
| 470 | 0.653 | 0.898 | 4.661 | 0.026 | 0.062 | 4.412 | 1.078 | 2.060 | 1.274 | 0.038 |
| 480 | 0.667 | 0.903 | 4.687 | 0.026 | 0.062 | 4.474 | 1.078 | 2.083 | 1.313 | 0.039 |
| 490 | 0.681 | 0.908 | 4.713 | 0.026 | 0.057 | 4.531 | 1.078 | 2.104 | 1.349 | 0.036 |
| 500 | 0.694 | 0.913 | 4.738 | 0.026 | 0.052 | 4.583 | 1.078 | 2.124 | 1.382 | 0.033 |
| 510 | 0.708 | 0.918 | 4.764 | 0.026 | 0.052 | 4.635 | 1.078 | 2.143 | 1.415 | 0.033 |
| 520 | 0.722 | 0.923 | 4.790 | 0.026 | 0.052 | 4.687 | 1.078 | 2.161 | 1.448 | 0.033 |
| 530 | 0.736 | 0.927 | 4.811 | 0.021 | 0.042 | 4.728 | 1.078 | 2.176 | 1.474 | 0.027 |
| 540 | 0.750 | 0.931 | 4.832 | 0.021 | 0.036 | 4.764 | 1.078 | 2.189 | 1.498 | 0.023 |
| 550 | 0.764 | 0.935 | 4.853 | 0.021 | 0.036 | 4.801 | 1.078 | 2.202 | 1.521 | 0.024 |
| 560 | 0.778 | 0.939 | 4.873 | 0.021 | 0.031 | 4.832 | 1.078 | 2.213 | 1.542 | 0.020 |
| 570 | 0.792 | 0.943 | 4.894 | 0.021 | 0.031 | 4.863 | 1.078 | 2.223 | 1.562 | 0.020 |
| 580 | 0.806 | 0.947 | 4.915 | 0.021 | 0.026 | 4.889 | 1.078 | 2.232 | 1.579 | 0.017 |
| 590 | 0.819 | 0.951 | 4.936 | 0.021 | 0.026 | 4.915 | 1.078 | 2.241 | 1.596 | 0.017 |
| 600 | 0.833 | 0.955 | 4.956 | 0.021 | 0.026 | 4.941 | 1.078 | 2.250 | 1.613 | 0.017 |
| 610 | 0.847 | 0.959 | 4.977 | 0.021 | 0.026 | 4.967 | 1.078 | 2.259 | 1.630 | 0.017 |
| 620 | 0.861 | 0.963 | 4.998 | 0.021 | 0.026 | 4.993 | 1.078 | 2.267 | 1.648 | 0.017 |
| 630 | 0.875 | 0.967 | 5.019 | 0.021 | 0.021 | 5.014 | 1.078 | 2.274 | 1.662 | 0.014 |
| 640 | 0.889 | 0.971 | 5.039 | 0.021 | 0.021 | 5.034 | 1.078 | 2.281 | 1.675 | 0.014 |
| 650 | 0.903 | 0.975 | 5.060 | 0.021 | 0.021 | 5.055 | 1.078 | 2.288 | 1.689 | 0.014 |
| 660 | 0.917 | 0.979 | 5.081 | 0.021 | 0.021 | 5.076 | 1.078 | 2.295 | 1.703 | 0.014 |
| 670 | 0.931 | 0.983 | 5.102 | 0.021 | 0.021 | 5.097 | 1.078 | 2.302 | 1.717 | 0.014 |
| 680 | 0.944 | 0.987 | 5.123 | 0.021 | 0.021 | 5.117 | 1.078 | 2.309 | 1.731 | 0.014 |
| 690 | 0.958 | 0.991 | 5.143 | 0.021 | 0.021 | 5.138 | 1.078 | 2.315 | 1.745 | 0.014 |
| 700 | 0.972 | 0.994 | 5.159 | 0.016 | 0.021 | 5.159 | 1.078 | 2.322 | 1.759 | 0.014 |
| 710 | 0.986 | 0.997 | 5.174 | 0.016 | 0.016 | 5.174 | 1.078 | 2.327 | 1.770 | 0.011 |
| 720 | 1.000 | 1.000 | 5.190 | 0.016 | 0.016 | 5.190 | 1.078 | 2.332 | 1.780 | 0.011 |

**Table A 8** Design Hyetograph of Bağırsak Creek Subbasin (Tr = 100 yr)

| duration (min) | duration / total duration | depth / total depth | cumulative depth (cm) | incremental depth (cm) | ordered depth (cm) | cumulative ordered depth (cm) | cum. initial abstriction, Ia (cm) | cumulative abstriction, Fa (cm) | cumulative excess depth, Pe (cm) | excess depth (cm) |
|---|---|---|---|---|---|---|---|---|---|---|
| 10 | 0.014 | 0.140 | 0.814 | 0.814 | 0.017 | 0.017 | 0.017 | 0.000 | 0.000 | 0.000 |
| 20 | 0.028 | 0.225 | 1.308 | 0.494 | 0.023 | 0.041 | 0.041 | 0.000 | 0.000 | 0.000 |
| 30 | 0.042 | 0.283 | 1.645 | 0.337 | 0.023 | 0.064 | 0.064 | 0.000 | 0.000 | 0.000 |
| 40 | 0.056 | 0.325 | 1.889 | 0.244 | 0.023 | 0.087 | 0.087 | 0.000 | 0.000 | 0.000 |
| 50 | 0.070 | 0.366 | 2.127 | 0.238 | 0.023 | 0.110 | 0.110 | 0.000 | 0.000 | 0.000 |
| 60 | 0.084 | 0.400 | 2.325 | 0.198 | 0.023 | 0.134 | 0.134 | 0.000 | 0.000 | 0.000 |
| 70 | 0.097 | 0.432 | 2.511 | 0.186 | 0.023 | 0.157 | 0.157 | 0.000 | 0.000 | 0.000 |
| 80 | 0.111 | 0.462 | 2.686 | 0.174 | 0.023 | 0.180 | 0.180 | 0.000 | 0.000 | 0.000 |
| 90 | 0.125 | 0.488 | 2.837 | 0.151 | 0.023 | 0.203 | 0.203 | 0.000 | 0.000 | 0.000 |
| 100 | 0.139 | 0.508 | 2.953 | 0.116 | 0.023 | 0.227 | 0.227 | 0.000 | 0.000 | 0.000 |
| 110 | 0.153 | 0.527 | 3.063 | 0.110 | 0.029 | 0.256 | 0.256 | 0.000 | 0.000 | 0.000 |
| 120 | 0.167 | 0.545 | 3.168 | 0.105 | 0.029 | 0.285 | 0.285 | 0.000 | 0.000 | 0.000 |
| 130 | 0.181 | 0.563 | 3.273 | 0.105 | 0.029 | 0.314 | 0.314 | 0.000 | 0.000 | 0.000 |
| 140 | 0.195 | 0.580 | 3.371 | 0.099 | 0.029 | 0.343 | 0.343 | 0.000 | 0.000 | 0.000 |
| 150 | 0.209 | 0.595 | 3.459 | 0.087 | 0.035 | 0.378 | 0.378 | 0.000 | 0.000 | 0.000 |
| 160 | 0.222 | 0.610 | 3.546 | 0.087 | 0.035 | 0.413 | 0.413 | 0.000 | 0.000 | 0.000 |
| 170 | 0.236 | 0.625 | 3.633 | 0.087 | 0.041 | 0.453 | 0.453 | 0.000 | 0.000 | 0.000 |
| 180 | 0.250 | 0.640 | 3.720 | 0.087 | 0.041 | 0.494 | 0.494 | 0.000 | 0.000 | 0.000 |
| 190 | 0.264 | 0.655 | 3.807 | 0.087 | 0.041 | 0.535 | 0.535 | 0.000 | 0.000 | 0.000 |
| 200 | 0.278 | 0.669 | 3.889 | 0.081 | 0.047 | 0.581 | 0.581 | 0.000 | 0.000 | 0.000 |
| 210 | 0.292 | 0.683 | 3.970 | 0.081 | 0.058 | 0.639 | 0.639 | 0.000 | 0.000 | 0.000 |
| 220 | 0.306 | 0.695 | 4.040 | 0.070 | 0.058 | 0.698 | 0.698 | 0.000 | 0.000 | 0.000 |
| 230 | 0.320 | 0.707 | 4.110 | 0.070 | 0.064 | 0.761 | 0.761 | 0.000 | 0.000 | 0.000 |
| 240 | 0.334 | 0.719 | 4.179 | 0.070 | 0.070 | 0.831 | 0.831 | 0.000 | 0.000 | 0.000 |
| 250 | 0.347 | 0.731 | 4.249 | 0.070 | 0.070 | 0.901 | 0.901 | 0.000 | 0.000 | 0.000 |
| 260 | 0.361 | 0.742 | 4.313 | 0.064 | 0.081 | 0.982 | 0.982 | 0.000 | 0.000 | 0.000 |
| 270 | 0.375 | 0.753 | 4.377 | 0.064 | 0.087 | 1.070 | 1.070 | 0.000 | 0.000 | 0.000 |
| 280 | 0.389 | 0.763 | 4.435 | 0.058 | 0.087 | 1.157 | 1.078 | 0.078 | 0.001 | 0.001 |
| 290 | 0.403 | 0.773 | 4.493 | 0.058 | 0.087 | 1.244 | 1.078 | 0.161 | 0.005 | 0.004 |
| 300 | 0.417 | 0.783 | 4.551 | 0.058 | 0.105 | 1.349 | 1.078 | 0.258 | 0.013 | 0.008 |
| 310 | 0.431 | 0.793 | 4.610 | 0.058 | 0.110 | 1.459 | 1.078 | 0.356 | 0.025 | 0.012 |
| 320 | 0.445 | 0.803 | 4.668 | 0.058 | 0.151 | 1.610 | 1.078 | 0.485 | 0.048 | 0.023 |
| 330 | 0.459 | 0.811 | 4.714 | 0.047 | 0.186 | 1.796 | 1.078 | 0.634 | 0.085 | 0.037 |
| 340 | 0.472 | 0.819 | 4.761 | 0.047 | 0.238 | 2.034 | 1.078 | 0.813 | 0.144 | 0.060 |
| 350 | 0.486 | 0.826 | 4.801 | 0.041 | 0.337 | 2.372 | 1.078 | 1.043 | 0.251 | 0.106 |
| 360 | 0.500 | 0.833 | 4.842 | 0.041 | 0.814 | 3.185 | 1.078 | 1.515 | 0.593 | 0.342 |

**Table A 8** (continued)

| duration (min) | duration / total duration | depth / total depth | cumulative depth (cm) | incremental depth (cm) | ordered depth (cm) | cumulative ordered depth (cm) | cum. initial abstriction, Ia (cm) | cumulative abstriction, Fa (cm) | cumulative excess depth, Pe (cm) | excess depth (cm) |
|---|---|---|---|---|---|---|---|---|---|---|
| 370 | 0.514 | 0.840 | 4.883 | 0.041 | 0.494 | 3.680 | 1.078 | 1.755 | 0.847 | 0.255 |
| 380 | 0.528 | 0.847 | 4.923 | 0.041 | 0.244 | 3.924 | 1.078 | 1.862 | 0.984 | 0.136 |
| 390 | 0.542 | 0.854 | 4.964 | 0.041 | 0.198 | 4.121 | 1.078 | 1.945 | 1.099 | 0.115 |
| 400 | 0.556 | 0.860 | 4.999 | 0.035 | 0.174 | 4.296 | 1.078 | 2.015 | 1.203 | 0.105 |
| 410 | 0.569 | 0.866 | 5.034 | 0.035 | 0.116 | 4.412 | 1.078 | 2.060 | 1.275 | 0.071 |
| 420 | 0.583 | 0.872 | 5.069 | 0.035 | 0.105 | 4.517 | 1.078 | 2.099 | 1.340 | 0.065 |
| 430 | 0.597 | 0.878 | 5.104 | 0.035 | 0.099 | 4.615 | 1.078 | 2.136 | 1.402 | 0.062 |
| 440 | 0.611 | 0.883 | 5.133 | 0.029 | 0.087 | 4.703 | 1.078 | 2.167 | 1.458 | 0.056 |
| 450 | 0.625 | 0.888 | 5.162 | 0.029 | 0.087 | 4.790 | 1.078 | 2.198 | 1.514 | 0.056 |
| 460 | 0.639 | 0.893 | 5.191 | 0.029 | 0.081 | 4.871 | 1.078 | 2.226 | 1.567 | 0.053 |
| 470 | 0.653 | 0.898 | 5.220 | 0.029 | 0.070 | 4.941 | 1.078 | 2.250 | 1.613 | 0.046 |
| 480 | 0.667 | 0.903 | 5.249 | 0.029 | 0.070 | 5.011 | 1.078 | 2.273 | 1.660 | 0.046 |
| 490 | 0.681 | 0.908 | 5.278 | 0.029 | 0.064 | 5.075 | 1.078 | 2.295 | 1.702 | 0.043 |
| 500 | 0.694 | 0.913 | 5.307 | 0.029 | 0.058 | 5.133 | 1.078 | 2.314 | 1.741 | 0.039 |
| 510 | 0.708 | 0.918 | 5.336 | 0.029 | 0.058 | 5.191 | 1.078 | 2.333 | 1.781 | 0.039 |
| 520 | 0.722 | 0.923 | 5.365 | 0.029 | 0.058 | 5.249 | 1.078 | 2.351 | 1.820 | 0.040 |
| 530 | 0.736 | 0.927 | 5.388 | 0.023 | 0.047 | 5.295 | 1.078 | 2.366 | 1.852 | 0.032 |
| 540 | 0.750 | 0.931 | 5.412 | 0.023 | 0.041 | 5.336 | 1.078 | 2.379 | 1.880 | 0.028 |
| 550 | 0.764 | 0.935 | 5.435 | 0.023 | 0.041 | 5.377 | 1.078 | 2.391 | 1.908 | 0.028 |
| 560 | 0.778 | 0.939 | 5.458 | 0.023 | 0.035 | 5.412 | 1.078 | 2.402 | 1.932 | 0.024 |
| 570 | 0.792 | 0.943 | 5.481 | 0.023 | 0.035 | 5.447 | 1.078 | 2.413 | 1.956 | 0.024 |
| 580 | 0.806 | 0.947 | 5.505 | 0.023 | 0.029 | 5.476 | 1.078 | 2.421 | 1.977 | 0.020 |
| 590 | 0.819 | 0.951 | 5.528 | 0.023 | 0.029 | 5.505 | 1.078 | 2.430 | 1.997 | 0.020 |
| 600 | 0.833 | 0.955 | 5.551 | 0.023 | 0.029 | 5.534 | 1.078 | 2.439 | 2.017 | 0.020 |
| 610 | 0.847 | 0.959 | 5.574 | 0.023 | 0.029 | 5.563 | 1.078 | 2.448 | 2.038 | 0.020 |
| 620 | 0.861 | 0.963 | 5.598 | 0.023 | 0.029 | 5.592 | 1.078 | 2.456 | 2.058 | 0.020 |
| 630 | 0.875 | 0.967 | 5.621 | 0.023 | 0.023 | 5.615 | 1.078 | 2.463 | 2.074 | 0.016 |
| 640 | 0.889 | 0.971 | 5.644 | 0.023 | 0.023 | 5.638 | 1.078 | 2.470 | 2.091 | 0.016 |
| 650 | 0.903 | 0.975 | 5.667 | 0.023 | 0.023 | 5.662 | 1.078 | 2.477 | 2.107 | 0.016 |
| 660 | 0.917 | 0.979 | 5.691 | 0.023 | 0.023 | 5.685 | 1.078 | 2.484 | 2.124 | 0.016 |
| 670 | 0.931 | 0.983 | 5.714 | 0.023 | 0.023 | 5.708 | 1.078 | 2.490 | 2.140 | 0.017 |
| 680 | 0.944 | 0.987 | 5.737 | 0.023 | 0.023 | 5.731 | 1.078 | 2.497 | 2.157 | 0.017 |
| 690 | 0.958 | 0.991 | 5.760 | 0.023 | 0.023 | 5.755 | 1.078 | 2.504 | 2.173 | 0.017 |
| 700 | 0.972 | 0.994 | 5.778 | 0.017 | 0.023 | 5.778 | 1.078 | 2.510 | 2.190 | 0.017 |
| 710 | 0.986 | 0.997 | 5.795 | 0.017 | 0.017 | 5.795 | 1.078 | 2.515 | 2.202 | 0.012 |
| 720 | 1.000 | 1.000 | 5.813 | 0.017 | 0.017 | 5.813 | 1.078 | 2.520 | 2.215 | 0.012 |

**Table A 9** Design Hyetograph of Bağırsak Creek Subbasin (Tr = 500 yr)

| duration (min) | duration / total duration | depth / total depth | cumulative depth (cm) | incremental depth (cm) | ordered depth (cm) | cumulative ordered depth (cm) | cum. initial abstriction, Ia (cm) | cumulative abstriction, Fa (cm) | cumulative excess depth, Pe (cm) | excess depth (cm) |
|---|---|---|---|---|---|---|---|---|---|---|
| 10 | 0.014 | 0.140 | 1.014 | 1.014 | 0.022 | 0.022 | 0.022 | 0.000 | 0.000 | 0.000 |
| 20 | 0.028 | 0.225 | 1.630 | 0.616 | 0.029 | 0.051 | 0.051 | 0.000 | 0.000 | 0.000 |
| 30 | 0.042 | 0.283 | 2.050 | 0.420 | 0.029 | 0.080 | 0.080 | 0.000 | 0.000 | 0.000 |
| 40 | 0.056 | 0.325 | 2.355 | 0.304 | 0.029 | 0.109 | 0.109 | 0.000 | 0.000 | 0.000 |
| 50 | 0.070 | 0.366 | 2.652 | 0.297 | 0.029 | 0.138 | 0.138 | 0.000 | 0.000 | 0.000 |
| 60 | 0.084 | 0.400 | 2.898 | 0.246 | 0.029 | 0.167 | 0.167 | 0.000 | 0.000 | 0.000 |
| 70 | 0.097 | 0.432 | 3.130 | 0.232 | 0.029 | 0.196 | 0.196 | 0.000 | 0.000 | 0.000 |
| 80 | 0.111 | 0.462 | 3.347 | 0.217 | 0.029 | 0.225 | 0.225 | 0.000 | 0.000 | 0.000 |
| 90 | 0.125 | 0.488 | 3.536 | 0.188 | 0.029 | 0.254 | 0.254 | 0.000 | 0.000 | 0.000 |
| 100 | 0.139 | 0.508 | 3.681 | 0.145 | 0.029 | 0.283 | 0.283 | 0.000 | 0.000 | 0.000 |
| 110 | 0.153 | 0.527 | 3.818 | 0.138 | 0.036 | 0.319 | 0.319 | 0.000 | 0.000 | 0.000 |
| 120 | 0.167 | 0.545 | 3.949 | 0.130 | 0.036 | 0.355 | 0.355 | 0.000 | 0.000 | 0.000 |
| 130 | 0.181 | 0.563 | 4.079 | 0.130 | 0.036 | 0.391 | 0.391 | 0.000 | 0.000 | 0.000 |
| 140 | 0.195 | 0.580 | 4.202 | 0.123 | 0.036 | 0.427 | 0.427 | 0.000 | 0.000 | 0.000 |
| 150 | 0.209 | 0.595 | 4.311 | 0.109 | 0.043 | 0.471 | 0.471 | 0.000 | 0.000 | 0.000 |
| 160 | 0.222 | 0.610 | 4.420 | 0.109 | 0.043 | 0.514 | 0.514 | 0.000 | 0.000 | 0.000 |
| 170 | 0.236 | 0.625 | 4.528 | 0.109 | 0.051 | 0.565 | 0.565 | 0.000 | 0.000 | 0.000 |
| 180 | 0.250 | 0.640 | 4.637 | 0.109 | 0.051 | 0.616 | 0.616 | 0.000 | 0.000 | 0.000 |
| 190 | 0.264 | 0.655 | 4.746 | 0.109 | 0.051 | 0.667 | 0.667 | 0.000 | 0.000 | 0.000 |
| 200 | 0.278 | 0.669 | 4.847 | 0.101 | 0.058 | 0.725 | 0.725 | 0.000 | 0.000 | 0.000 |
| 210 | 0.292 | 0.683 | 4.948 | 0.101 | 0.072 | 0.797 | 0.797 | 0.000 | 0.000 | 0.000 |
| 220 | 0.306 | 0.695 | 5.035 | 0.087 | 0.072 | 0.869 | 0.869 | 0.000 | 0.000 | 0.000 |
| 230 | 0.320 | 0.707 | 5.122 | 0.087 | 0.080 | 0.949 | 0.949 | 0.000 | 0.000 | 0.000 |
| 240 | 0.334 | 0.719 | 5.209 | 0.087 | 0.087 | 1.036 | 1.036 | 0.000 | 0.000 | 0.000 |
| 250 | 0.347 | 0.731 | 5.296 | 0.087 | 0.087 | 1.123 | 1.078 | 0.045 | 0.000 | 0.000 |
| 260 | 0.361 | 0.742 | 5.376 | 0.080 | 0.101 | 1.224 | 1.078 | 0.143 | 0.004 | 0.004 |
| 270 | 0.375 | 0.753 | 5.456 | 0.080 | 0.109 | 1.333 | 1.078 | 0.244 | 0.012 | 0.008 |
| 280 | 0.389 | 0.763 | 5.528 | 0.072 | 0.109 | 1.442 | 1.078 | 0.341 | 0.023 | 0.011 |
| 290 | 0.403 | 0.773 | 5.601 | 0.072 | 0.109 | 1.550 | 1.078 | 0.435 | 0.038 | 0.015 |
| 300 | 0.417 | 0.783 | 5.673 | 0.072 | 0.130 | 1.681 | 1.078 | 0.543 | 0.061 | 0.023 |
| 310 | 0.431 | 0.793 | 5.745 | 0.072 | 0.138 | 1.819 | 1.078 | 0.651 | 0.090 | 0.029 |
| 320 | 0.445 | 0.803 | 5.818 | 0.072 | 0.188 | 2.007 | 1.078 | 0.793 | 0.137 | 0.047 |
| 330 | 0.459 | 0.811 | 5.876 | 0.058 | 0.232 | 2.239 | 1.078 | 0.955 | 0.206 | 0.069 |
| 340 | 0.472 | 0.819 | 5.934 | 0.058 | 0.297 | 2.536 | 1.078 | 1.148 | 0.311 | 0.105 |
| 350 | 0.486 | 0.826 | 5.985 | 0.051 | 0.420 | 2.956 | 1.078 | 1.393 | 0.486 | 0.175 |
| 360 | 0.500 | 0.833 | 6.035 | 0.051 | 1.014 | 3.970 | 1.078 | 1.882 | 1.011 | 0.525 |

**Table A 9** (continued)

| duration (min) | duration / total duration | depth / total depth | cumulative depth (cm) | incremental depth (cm) | ordered depth (cm) | cumulative ordered depth (cm) | cum. initial abstriction, Ia (cm) | cumulative abstriction, Fa (cm) | cumulative excess depth, Pe (cm) | excess depth (cm) |
|---|---|---|---|---|---|---|---|---|---|---|
| 370 | 0.514 | 0.840 | 6.086 | 0.051 | 0.616 | 4.586 | 1.078 | 2.125 | 1.384 | 0.373 |
| 380 | 0.528 | 0.847 | 6.137 | 0.051 | 0.304 | 4.891 | 1.078 | 2.233 | 1.580 | 0.196 |
| 390 | 0.542 | 0.854 | 6.187 | 0.051 | 0.246 | 5.137 | 1.078 | 2.315 | 1.744 | 0.164 |
| 400 | 0.556 | 0.860 | 6.231 | 0.043 | 0.217 | 5.354 | 1.078 | 2.384 | 1.892 | 0.148 |
| 410 | 0.569 | 0.866 | 6.274 | 0.043 | 0.145 | 5.499 | 1.078 | 2.429 | 1.993 | 0.101 |
| 420 | 0.583 | 0.872 | 6.318 | 0.043 | 0.130 | 5.630 | 1.078 | 2.467 | 2.085 | 0.092 |
| 430 | 0.597 | 0.878 | 6.361 | 0.043 | 0.123 | 5.753 | 1.078 | 2.503 | 2.172 | 0.087 |
| 440 | 0.611 | 0.883 | 6.398 | 0.036 | 0.109 | 5.861 | 1.078 | 2.534 | 2.250 | 0.078 |
| 450 | 0.625 | 0.888 | 6.434 | 0.036 | 0.109 | 5.970 | 1.078 | 2.564 | 2.328 | 0.079 |
| 460 | 0.639 | 0.893 | 6.470 | 0.036 | 0.101 | 6.072 | 1.078 | 2.592 | 2.402 | 0.074 |
| 470 | 0.653 | 0.898 | 6.506 | 0.036 | 0.087 | 6.158 | 1.078 | 2.615 | 2.466 | 0.064 |
| 480 | 0.667 | 0.903 | 6.542 | 0.036 | 0.087 | 6.245 | 1.078 | 2.638 | 2.530 | 0.064 |
| 490 | 0.681 | 0.908 | 6.579 | 0.036 | 0.080 | 6.325 | 1.078 | 2.658 | 2.589 | 0.059 |
| 500 | 0.694 | 0.913 | 6.615 | 0.036 | 0.072 | 6.398 | 1.078 | 2.677 | 2.643 | 0.054 |
| 510 | 0.708 | 0.918 | 6.651 | 0.036 | 0.072 | 6.470 | 1.078 | 2.695 | 2.697 | 0.054 |
| 520 | 0.722 | 0.923 | 6.687 | 0.036 | 0.072 | 6.542 | 1.078 | 2.713 | 2.752 | 0.054 |
| 530 | 0.736 | 0.927 | 6.716 | 0.029 | 0.058 | 6.600 | 1.078 | 2.727 | 2.796 | 0.044 |
| 540 | 0.750 | 0.931 | 6.745 | 0.029 | 0.051 | 6.651 | 1.078 | 2.740 | 2.834 | 0.038 |
| 550 | 0.764 | 0.935 | 6.774 | 0.029 | 0.051 | 6.702 | 1.078 | 2.752 | 2.872 | 0.039 |
| 560 | 0.778 | 0.939 | 6.803 | 0.029 | 0.043 | 6.745 | 1.078 | 2.762 | 2.906 | 0.033 |
| 570 | 0.792 | 0.943 | 6.832 | 0.029 | 0.043 | 6.789 | 1.078 | 2.772 | 2.939 | 0.033 |
| 580 | 0.806 | 0.947 | 6.861 | 0.029 | 0.036 | 6.825 | 1.078 | 2.781 | 2.967 | 0.028 |
| 590 | 0.819 | 0.951 | 6.890 | 0.029 | 0.036 | 6.861 | 1.078 | 2.789 | 2.994 | 0.028 |
| 600 | 0.833 | 0.955 | 6.919 | 0.029 | 0.036 | 6.897 | 1.078 | 2.798 | 3.022 | 0.028 |
| 610 | 0.847 | 0.959 | 6.948 | 0.029 | 0.036 | 6.934 | 1.078 | 2.806 | 3.050 | 0.028 |
| 620 | 0.861 | 0.963 | 6.977 | 0.029 | 0.036 | 6.970 | 1.078 | 2.814 | 3.078 | 0.028 |
| 630 | 0.875 | 0.967 | 7.006 | 0.029 | 0.029 | 6.999 | 1.078 | 2.821 | 3.100 | 0.022 |
| 640 | 0.889 | 0.971 | 7.035 | 0.029 | 0.029 | 7.028 | 1.078 | 2.828 | 3.123 | 0.022 |
| 650 | 0.903 | 0.975 | 7.064 | 0.029 | 0.029 | 7.057 | 1.078 | 2.834 | 3.145 | 0.022 |
| 660 | 0.917 | 0.979 | 7.093 | 0.029 | 0.029 | 7.086 | 1.078 | 2.841 | 3.168 | 0.022 |
| 670 | 0.931 | 0.983 | 7.122 | 0.029 | 0.029 | 7.115 | 1.078 | 2.847 | 3.190 | 0.023 |
| 680 | 0.944 | 0.987 | 7.151 | 0.029 | 0.029 | 7.144 | 1.078 | 2.853 | 3.213 | 0.023 |
| 690 | 0.958 | 0.991 | 7.180 | 0.029 | 0.029 | 7.173 | 1.078 | 2.860 | 3.235 | 0.023 |
| 700 | 0.972 | 0.994 | 7.202 | 0.022 | 0.029 | 7.202 | 1.078 | 2.866 | 3.258 | 0.023 |
| 710 | 0.986 | 0.997 | 7.224 | 0.022 | 0.022 | 7.224 | 1.078 | 2.871 | 3.275 | 0.017 |
| 720 | 1.000 | 1.000 | 7.245 | 0.022 | 0.022 | 7.245 | 1.078 | 2.876 | 3.292 | 0.017 |

**Table A 10** Design Hyetograph of Gölcük Creek Subbasin (Tr = 50 yr)

| duration (min) | duration / total duration | depth / total depth | cumulative depth (cm) | incremental depth (cm) | ordered depth (cm) | cumulative ordered depth (cm) | cum. initial abstriction, Ia (cm) | cumulative abstriction, Fa (cm) | cumulative excess depth, Pe (cm) | excess depth (cm) |
|---|---|---|---|---|---|---|---|---|---|---|
| 10 | 0.014 | 0.140 | 0.727 | 0.727 | 0.016 | 0.016 | 0.016 | 0.000 | 0.000 | 0.000 |
| 20 | 0.028 | 0.225 | 1.168 | 0.441 | 0.021 | 0.036 | 0.036 | 0.000 | 0.000 | 0.000 |
| 30 | 0.042 | 0.283 | 1.469 | 0.301 | 0.021 | 0.057 | 0.057 | 0.000 | 0.000 | 0.000 |
| 40 | 0.056 | 0.325 | 1.687 | 0.218 | 0.021 | 0.078 | 0.078 | 0.000 | 0.000 | 0.000 |
| 50 | 0.070 | 0.366 | 1.900 | 0.213 | 0.021 | 0.099 | 0.099 | 0.000 | 0.000 | 0.000 |
| 60 | 0.084 | 0.400 | 2.076 | 0.176 | 0.021 | 0.119 | 0.119 | 0.000 | 0.000 | 0.000 |
| 70 | 0.097 | 0.432 | 2.242 | 0.166 | 0.021 | 0.140 | 0.140 | 0.000 | 0.000 | 0.000 |
| 80 | 0.111 | 0.462 | 2.398 | 0.156 | 0.021 | 0.161 | 0.161 | 0.000 | 0.000 | 0.000 |
| 90 | 0.125 | 0.488 | 2.533 | 0.135 | 0.021 | 0.182 | 0.182 | 0.000 | 0.000 | 0.000 |
| 100 | 0.139 | 0.508 | 2.637 | 0.104 | 0.021 | 0.202 | 0.202 | 0.000 | 0.000 | 0.000 |
| 110 | 0.153 | 0.527 | 2.735 | 0.099 | 0.026 | 0.228 | 0.228 | 0.000 | 0.000 | 0.000 |
| 120 | 0.167 | 0.545 | 2.829 | 0.093 | 0.026 | 0.254 | 0.254 | 0.000 | 0.000 | 0.000 |
| 130 | 0.181 | 0.563 | 2.922 | 0.093 | 0.026 | 0.280 | 0.280 | 0.000 | 0.000 | 0.000 |
| 140 | 0.195 | 0.580 | 3.010 | 0.088 | 0.026 | 0.306 | 0.306 | 0.000 | 0.000 | 0.000 |
| 150 | 0.209 | 0.595 | 3.088 | 0.078 | 0.031 | 0.337 | 0.337 | 0.000 | 0.000 | 0.000 |
| 160 | 0.222 | 0.610 | 3.166 | 0.078 | 0.031 | 0.368 | 0.368 | 0.000 | 0.000 | 0.000 |
| 170 | 0.236 | 0.625 | 3.244 | 0.078 | 0.036 | 0.405 | 0.405 | 0.000 | 0.000 | 0.000 |
| 180 | 0.250 | 0.640 | 3.322 | 0.078 | 0.036 | 0.441 | 0.441 | 0.000 | 0.000 | 0.000 |
| 190 | 0.264 | 0.655 | 3.399 | 0.078 | 0.036 | 0.477 | 0.477 | 0.000 | 0.000 | 0.000 |
| 200 | 0.278 | 0.669 | 3.472 | 0.073 | 0.042 | 0.519 | 0.519 | 0.000 | 0.000 | 0.000 |
| 210 | 0.292 | 0.683 | 3.545 | 0.073 | 0.052 | 0.571 | 0.571 | 0.000 | 0.000 | 0.000 |
| 220 | 0.306 | 0.695 | 3.607 | 0.062 | 0.052 | 0.623 | 0.623 | 0.000 | 0.000 | 0.000 |
| 230 | 0.320 | 0.707 | 3.669 | 0.062 | 0.057 | 0.680 | 0.680 | 0.000 | 0.000 | 0.000 |
| 240 | 0.334 | 0.719 | 3.732 | 0.062 | 0.062 | 0.742 | 0.742 | 0.000 | 0.000 | 0.000 |
| 250 | 0.347 | 0.731 | 3.794 | 0.062 | 0.062 | 0.804 | 0.793 | 0.012 | 0.000 | 0.000 |
| 260 | 0.361 | 0.742 | 3.851 | 0.057 | 0.073 | 0.877 | 0.793 | 0.083 | 0.002 | 0.002 |
| 270 | 0.375 | 0.753 | 3.908 | 0.057 | 0.078 | 0.955 | 0.793 | 0.156 | 0.006 | 0.005 |
| 280 | 0.389 | 0.763 | 3.960 | 0.052 | 0.078 | 1.033 | 0.793 | 0.226 | 0.014 | 0.007 |
| 290 | 0.403 | 0.773 | 4.012 | 0.052 | 0.078 | 1.111 | 0.793 | 0.294 | 0.024 | 0.010 |
| 300 | 0.417 | 0.783 | 4.064 | 0.052 | 0.093 | 1.204 | 0.793 | 0.373 | 0.039 | 0.015 |
| 310 | 0.431 | 0.793 | 4.116 | 0.052 | 0.099 | 1.303 | 0.793 | 0.452 | 0.058 | 0.019 |
| 320 | 0.445 | 0.803 | 4.168 | 0.052 | 0.135 | 1.438 | 0.793 | 0.555 | 0.090 | 0.032 |
| 330 | 0.459 | 0.811 | 4.209 | 0.042 | 0.166 | 1.604 | 0.793 | 0.673 | 0.138 | 0.047 |
| 340 | 0.472 | 0.819 | 4.251 | 0.042 | 0.213 | 1.817 | 0.793 | 0.814 | 0.210 | 0.072 |
| 350 | 0.486 | 0.826 | 4.287 | 0.036 | 0.301 | 2.118 | 0.793 | 0.993 | 0.332 | 0.122 |
| 360 | 0.500 | 0.833 | 4.323 | 0.036 | 0.727 | 2.844 | 0.793 | 1.352 | 0.699 | 0.368 |

**Table A 10** (continued)

| duration (min) | duration / total duration | depth / total depth | cumulative depth (cm) | incremental depth (cm) | ordered depth (cm) | cumulative ordered depth (cm) | cum. initial abstriction, Ia (cm) | cumulative abstriction, Fa (cm) | cumulative excess depth, Pe (cm) | excess depth (cm) |
|---|---|---|---|---|---|---|---|---|---|---|
| 370 | 0.514 | 0.840 | 4.360 | 0.036 | 0.441 | 3.285 | 0.793 | 1.530 | 0.962 | 0.263 |
| 380 | 0.528 | 0.847 | 4.396 | 0.036 | 0.218 | 3.503 | 0.793 | 1.610 | 1.101 | 0.138 |
| 390 | 0.542 | 0.854 | 4.432 | 0.036 | 0.176 | 3.680 | 0.793 | 1.670 | 1.216 | 0.116 |
| 400 | 0.556 | 0.860 | 4.463 | 0.031 | 0.156 | 3.835 | 0.793 | 1.721 | 1.321 | 0.105 |
| 410 | 0.569 | 0.866 | 4.495 | 0.031 | 0.104 | 3.939 | 0.793 | 1.754 | 1.392 | 0.071 |
| 420 | 0.583 | 0.872 | 4.526 | 0.031 | 0.093 | 4.033 | 0.793 | 1.783 | 1.457 | 0.065 |
| 430 | 0.597 | 0.878 | 4.557 | 0.031 | 0.088 | 4.121 | 0.793 | 1.809 | 1.519 | 0.062 |
| 440 | 0.611 | 0.883 | 4.583 | 0.026 | 0.078 | 4.199 | 0.793 | 1.832 | 1.574 | 0.055 |
| 450 | 0.625 | 0.888 | 4.609 | 0.026 | 0.078 | 4.277 | 0.793 | 1.854 | 1.629 | 0.056 |
| 460 | 0.639 | 0.893 | 4.635 | 0.026 | 0.073 | 4.349 | 0.793 | 1.875 | 1.682 | 0.052 |
| 470 | 0.653 | 0.898 | 4.661 | 0.026 | 0.062 | 4.412 | 0.793 | 1.892 | 1.727 | 0.045 |
| 480 | 0.667 | 0.903 | 4.687 | 0.026 | 0.062 | 4.474 | 0.793 | 1.909 | 1.772 | 0.045 |
| 490 | 0.681 | 0.908 | 4.713 | 0.026 | 0.057 | 4.531 | 0.793 | 1.924 | 1.814 | 0.042 |
| 500 | 0.694 | 0.913 | 4.738 | 0.026 | 0.052 | 4.583 | 0.793 | 1.938 | 1.852 | 0.038 |
| 510 | 0.708 | 0.918 | 4.764 | 0.026 | 0.052 | 4.635 | 0.793 | 1.951 | 1.891 | 0.038 |
| 520 | 0.722 | 0.923 | 4.790 | 0.026 | 0.052 | 4.687 | 0.793 | 1.964 | 1.929 | 0.039 |
| 530 | 0.736 | 0.927 | 4.811 | 0.021 | 0.042 | 4.728 | 0.793 | 1.975 | 1.960 | 0.031 |
| 540 | 0.750 | 0.931 | 4.832 | 0.021 | 0.036 | 4.764 | 0.793 | 1.984 | 1.988 | 0.027 |
| 550 | 0.764 | 0.935 | 4.853 | 0.021 | 0.036 | 4.801 | 0.793 | 1.993 | 2.015 | 0.027 |
| 560 | 0.778 | 0.939 | 4.873 | 0.021 | 0.031 | 4.832 | 0.793 | 2.001 | 2.038 | 0.023 |
| 570 | 0.792 | 0.943 | 4.894 | 0.021 | 0.031 | 4.863 | 0.793 | 2.008 | 2.062 | 0.024 |
| 580 | 0.806 | 0.947 | 4.915 | 0.021 | 0.026 | 4.889 | 0.793 | 2.015 | 2.082 | 0.020 |
| 590 | 0.819 | 0.951 | 4.936 | 0.021 | 0.026 | 4.915 | 0.793 | 2.021 | 2.101 | 0.020 |
| 600 | 0.833 | 0.955 | 4.956 | 0.021 | 0.026 | 4.941 | 0.793 | 2.027 | 2.121 | 0.020 |
| 610 | 0.847 | 0.959 | 4.977 | 0.021 | 0.026 | 4.967 | 0.793 | 2.033 | 2.141 | 0.020 |
| 620 | 0.861 | 0.963 | 4.998 | 0.021 | 0.026 | 4.993 | 0.793 | 2.039 | 2.161 | 0.020 |
| 630 | 0.875 | 0.967 | 5.019 | 0.021 | 0.021 | 5.014 | 0.793 | 2.044 | 2.176 | 0.016 |
| 640 | 0.889 | 0.971 | 5.039 | 0.021 | 0.021 | 5.034 | 0.793 | 2.049 | 2.192 | 0.016 |
| 650 | 0.903 | 0.975 | 5.060 | 0.021 | 0.021 | 5.055 | 0.793 | 2.054 | 2.208 | 0.016 |
| 660 | 0.917 | 0.979 | 5.081 | 0.021 | 0.021 | 5.076 | 0.793 | 2.059 | 2.224 | 0.016 |
| 670 | 0.931 | 0.983 | 5.102 | 0.021 | 0.021 | 5.097 | 0.793 | 2.063 | 2.240 | 0.016 |
| 680 | 0.944 | 0.987 | 5.123 | 0.021 | 0.021 | 5.117 | 0.793 | 2.068 | 2.256 | 0.016 |
| 690 | 0.958 | 0.991 | 5.143 | 0.021 | 0.021 | 5.138 | 0.793 | 2.073 | 2.272 | 0.016 |
| 700 | 0.972 | 0.994 | 5.159 | 0.016 | 0.021 | 5.159 | 0.793 | 2.078 | 2.288 | 0.016 |
| 710 | 0.986 | 0.997 | 5.174 | 0.016 | 0.016 | 5.174 | 0.793 | 2.081 | 2.300 | 0.012 |
| 720 | 1.000 | 1.000 | 5.190 | 0.016 | 0.016 | 5.190 | 0.793 | 2.085 | 2.312 | 0.012 |

**Table A 11** Design Hyetograph of Gölcük Creek Subbasin (Tr = 100 yr)

| duration (min) | duration / total duration | depth / total depth | cumulative depth (cm) | incremental depth (cm) | ordered depth (cm) | cumulative ordered depth (cm) | cum. initial abstriction, Ia (cm) | cumulative abstriction, Fa (cm) | cumulative excess depth, Pe (cm) | excess depth (cm) |
|---|---|---|---|---|---|---|---|---|---|---|
| 10 | 0.014 | 0.140 | 0.814 | 0.814 | 0.017 | 0.017 | 0.017 | 0.000 | 0.000 | 0.000 |
| 20 | 0.028 | 0.225 | 1.308 | 0.494 | 0.023 | 0.041 | 0.041 | 0.000 | 0.000 | 0.000 |
| 30 | 0.042 | 0.283 | 1.645 | 0.337 | 0.023 | 0.064 | 0.064 | 0.000 | 0.000 | 0.000 |
| 40 | 0.056 | 0.325 | 1.889 | 0.244 | 0.023 | 0.087 | 0.087 | 0.000 | 0.000 | 0.000 |
| 50 | 0.070 | 0.366 | 2.127 | 0.238 | 0.023 | 0.110 | 0.110 | 0.000 | 0.000 | 0.000 |
| 60 | 0.084 | 0.400 | 2.325 | 0.198 | 0.023 | 0.134 | 0.134 | 0.000 | 0.000 | 0.000 |
| 70 | 0.097 | 0.432 | 2.511 | 0.186 | 0.023 | 0.157 | 0.157 | 0.000 | 0.000 | 0.000 |
| 80 | 0.111 | 0.462 | 2.686 | 0.174 | 0.023 | 0.180 | 0.180 | 0.000 | 0.000 | 0.000 |
| 90 | 0.125 | 0.488 | 2.837 | 0.151 | 0.023 | 0.203 | 0.203 | 0.000 | 0.000 | 0.000 |
| 100 | 0.139 | 0.508 | 2.953 | 0.116 | 0.023 | 0.227 | 0.227 | 0.000 | 0.000 | 0.000 |
| 110 | 0.153 | 0.527 | 3.063 | 0.110 | 0.029 | 0.256 | 0.256 | 0.000 | 0.000 | 0.000 |
| 120 | 0.167 | 0.545 | 3.168 | 0.105 | 0.029 | 0.285 | 0.285 | 0.000 | 0.000 | 0.000 |
| 130 | 0.181 | 0.563 | 3.273 | 0.105 | 0.029 | 0.314 | 0.314 | 0.000 | 0.000 | 0.000 |
| 140 | 0.195 | 0.580 | 3.371 | 0.099 | 0.029 | 0.343 | 0.343 | 0.000 | 0.000 | 0.000 |
| 150 | 0.209 | 0.595 | 3.459 | 0.087 | 0.035 | 0.378 | 0.378 | 0.000 | 0.000 | 0.000 |
| 160 | 0.222 | 0.610 | 3.546 | 0.087 | 0.035 | 0.413 | 0.413 | 0.000 | 0.000 | 0.000 |
| 170 | 0.236 | 0.625 | 3.633 | 0.087 | 0.041 | 0.453 | 0.453 | 0.000 | 0.000 | 0.000 |
| 180 | 0.250 | 0.640 | 3.720 | 0.087 | 0.041 | 0.494 | 0.494 | 0.000 | 0.000 | 0.000 |
| 190 | 0.264 | 0.655 | 3.807 | 0.087 | 0.041 | 0.535 | 0.535 | 0.000 | 0.000 | 0.000 |
| 200 | 0.278 | 0.669 | 3.889 | 0.081 | 0.047 | 0.581 | 0.581 | 0.000 | 0.000 | 0.000 |
| 210 | 0.292 | 0.683 | 3.970 | 0.081 | 0.058 | 0.639 | 0.639 | 0.000 | 0.000 | 0.000 |
| 220 | 0.306 | 0.695 | 4.040 | 0.070 | 0.058 | 0.698 | 0.698 | 0.000 | 0.000 | 0.000 |
| 230 | 0.320 | 0.707 | 4.110 | 0.070 | 0.064 | 0.761 | 0.761 | 0.000 | 0.000 | 0.000 |
| 240 | 0.334 | 0.719 | 4.179 | 0.070 | 0.070 | 0.831 | 0.793 | 0.038 | 0.000 | 0.000 |
| 250 | 0.347 | 0.731 | 4.249 | 0.070 | 0.070 | 0.901 | 0.793 | 0.105 | 0.003 | 0.003 |
| 260 | 0.361 | 0.742 | 4.313 | 0.064 | 0.081 | 0.982 | 0.793 | 0.181 | 0.009 | 0.006 |
| 270 | 0.375 | 0.753 | 4.377 | 0.064 | 0.087 | 1.070 | 0.793 | 0.259 | 0.018 | 0.009 |
| 280 | 0.389 | 0.763 | 4.435 | 0.058 | 0.087 | 1.157 | 0.793 | 0.333 | 0.031 | 0.013 |
| 290 | 0.403 | 0.773 | 4.493 | 0.058 | 0.087 | 1.244 | 0.793 | 0.405 | 0.046 | 0.015 |
| 300 | 0.417 | 0.783 | 4.551 | 0.058 | 0.105 | 1.349 | 0.793 | 0.487 | 0.068 | 0.022 |
| 310 | 0.431 | 0.793 | 4.610 | 0.058 | 0.110 | 1.459 | 0.793 | 0.570 | 0.096 | 0.028 |
| 320 | 0.445 | 0.803 | 4.668 | 0.058 | 0.151 | 1.610 | 0.793 | 0.678 | 0.140 | 0.044 |
| 330 | 0.459 | 0.811 | 4.714 | 0.047 | 0.186 | 1.796 | 0.793 | 0.801 | 0.203 | 0.063 |
| 340 | 0.472 | 0.819 | 4.761 | 0.047 | 0.238 | 2.034 | 0.793 | 0.945 | 0.296 | 0.093 |
| 350 | 0.486 | 0.826 | 4.801 | 0.041 | 0.337 | 2.372 | 0.793 | 1.129 | 0.450 | 0.154 |
| 360 | 0.500 | 0.833 | 4.842 | 0.041 | 0.814 | 3.185 | 0.793 | 1.492 | 0.901 | 0.451 |

**Table A 11** (continued)

| duration (min) | duration / total duration | depth / total depth | cumulative depth (cm) | incremental depth (cm) | ordered depth (cm) | cumulative ordered depth (cm) | cum. initial abstriction, Ia (cm) | cumulative abstriction, Fa (cm) | cumulative excess depth, Pe (cm) | excess depth (cm) |
|---|---|---|---|---|---|---|---|---|---|---|
| 370 | 0.514 | 0.840 | 4.883 | 0.041 | 0.494 | 3.680 | 0.793 | 1.670 | 1.216 | 0.316 |
| 380 | 0.528 | 0.847 | 4.923 | 0.041 | 0.244 | 3.924 | 0.793 | 1.749 | 1.382 | 0.165 |
| 390 | 0.542 | 0.854 | 4.964 | 0.041 | 0.198 | 4.121 | 0.793 | 1.809 | 1.519 | 0.138 |
| 400 | 0.556 | 0.860 | 4.999 | 0.035 | 0.174 | 4.296 | 0.793 | 1.860 | 1.643 | 0.124 |
| 410 | 0.569 | 0.866 | 5.034 | 0.035 | 0.116 | 4.412 | 0.793 | 1.892 | 1.727 | 0.084 |
| 420 | 0.583 | 0.872 | 5.069 | 0.035 | 0.105 | 4.517 | 0.793 | 1.920 | 1.804 | 0.076 |
| 430 | 0.597 | 0.878 | 5.104 | 0.035 | 0.099 | 4.615 | 0.793 | 1.946 | 1.876 | 0.073 |
| 440 | 0.611 | 0.883 | 5.133 | 0.029 | 0.087 | 4.703 | 0.793 | 1.968 | 1.941 | 0.065 |
| 450 | 0.625 | 0.888 | 5.162 | 0.029 | 0.087 | 4.790 | 0.793 | 1.990 | 2.007 | 0.065 |
| 460 | 0.639 | 0.893 | 5.191 | 0.029 | 0.081 | 4.871 | 0.793 | 2.010 | 2.068 | 0.061 |
| 470 | 0.653 | 0.898 | 5.220 | 0.029 | 0.070 | 4.941 | 0.793 | 2.027 | 2.121 | 0.053 |
| 480 | 0.667 | 0.903 | 5.249 | 0.029 | 0.070 | 5.011 | 0.793 | 2.044 | 2.174 | 0.053 |
| 490 | 0.681 | 0.908 | 5.278 | 0.029 | 0.064 | 5.075 | 0.793 | 2.058 | 2.223 | 0.049 |
| 500 | 0.694 | 0.913 | 5.307 | 0.029 | 0.058 | 5.133 | 0.793 | 2.072 | 2.268 | 0.045 |
| 510 | 0.708 | 0.918 | 5.336 | 0.029 | 0.058 | 5.191 | 0.793 | 2.085 | 2.313 | 0.045 |
| 520 | 0.722 | 0.923 | 5.365 | 0.029 | 0.058 | 5.249 | 0.793 | 2.098 | 2.358 | 0.045 |
| 530 | 0.736 | 0.927 | 5.388 | 0.023 | 0.047 | 5.295 | 0.793 | 2.108 | 2.394 | 0.036 |
| 540 | 0.750 | 0.931 | 5.412 | 0.023 | 0.041 | 5.336 | 0.793 | 2.117 | 2.426 | 0.032 |
| 550 | 0.764 | 0.935 | 5.435 | 0.023 | 0.041 | 5.377 | 0.793 | 2.126 | 2.458 | 0.032 |
| 560 | 0.778 | 0.939 | 5.458 | 0.023 | 0.035 | 5.412 | 0.793 | 2.133 | 2.486 | 0.027 |
| 570 | 0.792 | 0.943 | 5.481 | 0.023 | 0.035 | 5.447 | 0.793 | 2.141 | 2.513 | 0.027 |
| 580 | 0.806 | 0.947 | 5.505 | 0.023 | 0.029 | 5.476 | 0.793 | 2.147 | 2.536 | 0.023 |
| 590 | 0.819 | 0.951 | 5.528 | 0.023 | 0.029 | 5.505 | 0.793 | 2.153 | 2.559 | 0.023 |
| 600 | 0.833 | 0.955 | 5.551 | 0.023 | 0.029 | 5.534 | 0.793 | 2.159 | 2.582 | 0.023 |
| 610 | 0.847 | 0.959 | 5.574 | 0.023 | 0.029 | 5.563 | 0.793 | 2.165 | 2.605 | 0.023 |
| 620 | 0.861 | 0.963 | 5.598 | 0.023 | 0.029 | 5.592 | 0.793 | 2.171 | 2.628 | 0.023 |
| 630 | 0.875 | 0.967 | 5.621 | 0.023 | 0.023 | 5.615 | 0.793 | 2.176 | 2.647 | 0.019 |
| 640 | 0.889 | 0.971 | 5.644 | 0.023 | 0.023 | 5.638 | 0.793 | 2.180 | 2.665 | 0.019 |
| 650 | 0.903 | 0.975 | 5.667 | 0.023 | 0.023 | 5.662 | 0.793 | 2.185 | 2.684 | 0.019 |
| 660 | 0.917 | 0.979 | 5.691 | 0.023 | 0.023 | 5.685 | 0.793 | 2.190 | 2.702 | 0.019 |
| 670 | 0.931 | 0.983 | 5.714 | 0.023 | 0.023 | 5.708 | 0.793 | 2.194 | 2.721 | 0.019 |
| 680 | 0.944 | 0.987 | 5.737 | 0.023 | 0.023 | 5.731 | 0.793 | 2.199 | 2.740 | 0.019 |
| 690 | 0.958 | 0.991 | 5.760 | 0.023 | 0.023 | 5.755 | 0.793 | 2.204 | 2.758 | 0.019 |
| 700 | 0.972 | 0.994 | 5.778 | 0.017 | 0.023 | 5.778 | 0.793 | 2.208 | 2.777 | 0.019 |
| 710 | 0.986 | 0.997 | 5.795 | 0.017 | 0.017 | 5.795 | 0.793 | 2.212 | 2.791 | 0.014 |
| 720 | 1.000 | 1.000 | 5.813 | 0.017 | 0.017 | 5.813 | 0.793 | 2.215 | 2.805 | 0.014 |

**Table A 12** Design Hyetograph of Gölcük Creek Subbasin (Tr = 500 yr)

| duration (min) | duration / total duration | depth / total depth | cumulative depth (cm) | incremental depth (cm) | ordered depth (cm) | cumulative ordered depth (cm) | cum. initial abstriction, Ia (cm) | cumulative abstriction, Fa (cm) | cumulative excess depth, Pe (cm) | excess depth (cm) |
|---|---|---|---|---|---|---|---|---|---|---|
| 10 | 0.014 | 0.140 | 1.014 | 1.014 | 0.022 | 0.022 | 0.022 | 0.000 | 0.000 | 0.000 |
| 20 | 0.028 | 0.225 | 1.630 | 0.616 | 0.029 | 0.051 | 0.051 | 0.000 | 0.000 | 0.000 |
| 30 | 0.042 | 0.283 | 2.050 | 0.420 | 0.029 | 0.080 | 0.080 | 0.000 | 0.000 | 0.000 |
| 40 | 0.056 | 0.325 | 2.355 | 0.304 | 0.029 | 0.109 | 0.109 | 0.000 | 0.000 | 0.000 |
| 50 | 0.070 | 0.366 | 2.652 | 0.297 | 0.029 | 0.138 | 0.138 | 0.000 | 0.000 | 0.000 |
| 60 | 0.084 | 0.400 | 2.898 | 0.246 | 0.029 | 0.167 | 0.167 | 0.000 | 0.000 | 0.000 |
| 70 | 0.097 | 0.432 | 3.130 | 0.232 | 0.029 | 0.196 | 0.196 | 0.000 | 0.000 | 0.000 |
| 80 | 0.111 | 0.462 | 3.347 | 0.217 | 0.029 | 0.225 | 0.225 | 0.000 | 0.000 | 0.000 |
| 90 | 0.125 | 0.488 | 3.536 | 0.188 | 0.029 | 0.254 | 0.254 | 0.000 | 0.000 | 0.000 |
| 100 | 0.139 | 0.508 | 3.681 | 0.145 | 0.029 | 0.283 | 0.283 | 0.000 | 0.000 | 0.000 |
| 110 | 0.153 | 0.527 | 3.818 | 0.138 | 0.036 | 0.319 | 0.319 | 0.000 | 0.000 | 0.000 |
| 120 | 0.167 | 0.545 | 3.949 | 0.130 | 0.036 | 0.355 | 0.355 | 0.000 | 0.000 | 0.000 |
| 130 | 0.181 | 0.563 | 4.079 | 0.130 | 0.036 | 0.391 | 0.391 | 0.000 | 0.000 | 0.000 |
| 140 | 0.195 | 0.580 | 4.202 | 0.123 | 0.036 | 0.427 | 0.427 | 0.000 | 0.000 | 0.000 |
| 150 | 0.209 | 0.595 | 4.311 | 0.109 | 0.043 | 0.471 | 0.471 | 0.000 | 0.000 | 0.000 |
| 160 | 0.222 | 0.610 | 4.420 | 0.109 | 0.043 | 0.514 | 0.514 | 0.000 | 0.000 | 0.000 |
| 170 | 0.236 | 0.625 | 4.528 | 0.109 | 0.051 | 0.565 | 0.565 | 0.000 | 0.000 | 0.000 |
| 180 | 0.250 | 0.640 | 4.637 | 0.109 | 0.051 | 0.616 | 0.616 | 0.000 | 0.000 | 0.000 |
| 190 | 0.264 | 0.655 | 4.746 | 0.109 | 0.051 | 0.667 | 0.667 | 0.000 | 0.000 | 0.000 |
| 200 | 0.278 | 0.669 | 4.847 | 0.101 | 0.058 | 0.725 | 0.725 | 0.000 | 0.000 | 0.000 |
| 210 | 0.292 | 0.683 | 4.948 | 0.101 | 0.072 | 0.797 | 0.793 | 0.004 | 0.000 | 0.000 |
| 220 | 0.306 | 0.695 | 5.035 | 0.087 | 0.072 | 0.869 | 0.793 | 0.075 | 0.001 | 0.001 |
| 230 | 0.320 | 0.707 | 5.122 | 0.087 | 0.080 | 0.949 | 0.793 | 0.150 | 0.006 | 0.004 |
| 240 | 0.334 | 0.719 | 5.209 | 0.087 | 0.087 | 1.036 | 0.793 | 0.229 | 0.014 | 0.008 |
| 250 | 0.347 | 0.731 | 5.296 | 0.087 | 0.087 | 1.123 | 0.793 | 0.305 | 0.025 | 0.011 |
| 260 | 0.361 | 0.742 | 5.376 | 0.080 | 0.101 | 1.224 | 0.793 | 0.389 | 0.042 | 0.017 |
| 270 | 0.375 | 0.753 | 5.456 | 0.080 | 0.109 | 1.333 | 0.793 | 0.475 | 0.065 | 0.022 |
| 280 | 0.389 | 0.763 | 5.528 | 0.072 | 0.109 | 1.442 | 0.793 | 0.558 | 0.091 | 0.026 |
| 290 | 0.403 | 0.773 | 5.601 | 0.072 | 0.109 | 1.550 | 0.793 | 0.636 | 0.122 | 0.030 |
| 300 | 0.417 | 0.783 | 5.673 | 0.072 | 0.130 | 1.681 | 0.793 | 0.726 | 0.163 | 0.041 |
| 310 | 0.431 | 0.793 | 5.745 | 0.072 | 0.138 | 1.819 | 0.793 | 0.815 | 0.211 | 0.048 |
| 320 | 0.445 | 0.803 | 5.818 | 0.072 | 0.188 | 2.007 | 0.793 | 0.929 | 0.285 | 0.074 |
| 330 | 0.459 | 0.811 | 5.876 | 0.058 | 0.232 | 2.239 | 0.793 | 1.059 | 0.386 | 0.102 |
| 340 | 0.472 | 0.819 | 5.934 | 0.058 | 0.297 | 2.536 | 0.793 | 1.211 | 0.532 | 0.146 |
| 350 | 0.486 | 0.826 | 5.985 | 0.051 | 0.420 | 2.956 | 0.793 | 1.400 | 0.764 | 0.231 |
| 360 | 0.500 | 0.833 | 6.035 | 0.051 | 1.014 | 3.970 | 0.793 | 1.764 | 1.414 | 0.650 |

**Table A 12** (continued)

| duration (min) | duration / total duration | depth / total depth | cumulative depth (cm) | incremental depth (cm) | ordered depth (cm) | cumulative ordered depth (cm) | cum. initial abstriction, Ia (cm) | cumulative abstriction, Fa (cm) | cumulative excess depth, Pe (cm) | excess depth (cm) |
|---|---|---|---|---|---|---|---|---|---|---|
| 370 | 0.514 | 0.840 | 6.086 | 0.051 | 0.616 | 4.586 | 0.793 | 1.938 | 1.855 | 0.441 |
| 380 | 0.528 | 0.847 | 6.137 | 0.051 | 0.304 | 4.891 | 0.793 | 2.015 | 2.083 | 0.228 |
| 390 | 0.542 | 0.854 | 6.187 | 0.051 | 0.246 | 5.137 | 0.793 | 2.073 | 2.271 | 0.189 |
| 400 | 0.556 | 0.860 | 6.231 | 0.043 | 0.217 | 5.354 | 0.793 | 2.121 | 2.440 | 0.169 |
| 410 | 0.569 | 0.866 | 6.274 | 0.043 | 0.145 | 5.499 | 0.793 | 2.152 | 2.555 | 0.114 |
| 420 | 0.583 | 0.872 | 6.318 | 0.043 | 0.130 | 5.630 | 0.793 | 2.179 | 2.658 | 0.104 |
| 430 | 0.597 | 0.878 | 6.361 | 0.043 | 0.123 | 5.753 | 0.793 | 2.203 | 2.757 | 0.099 |
| 440 | 0.611 | 0.883 | 6.398 | 0.036 | 0.109 | 5.861 | 0.793 | 2.224 | 2.844 | 0.087 |
| 450 | 0.625 | 0.888 | 6.434 | 0.036 | 0.109 | 5.970 | 0.793 | 2.245 | 2.932 | 0.088 |
| 460 | 0.639 | 0.893 | 6.470 | 0.036 | 0.101 | 6.072 | 0.793 | 2.264 | 3.015 | 0.083 |
| 470 | 0.653 | 0.898 | 6.506 | 0.036 | 0.087 | 6.158 | 0.793 | 2.280 | 3.086 | 0.071 |
| 480 | 0.667 | 0.903 | 6.542 | 0.036 | 0.087 | 6.245 | 0.793 | 2.295 | 3.157 | 0.071 |
| 490 | 0.681 | 0.908 | 6.579 | 0.036 | 0.080 | 6.325 | 0.793 | 2.309 | 3.223 | 0.066 |
| 500 | 0.694 | 0.913 | 6.615 | 0.036 | 0.072 | 6.398 | 0.793 | 2.322 | 3.283 | 0.060 |
| 510 | 0.708 | 0.918 | 6.651 | 0.036 | 0.072 | 6.470 | 0.793 | 2.334 | 3.343 | 0.060 |
| 520 | 0.722 | 0.923 | 6.687 | 0.036 | 0.072 | 6.542 | 0.793 | 2.346 | 3.403 | 0.060 |
| 530 | 0.736 | 0.927 | 6.716 | 0.029 | 0.058 | 6.600 | 0.793 | 2.356 | 3.452 | 0.048 |
| 540 | 0.750 | 0.931 | 6.745 | 0.029 | 0.051 | 6.651 | 0.793 | 2.364 | 3.494 | 0.042 |
| 550 | 0.764 | 0.935 | 6.774 | 0.029 | 0.051 | 6.702 | 0.793 | 2.373 | 3.536 | 0.042 |
| 560 | 0.778 | 0.939 | 6.803 | 0.029 | 0.043 | 6.745 | 0.793 | 2.379 | 3.573 | 0.036 |
| 570 | 0.792 | 0.943 | 6.832 | 0.029 | 0.043 | 6.789 | 0.793 | 2.386 | 3.610 | 0.037 |
| 580 | 0.806 | 0.947 | 6.861 | 0.029 | 0.036 | 6.825 | 0.793 | 2.392 | 3.640 | 0.031 |
| 590 | 0.819 | 0.951 | 6.890 | 0.029 | 0.036 | 6.861 | 0.793 | 2.398 | 3.671 | 0.031 |
| 600 | 0.833 | 0.955 | 6.919 | 0.029 | 0.036 | 6.897 | 0.793 | 2.403 | 3.701 | 0.031 |
| 610 | 0.847 | 0.959 | 6.948 | 0.029 | 0.036 | 6.934 | 0.793 | 2.409 | 3.732 | 0.031 |
| 620 | 0.861 | 0.963 | 6.977 | 0.029 | 0.036 | 6.970 | 0.793 | 2.415 | 3.762 | 0.031 |
| 630 | 0.875 | 0.967 | 7.006 | 0.029 | 0.029 | 6.999 | 0.793 | 2.419 | 3.787 | 0.025 |
| 640 | 0.889 | 0.971 | 7.035 | 0.029 | 0.029 | 7.028 | 0.793 | 2.423 | 3.812 | 0.025 |
| 650 | 0.903 | 0.975 | 7.064 | 0.029 | 0.029 | 7.057 | 0.793 | 2.428 | 3.836 | 0.025 |
| 660 | 0.917 | 0.979 | 7.093 | 0.029 | 0.029 | 7.086 | 0.793 | 2.432 | 3.861 | 0.025 |
| 670 | 0.931 | 0.983 | 7.122 | 0.029 | 0.029 | 7.115 | 0.793 | 2.436 | 3.886 | 0.025 |
| 680 | 0.944 | 0.987 | 7.151 | 0.029 | 0.029 | 7.144 | 0.793 | 2.441 | 3.910 | 0.025 |
| 690 | 0.958 | 0.991 | 7.180 | 0.029 | 0.029 | 7.173 | 0.793 | 2.445 | 3.935 | 0.025 |
| 700 | 0.972 | 0.994 | 7.202 | 0.022 | 0.029 | 7.202 | 0.793 | 2.449 | 3.960 | 0.025 |
| 710 | 0.986 | 0.997 | 7.224 | 0.022 | 0.022 | 7.224 | 0.793 | 2.452 | 3.978 | 0.019 |
| 720 | 1.000 | 1.000 | 7.245 | 0.022 | 0.022 | 7.245 | 0.793 | 2.456 | 3.997 | 0.019 |

**Table A 13** Design Hyetograph of Sukesen Creek Subbasin (Tr = 50 yr)

| duration (min) | duration / total duration | depth / total depth | cumulative depth (cm) | incremental depth (cm) | ordered depth (cm) | cumulative ordered depth (cm) | cum. initial abstriction, Ia (cm) | cumulative abstriction, Fa (cm) | cumulative excess depth, Pe (cm) | excess depth (cm) |
|---|---|---|---|---|---|---|---|---|---|---|
| 10 | 0.014 | 0.140 | 0.727 | 0.727 | 0.016 | 0.016 | 0.016 | 0.000 | 0.000 | 0.000 |
| 20 | 0.028 | 0.225 | 1.168 | 0.441 | 0.021 | 0.036 | 0.036 | 0.000 | 0.000 | 0.000 |
| 30 | 0.042 | 0.283 | 1.469 | 0.301 | 0.021 | 0.057 | 0.057 | 0.000 | 0.000 | 0.000 |
| 40 | 0.056 | 0.325 | 1.687 | 0.218 | 0.021 | 0.078 | 0.078 | 0.000 | 0.000 | 0.000 |
| 50 | 0.070 | 0.366 | 1.900 | 0.213 | 0.021 | 0.099 | 0.099 | 0.000 | 0.000 | 0.000 |
| 60 | 0.084 | 0.400 | 2.076 | 0.176 | 0.021 | 0.119 | 0.119 | 0.000 | 0.000 | 0.000 |
| 70 | 0.097 | 0.432 | 2.242 | 0.166 | 0.021 | 0.140 | 0.140 | 0.000 | 0.000 | 0.000 |
| 80 | 0.111 | 0.462 | 2.398 | 0.156 | 0.021 | 0.161 | 0.161 | 0.000 | 0.000 | 0.000 |
| 90 | 0.125 | 0.488 | 2.533 | 0.135 | 0.021 | 0.182 | 0.182 | 0.000 | 0.000 | 0.000 |
| 100 | 0.139 | 0.508 | 2.637 | 0.104 | 0.021 | 0.202 | 0.202 | 0.000 | 0.000 | 0.000 |
| 110 | 0.153 | 0.527 | 2.735 | 0.099 | 0.026 | 0.228 | 0.228 | 0.000 | 0.000 | 0.000 |
| 120 | 0.167 | 0.545 | 2.829 | 0.093 | 0.026 | 0.254 | 0.254 | 0.000 | 0.000 | 0.000 |
| 130 | 0.181 | 0.563 | 2.922 | 0.093 | 0.026 | 0.280 | 0.280 | 0.000 | 0.000 | 0.000 |
| 140 | 0.195 | 0.580 | 3.010 | 0.088 | 0.026 | 0.306 | 0.306 | 0.000 | 0.000 | 0.000 |
| 150 | 0.209 | 0.595 | 3.088 | 0.078 | 0.031 | 0.337 | 0.337 | 0.000 | 0.000 | 0.000 |
| 160 | 0.222 | 0.610 | 3.166 | 0.078 | 0.031 | 0.368 | 0.368 | 0.000 | 0.000 | 0.000 |
| 170 | 0.236 | 0.625 | 3.244 | 0.078 | 0.036 | 0.405 | 0.405 | 0.000 | 0.000 | 0.000 |
| 180 | 0.250 | 0.640 | 3.322 | 0.078 | 0.036 | 0.441 | 0.441 | 0.000 | 0.000 | 0.000 |
| 190 | 0.264 | 0.655 | 3.399 | 0.078 | 0.036 | 0.477 | 0.477 | 0.000 | 0.000 | 0.000 |
| 200 | 0.278 | 0.669 | 3.472 | 0.073 | 0.042 | 0.519 | 0.519 | 0.000 | 0.000 | 0.000 |
| 210 | 0.292 | 0.683 | 3.545 | 0.073 | 0.052 | 0.571 | 0.571 | 0.000 | 0.000 | 0.000 |
| 220 | 0.306 | 0.695 | 3.607 | 0.062 | 0.052 | 0.623 | 0.623 | 0.000 | 0.000 | 0.000 |
| 230 | 0.320 | 0.707 | 3.669 | 0.062 | 0.057 | 0.680 | 0.680 | 0.000 | 0.000 | 0.000 |
| 240 | 0.334 | 0.719 | 3.732 | 0.062 | 0.062 | 0.742 | 0.742 | 0.000 | 0.000 | 0.000 |
| 250 | 0.347 | 0.731 | 3.794 | 0.062 | 0.062 | 0.804 | 0.804 | 0.000 | 0.000 | 0.000 |
| 260 | 0.361 | 0.742 | 3.851 | 0.057 | 0.073 | 0.877 | 0.877 | 0.000 | 0.000 | 0.000 |
| 270 | 0.375 | 0.753 | 3.908 | 0.057 | 0.078 | 0.955 | 0.955 | 0.000 | 0.000 | 0.000 |
| 280 | 0.389 | 0.763 | 3.960 | 0.052 | 0.078 | 1.033 | 1.033 | 0.000 | 0.000 | 0.000 |
| 290 | 0.403 | 0.773 | 4.012 | 0.052 | 0.078 | 1.111 | 1.111 | 0.000 | 0.000 | 0.000 |
| 300 | 0.417 | 0.783 | 4.064 | 0.052 | 0.093 | 1.204 | 1.204 | 0.000 | 0.000 | 0.000 |
| 310 | 0.431 | 0.793 | 4.116 | 0.052 | 0.099 | 1.303 | 1.303 | 0.000 | 0.000 | 0.000 |
| 320 | 0.445 | 0.803 | 4.168 | 0.052 | 0.135 | 1.438 | 1.433 | 0.005 | 0.000 | 0.000 |
| 330 | 0.459 | 0.811 | 4.209 | 0.042 | 0.166 | 1.604 | 1.433 | 0.167 | 0.004 | 0.004 |
| 340 | 0.472 | 0.819 | 4.251 | 0.042 | 0.213 | 1.817 | 1.433 | 0.364 | 0.020 | 0.016 |
| 350 | 0.486 | 0.826 | 4.287 | 0.036 | 0.301 | 2.118 | 1.433 | 0.625 | 0.060 | 0.040 |
| 360 | 0.500 | 0.833 | 4.323 | 0.036 | 0.727 | 2.844 | 1.433 | 1.179 | 0.232 | 0.173 |

**Table A 13** (continued)

| duration (min) | duration / total duration | depth / total depth | cumulative depth (cm) | incremental depth (cm) | ordered depth (cm) | cumulative ordered depth (cm) | cum. initial abstriction, Ia (cm) | cumulative abstriction, Fa (cm) | cumulative excess depth, Pe (cm) | excess depth (cm) |
|---|---|---|---|---|---|---|---|---|---|---|
| 370 | 0.514 | 0.840 | 4.360 | 0.036 | 0.441 | 3.285 | 1.433 | 1.472 | 0.381 | 0.148 |
| 380 | 0.528 | 0.847 | 4.396 | 0.036 | 0.218 | 3.503 | 1.433 | 1.606 | 0.464 | 0.084 |
| 390 | 0.542 | 0.854 | 4.432 | 0.036 | 0.176 | 3.680 | 1.433 | 1.710 | 0.536 | 0.072 |
| 400 | 0.556 | 0.860 | 4.463 | 0.031 | 0.156 | 3.835 | 1.433 | 1.799 | 0.603 | 0.067 |
| 410 | 0.569 | 0.866 | 4.495 | 0.031 | 0.104 | 3.939 | 1.433 | 1.857 | 0.650 | 0.046 |
| 420 | 0.583 | 0.872 | 4.526 | 0.031 | 0.093 | 4.033 | 1.433 | 1.908 | 0.692 | 0.043 |
| 430 | 0.597 | 0.878 | 4.557 | 0.031 | 0.088 | 4.121 | 1.433 | 1.955 | 0.733 | 0.041 |
| 440 | 0.611 | 0.883 | 4.583 | 0.026 | 0.078 | 4.199 | 1.433 | 1.995 | 0.770 | 0.037 |
| 450 | 0.625 | 0.888 | 4.609 | 0.026 | 0.078 | 4.277 | 1.433 | 2.036 | 0.808 | 0.038 |
| 460 | 0.639 | 0.893 | 4.635 | 0.026 | 0.073 | 4.349 | 1.433 | 2.073 | 0.844 | 0.036 |
| 470 | 0.653 | 0.898 | 4.661 | 0.026 | 0.062 | 4.412 | 1.433 | 2.104 | 0.875 | 0.031 |
| 480 | 0.667 | 0.903 | 4.687 | 0.026 | 0.062 | 4.474 | 1.433 | 2.135 | 0.906 | 0.031 |
| 490 | 0.681 | 0.908 | 4.713 | 0.026 | 0.057 | 4.531 | 1.433 | 2.163 | 0.935 | 0.029 |
| 500 | 0.694 | 0.913 | 4.738 | 0.026 | 0.052 | 4.583 | 1.433 | 2.188 | 0.962 | 0.027 |
| 510 | 0.708 | 0.918 | 4.764 | 0.026 | 0.052 | 4.635 | 1.433 | 2.213 | 0.989 | 0.027 |
| 520 | 0.722 | 0.923 | 4.790 | 0.026 | 0.052 | 4.687 | 1.433 | 2.238 | 1.016 | 0.027 |
| 530 | 0.736 | 0.927 | 4.811 | 0.021 | 0.042 | 4.728 | 1.433 | 2.257 | 1.038 | 0.022 |
| 540 | 0.750 | 0.931 | 4.832 | 0.021 | 0.036 | 4.764 | 1.433 | 2.274 | 1.058 | 0.019 |
| 550 | 0.764 | 0.935 | 4.853 | 0.021 | 0.036 | 4.801 | 1.433 | 2.291 | 1.077 | 0.019 |
| 560 | 0.778 | 0.939 | 4.873 | 0.021 | 0.031 | 4.832 | 1.433 | 2.305 | 1.094 | 0.017 |
| 570 | 0.792 | 0.943 | 4.894 | 0.021 | 0.031 | 4.863 | 1.433 | 2.320 | 1.111 | 0.017 |
| 580 | 0.806 | 0.947 | 4.915 | 0.021 | 0.026 | 4.889 | 1.433 | 2.331 | 1.125 | 0.014 |
| 590 | 0.819 | 0.951 | 4.936 | 0.021 | 0.026 | 4.915 | 1.433 | 2.343 | 1.139 | 0.014 |
| 600 | 0.833 | 0.955 | 4.956 | 0.021 | 0.026 | 4.941 | 1.433 | 2.355 | 1.153 | 0.014 |
| 610 | 0.847 | 0.959 | 4.977 | 0.021 | 0.026 | 4.967 | 1.433 | 2.367 | 1.167 | 0.014 |
| 620 | 0.861 | 0.963 | 4.998 | 0.021 | 0.026 | 4.993 | 1.433 | 2.378 | 1.182 | 0.014 |
| 630 | 0.875 | 0.967 | 5.019 | 0.021 | 0.021 | 5.014 | 1.433 | 2.387 | 1.193 | 0.012 |
| 640 | 0.889 | 0.971 | 5.039 | 0.021 | 0.021 | 5.034 | 1.433 | 2.397 | 1.205 | 0.012 |
| 650 | 0.903 | 0.975 | 5.060 | 0.021 | 0.021 | 5.055 | 1.433 | 2.406 | 1.216 | 0.012 |
| 660 | 0.917 | 0.979 | 5.081 | 0.021 | 0.021 | 5.076 | 1.433 | 2.415 | 1.228 | 0.012 |
| 670 | 0.931 | 0.983 | 5.102 | 0.021 | 0.021 | 5.097 | 1.433 | 2.424 | 1.240 | 0.012 |
| 680 | 0.944 | 0.987 | 5.123 | 0.021 | 0.021 | 5.117 | 1.433 | 2.433 | 1.251 | 0.012 |
| 690 | 0.958 | 0.991 | 5.143 | 0.021 | 0.021 | 5.138 | 1.433 | 2.442 | 1.263 | 0.012 |
| 700 | 0.972 | 0.994 | 5.159 | 0.016 | 0.021 | 5.159 | 1.433 | 2.451 | 1.275 | 0.012 |
| 710 | 0.986 | 0.997 | 5.174 | 0.016 | 0.016 | 5.174 | 1.433 | 2.458 | 1.284 | 0.009 |
| 720 | 1.000 | 1.000 | 5.190 | 0.016 | 0.016 | 5.190 | 1.433 | 2.465 | 1.293 | 0.009 |

**Table A 14** Design Hyetograph of Sukesen Creek Subbasin (Tr = 100 yr)

| duration (min) | duration / total duration | depth / total depth | cumulative depth (cm) | incremental depth (cm) | ordered depth (cm) | cumulative ordered depth (cm) | cum. initial abstriction, Ia (cm) | cumulative abstriction, Fa (cm) | cumulative excess depth, Pe (cm) | excess depth (cm) |
|---|---|---|---|---|---|---|---|---|---|---|
| 10 | 0.014 | 0.140 | 0.814 | 0.814 | 0.017 | 0.017 | 0.017 | 0.000 | 0.000 | 0.000 |
| 20 | 0.028 | 0.225 | 1.308 | 0.494 | 0.023 | 0.041 | 0.041 | 0.000 | 0.000 | 0.000 |
| 30 | 0.042 | 0.283 | 1.645 | 0.337 | 0.023 | 0.064 | 0.064 | 0.000 | 0.000 | 0.000 |
| 40 | 0.056 | 0.325 | 1.889 | 0.244 | 0.023 | 0.087 | 0.087 | 0.000 | 0.000 | 0.000 |
| 50 | 0.070 | 0.366 | 2.127 | 0.238 | 0.023 | 0.110 | 0.110 | 0.000 | 0.000 | 0.000 |
| 60 | 0.084 | 0.400 | 2.325 | 0.198 | 0.023 | 0.134 | 0.134 | 0.000 | 0.000 | 0.000 |
| 70 | 0.097 | 0.432 | 2.511 | 0.186 | 0.023 | 0.157 | 0.157 | 0.000 | 0.000 | 0.000 |
| 80 | 0.111 | 0.462 | 2.686 | 0.174 | 0.023 | 0.180 | 0.180 | 0.000 | 0.000 | 0.000 |
| 90 | 0.125 | 0.488 | 2.837 | 0.151 | 0.023 | 0.203 | 0.203 | 0.000 | 0.000 | 0.000 |
| 100 | 0.139 | 0.508 | 2.953 | 0.116 | 0.023 | 0.227 | 0.227 | 0.000 | 0.000 | 0.000 |
| 110 | 0.153 | 0.527 | 3.063 | 0.110 | 0.029 | 0.256 | 0.256 | 0.000 | 0.000 | 0.000 |
| 120 | 0.167 | 0.545 | 3.168 | 0.105 | 0.029 | 0.285 | 0.285 | 0.000 | 0.000 | 0.000 |
| 130 | 0.181 | 0.563 | 3.273 | 0.105 | 0.029 | 0.314 | 0.314 | 0.000 | 0.000 | 0.000 |
| 140 | 0.195 | 0.580 | 3.371 | 0.099 | 0.029 | 0.343 | 0.343 | 0.000 | 0.000 | 0.000 |
| 150 | 0.209 | 0.595 | 3.459 | 0.087 | 0.035 | 0.378 | 0.378 | 0.000 | 0.000 | 0.000 |
| 160 | 0.222 | 0.610 | 3.546 | 0.087 | 0.035 | 0.413 | 0.413 | 0.000 | 0.000 | 0.000 |
| 170 | 0.236 | 0.625 | 3.633 | 0.087 | 0.041 | 0.453 | 0.453 | 0.000 | 0.000 | 0.000 |
| 180 | 0.250 | 0.640 | 3.720 | 0.087 | 0.041 | 0.494 | 0.494 | 0.000 | 0.000 | 0.000 |
| 190 | 0.264 | 0.655 | 3.807 | 0.087 | 0.041 | 0.535 | 0.535 | 0.000 | 0.000 | 0.000 |
| 200 | 0.278 | 0.669 | 3.889 | 0.081 | 0.047 | 0.581 | 0.581 | 0.000 | 0.000 | 0.000 |
| 210 | 0.292 | 0.683 | 3.970 | 0.081 | 0.058 | 0.639 | 0.639 | 0.000 | 0.000 | 0.000 |
| 220 | 0.306 | 0.695 | 4.040 | 0.070 | 0.058 | 0.698 | 0.698 | 0.000 | 0.000 | 0.000 |
| 230 | 0.320 | 0.707 | 4.110 | 0.070 | 0.064 | 0.761 | 0.761 | 0.000 | 0.000 | 0.000 |
| 240 | 0.334 | 0.719 | 4.179 | 0.070 | 0.070 | 0.831 | 0.831 | 0.000 | 0.000 | 0.000 |
| 250 | 0.347 | 0.731 | 4.249 | 0.070 | 0.070 | 0.901 | 0.901 | 0.000 | 0.000 | 0.000 |
| 260 | 0.361 | 0.742 | 4.313 | 0.064 | 0.081 | 0.982 | 0.982 | 0.000 | 0.000 | 0.000 |
| 270 | 0.375 | 0.753 | 4.377 | 0.064 | 0.087 | 1.070 | 1.070 | 0.000 | 0.000 | 0.000 |
| 280 | 0.389 | 0.763 | 4.435 | 0.058 | 0.087 | 1.157 | 1.157 | 0.000 | 0.000 | 0.000 |
| 290 | 0.403 | 0.773 | 4.493 | 0.058 | 0.087 | 1.244 | 1.244 | 0.000 | 0.000 | 0.000 |
| 300 | 0.417 | 0.783 | 4.551 | 0.058 | 0.105 | 1.349 | 1.349 | 0.000 | 0.000 | 0.000 |
| 310 | 0.431 | 0.793 | 4.610 | 0.058 | 0.110 | 1.459 | 1.433 | 0.026 | 0.000 | 0.000 |
| 320 | 0.445 | 0.803 | 4.668 | 0.058 | 0.151 | 1.610 | 1.433 | 0.173 | 0.004 | 0.004 |
| 330 | 0.459 | 0.811 | 4.714 | 0.047 | 0.186 | 1.796 | 1.433 | 0.346 | 0.018 | 0.013 |
| 340 | 0.472 | 0.819 | 4.761 | 0.047 | 0.238 | 2.034 | 1.433 | 0.555 | 0.047 | 0.029 |
| 350 | 0.486 | 0.826 | 4.801 | 0.041 | 0.337 | 2.372 | 1.433 | 0.830 | 0.109 | 0.062 |
| 360 | 0.500 | 0.833 | 4.842 | 0.041 | 0.814 | 3.185 | 1.433 | 1.408 | 0.344 | 0.236 |

**Table A 14** (continued)

| duration (min) | duration / total duration | depth / total depth | cumulative depth (cm) | incremental depth (cm) | ordered depth (cm) | cumulative ordered depth (cm) | cum. initial abstriction, Ia (cm) | cumulative abstriction, Fa (cm) | cumulative excess depth, Pe (cm) | excess depth (cm) |
|---|---|---|---|---|---|---|---|---|---|---|
| 370 | 0.514 | 0.840 | 4.883 | 0.041 | 0.494 | 3.680 | 1.433 | 1.710 | 0.536 | 0.192 |
| 380 | 0.528 | 0.847 | 4.923 | 0.041 | 0.244 | 3.924 | 1.433 | 1.848 | 0.643 | 0.106 |
| 390 | 0.542 | 0.854 | 4.964 | 0.041 | 0.198 | 4.121 | 1.433 | 1.955 | 0.734 | 0.091 |
| 400 | 0.556 | 0.860 | 4.999 | 0.035 | 0.174 | 4.296 | 1.433 | 2.045 | 0.817 | 0.084 |
| 410 | 0.569 | 0.866 | 5.034 | 0.035 | 0.116 | 4.412 | 1.433 | 2.104 | 0.875 | 0.058 |
| 420 | 0.583 | 0.872 | 5.069 | 0.035 | 0.105 | 4.517 | 1.433 | 2.156 | 0.928 | 0.053 |
| 430 | 0.597 | 0.878 | 5.104 | 0.035 | 0.099 | 4.615 | 1.433 | 2.204 | 0.979 | 0.051 |
| 440 | 0.611 | 0.883 | 5.133 | 0.029 | 0.087 | 4.703 | 1.433 | 2.245 | 1.025 | 0.046 |
| 450 | 0.625 | 0.888 | 5.162 | 0.029 | 0.087 | 4.790 | 1.433 | 2.286 | 1.071 | 0.046 |
| 460 | 0.639 | 0.893 | 5.191 | 0.029 | 0.081 | 4.871 | 1.433 | 2.323 | 1.115 | 0.044 |
| 470 | 0.653 | 0.898 | 5.220 | 0.029 | 0.070 | 4.941 | 1.433 | 2.355 | 1.153 | 0.038 |
| 480 | 0.667 | 0.903 | 5.249 | 0.029 | 0.070 | 5.011 | 1.433 | 2.386 | 1.192 | 0.039 |
| 490 | 0.681 | 0.908 | 5.278 | 0.029 | 0.064 | 5.075 | 1.433 | 2.414 | 1.227 | 0.036 |
| 500 | 0.694 | 0.913 | 5.307 | 0.029 | 0.058 | 5.133 | 1.433 | 2.440 | 1.260 | 0.033 |
| 510 | 0.708 | 0.918 | 5.336 | 0.029 | 0.058 | 5.191 | 1.433 | 2.465 | 1.293 | 0.033 |
| 520 | 0.722 | 0.923 | 5.365 | 0.029 | 0.058 | 5.249 | 1.433 | 2.490 | 1.326 | 0.033 |
| 530 | 0.736 | 0.927 | 5.388 | 0.023 | 0.047 | 5.295 | 1.433 | 2.510 | 1.353 | 0.027 |
| 540 | 0.750 | 0.931 | 5.412 | 0.023 | 0.041 | 5.336 | 1.433 | 2.527 | 1.377 | 0.024 |
| 550 | 0.764 | 0.935 | 5.435 | 0.023 | 0.041 | 5.377 | 1.433 | 2.544 | 1.400 | 0.024 |
| 560 | 0.778 | 0.939 | 5.458 | 0.023 | 0.035 | 5.412 | 1.433 | 2.558 | 1.421 | 0.020 |
| 570 | 0.792 | 0.943 | 5.481 | 0.023 | 0.035 | 5.447 | 1.433 | 2.572 | 1.441 | 0.021 |
| 580 | 0.806 | 0.947 | 5.505 | 0.023 | 0.029 | 5.476 | 1.433 | 2.584 | 1.458 | 0.017 |
| 590 | 0.819 | 0.951 | 5.528 | 0.023 | 0.029 | 5.505 | 1.433 | 2.596 | 1.476 | 0.017 |
| 600 | 0.833 | 0.955 | 5.551 | 0.023 | 0.029 | 5.534 | 1.433 | 2.608 | 1.493 | 0.017 |
| 610 | 0.847 | 0.959 | 5.574 | 0.023 | 0.029 | 5.563 | 1.433 | 2.620 | 1.510 | 0.017 |
| 620 | 0.861 | 0.963 | 5.598 | 0.023 | 0.029 | 5.592 | 1.433 | 2.631 | 1.528 | 0.017 |
| 630 | 0.875 | 0.967 | 5.621 | 0.023 | 0.023 | 5.615 | 1.433 | 2.641 | 1.542 | 0.014 |
| 640 | 0.889 | 0.971 | 5.644 | 0.023 | 0.023 | 5.638 | 1.433 | 2.650 | 1.556 | 0.014 |
| 650 | 0.903 | 0.975 | 5.667 | 0.023 | 0.023 | 5.662 | 1.433 | 2.659 | 1.570 | 0.014 |
| 660 | 0.917 | 0.979 | 5.691 | 0.023 | 0.023 | 5.685 | 1.433 | 2.668 | 1.584 | 0.014 |
| 670 | 0.931 | 0.983 | 5.714 | 0.023 | 0.023 | 5.708 | 1.433 | 2.677 | 1.598 | 0.014 |
| 680 | 0.944 | 0.987 | 5.737 | 0.023 | 0.023 | 5.731 | 1.433 | 2.687 | 1.612 | 0.014 |
| 690 | 0.958 | 0.991 | 5.760 | 0.023 | 0.023 | 5.755 | 1.433 | 2.696 | 1.626 | 0.014 |
| 700 | 0.972 | 0.994 | 5.778 | 0.017 | 0.023 | 5.778 | 1.433 | 2.705 | 1.640 | 0.014 |
| 710 | 0.986 | 0.997 | 5.795 | 0.017 | 0.017 | 5.795 | 1.433 | 2.711 | 1.651 | 0.011 |
| 720 | 1.000 | 1.000 | 5.813 | 0.017 | 0.017 | 5.813 | 1.433 | 2.718 | 1.662 | 0.011 |

**Table A 15** Design Hyetograph of Sukesen Creek Subbasin (Tr = 500 yr)

| duration (min) | duration / total duration | depth / total depth | cumulative depth (cm) | incremental depth (cm) | ordered depth (cm) | cumulative ordered depth (cm) | cum. initial abstriction, Ia (cm) | cumulative abstriction, Fa (cm) | cumulative excess depth, Pe (cm) | excess depth (cm) |
|---|---|---|---|---|---|---|---|---|---|---|
| 10 | 0.014 | 0.140 | 1.014 | 1.014 | 0.022 | 0.022 | 0.022 | 0.000 | 0.000 | 0.000 |
| 20 | 0.028 | 0.225 | 1.630 | 0.616 | 0.029 | 0.051 | 0.051 | 0.000 | 0.000 | 0.000 |
| 30 | 0.042 | 0.283 | 2.050 | 0.420 | 0.029 | 0.080 | 0.080 | 0.000 | 0.000 | 0.000 |
| 40 | 0.056 | 0.325 | 2.355 | 0.304 | 0.029 | 0.109 | 0.109 | 0.000 | 0.000 | 0.000 |
| 50 | 0.070 | 0.366 | 2.652 | 0.297 | 0.029 | 0.138 | 0.138 | 0.000 | 0.000 | 0.000 |
| 60 | 0.084 | 0.400 | 2.898 | 0.246 | 0.029 | 0.167 | 0.167 | 0.000 | 0.000 | 0.000 |
| 70 | 0.097 | 0.432 | 3.130 | 0.232 | 0.029 | 0.196 | 0.196 | 0.000 | 0.000 | 0.000 |
| 80 | 0.111 | 0.462 | 3.347 | 0.217 | 0.029 | 0.225 | 0.225 | 0.000 | 0.000 | 0.000 |
| 90 | 0.125 | 0.488 | 3.536 | 0.188 | 0.029 | 0.254 | 0.254 | 0.000 | 0.000 | 0.000 |
| 100 | 0.139 | 0.508 | 3.681 | 0.145 | 0.029 | 0.283 | 0.283 | 0.000 | 0.000 | 0.000 |
| 110 | 0.153 | 0.527 | 3.818 | 0.138 | 0.036 | 0.319 | 0.319 | 0.000 | 0.000 | 0.000 |
| 120 | 0.167 | 0.545 | 3.949 | 0.130 | 0.036 | 0.355 | 0.355 | 0.000 | 0.000 | 0.000 |
| 130 | 0.181 | 0.563 | 4.079 | 0.130 | 0.036 | 0.391 | 0.391 | 0.000 | 0.000 | 0.000 |
| 140 | 0.195 | 0.580 | 4.202 | 0.123 | 0.036 | 0.427 | 0.427 | 0.000 | 0.000 | 0.000 |
| 150 | 0.209 | 0.595 | 4.311 | 0.109 | 0.043 | 0.471 | 0.471 | 0.000 | 0.000 | 0.000 |
| 160 | 0.222 | 0.610 | 4.420 | 0.109 | 0.043 | 0.514 | 0.514 | 0.000 | 0.000 | 0.000 |
| 170 | 0.236 | 0.625 | 4.528 | 0.109 | 0.051 | 0.565 | 0.565 | 0.000 | 0.000 | 0.000 |
| 180 | 0.250 | 0.640 | 4.637 | 0.109 | 0.051 | 0.616 | 0.616 | 0.000 | 0.000 | 0.000 |
| 190 | 0.264 | 0.655 | 4.746 | 0.109 | 0.051 | 0.667 | 0.667 | 0.000 | 0.000 | 0.000 |
| 200 | 0.278 | 0.669 | 4.847 | 0.101 | 0.058 | 0.725 | 0.725 | 0.000 | 0.000 | 0.000 |
| 210 | 0.292 | 0.683 | 4.948 | 0.101 | 0.072 | 0.797 | 0.797 | 0.000 | 0.000 | 0.000 |
| 220 | 0.306 | 0.695 | 5.035 | 0.087 | 0.072 | 0.869 | 0.869 | 0.000 | 0.000 | 0.000 |
| 230 | 0.320 | 0.707 | 5.122 | 0.087 | 0.080 | 0.949 | 0.949 | 0.000 | 0.000 | 0.000 |
| 240 | 0.334 | 0.719 | 5.209 | 0.087 | 0.087 | 1.036 | 1.036 | 0.000 | 0.000 | 0.000 |
| 250 | 0.347 | 0.731 | 5.296 | 0.087 | 0.087 | 1.123 | 1.123 | 0.000 | 0.000 | 0.000 |
| 260 | 0.361 | 0.742 | 5.376 | 0.080 | 0.101 | 1.224 | 1.224 | 0.000 | 0.000 | 0.000 |
| 270 | 0.375 | 0.753 | 5.456 | 0.080 | 0.109 | 1.333 | 1.333 | 0.000 | 0.000 | 0.000 |
| 280 | 0.389 | 0.763 | 5.528 | 0.072 | 0.109 | 1.442 | 1.433 | 0.009 | 0.000 | 0.000 |
| 290 | 0.403 | 0.773 | 5.601 | 0.072 | 0.109 | 1.550 | 1.433 | 0.116 | 0.002 | 0.002 |
| 300 | 0.417 | 0.783 | 5.673 | 0.072 | 0.130 | 1.681 | 1.433 | 0.240 | 0.008 | 0.006 |
| 310 | 0.431 | 0.793 | 5.745 | 0.072 | 0.138 | 1.819 | 1.433 | 0.366 | 0.020 | 0.011 |
| 320 | 0.445 | 0.803 | 5.818 | 0.072 | 0.188 | 2.007 | 1.433 | 0.532 | 0.043 | 0.023 |
| 330 | 0.459 | 0.811 | 5.876 | 0.058 | 0.232 | 2.239 | 1.433 | 0.724 | 0.082 | 0.039 |
| 340 | 0.472 | 0.819 | 5.934 | 0.058 | 0.297 | 2.536 | 1.433 | 0.956 | 0.147 | 0.066 |
| 350 | 0.486 | 0.826 | 5.985 | 0.051 | 0.420 | 2.956 | 1.433 | 1.256 | 0.267 | 0.120 |
| 360 | 0.500 | 0.833 | 6.035 | 0.051 | 1.014 | 3.970 | 1.433 | 1.874 | 0.664 | 0.397 |

**Table A 15** (continued)

| duration (min) | duration / total duration | depth / total depth | cumulative depth (cm) | incremental depth (cm) | ordered depth (cm) | cumulative ordered depth (cm) | cum. initial abstriction, Ia (cm) | cumulative abstriction, Fa (cm) | cumulative excess depth, Pe (cm) | excess depth (cm) |
|---|---|---|---|---|---|---|---|---|---|---|
| 370 | 0.514 | 0.840 | 6.086 | 0.051 | 0.616 | 4.586 | 1.433 | 2.190 | 0.964 | 0.300 |
| 380 | 0.528 | 0.847 | 6.137 | 0.051 | 0.304 | 4.891 | 1.433 | 2.332 | 1.126 | 0.162 |
| 390 | 0.542 | 0.854 | 6.187 | 0.051 | 0.246 | 5.137 | 1.433 | 2.442 | 1.262 | 0.137 |
| 400 | 0.556 | 0.860 | 6.231 | 0.043 | 0.217 | 5.354 | 1.433 | 2.534 | 1.387 | 0.125 |
| 410 | 0.569 | 0.866 | 6.274 | 0.043 | 0.145 | 5.499 | 1.433 | 2.594 | 1.472 | 0.085 |
| 420 | 0.583 | 0.872 | 6.318 | 0.043 | 0.130 | 5.630 | 1.433 | 2.646 | 1.550 | 0.078 |
| 430 | 0.597 | 0.878 | 6.361 | 0.043 | 0.123 | 5.753 | 1.433 | 2.695 | 1.625 | 0.075 |
| 440 | 0.611 | 0.883 | 6.398 | 0.036 | 0.109 | 5.861 | 1.433 | 2.737 | 1.692 | 0.067 |
| 450 | 0.625 | 0.888 | 6.434 | 0.036 | 0.109 | 5.970 | 1.433 | 2.778 | 1.759 | 0.068 |
| 460 | 0.639 | 0.893 | 6.470 | 0.036 | 0.101 | 6.072 | 1.433 | 2.816 | 1.823 | 0.064 |
| 470 | 0.653 | 0.898 | 6.506 | 0.036 | 0.087 | 6.158 | 1.433 | 2.847 | 1.878 | 0.055 |
| 480 | 0.667 | 0.903 | 6.542 | 0.036 | 0.087 | 6.245 | 1.433 | 2.879 | 1.934 | 0.056 |
| 490 | 0.681 | 0.908 | 6.579 | 0.036 | 0.080 | 6.325 | 1.433 | 2.907 | 1.985 | 0.051 |
| 500 | 0.694 | 0.913 | 6.615 | 0.036 | 0.072 | 6.398 | 1.433 | 2.932 | 2.032 | 0.047 |
| 510 | 0.708 | 0.918 | 6.651 | 0.036 | 0.072 | 6.470 | 1.433 | 2.958 | 2.080 | 0.047 |
| 520 | 0.722 | 0.923 | 6.687 | 0.036 | 0.072 | 6.542 | 1.433 | 2.982 | 2.127 | 0.048 |
| 530 | 0.736 | 0.927 | 6.716 | 0.029 | 0.058 | 6.600 | 1.433 | 3.002 | 2.165 | 0.038 |
| 540 | 0.750 | 0.931 | 6.745 | 0.029 | 0.051 | 6.651 | 1.433 | 3.019 | 2.199 | 0.034 |
| 550 | 0.764 | 0.935 | 6.774 | 0.029 | 0.051 | 6.702 | 1.433 | 3.036 | 2.233 | 0.034 |
| 560 | 0.778 | 0.939 | 6.803 | 0.029 | 0.043 | 6.745 | 1.433 | 3.050 | 2.262 | 0.029 |
| 570 | 0.792 | 0.943 | 6.832 | 0.029 | 0.043 | 6.789 | 1.433 | 3.065 | 2.291 | 0.029 |
| 580 | 0.806 | 0.947 | 6.861 | 0.029 | 0.036 | 6.825 | 1.433 | 3.077 | 2.316 | 0.024 |
| 590 | 0.819 | 0.951 | 6.890 | 0.029 | 0.036 | 6.861 | 1.433 | 3.088 | 2.340 | 0.024 |
| 600 | 0.833 | 0.955 | 6.919 | 0.029 | 0.036 | 6.897 | 1.433 | 3.100 | 2.365 | 0.025 |
| 610 | 0.847 | 0.959 | 6.948 | 0.029 | 0.036 | 6.934 | 1.433 | 3.112 | 2.389 | 0.025 |
| 620 | 0.861 | 0.963 | 6.977 | 0.029 | 0.036 | 6.970 | 1.433 | 3.123 | 2.414 | 0.025 |
| 630 | 0.875 | 0.967 | 7.006 | 0.029 | 0.029 | 6.999 | 1.433 | 3.132 | 2.434 | 0.020 |
| 640 | 0.889 | 0.971 | 7.035 | 0.029 | 0.029 | 7.028 | 1.433 | 3.142 | 2.453 | 0.020 |
| 650 | 0.903 | 0.975 | 7.064 | 0.029 | 0.029 | 7.057 | 1.433 | 3.151 | 2.473 | 0.020 |
| 660 | 0.917 | 0.979 | 7.093 | 0.029 | 0.029 | 7.086 | 1.433 | 3.160 | 2.493 | 0.020 |
| 670 | 0.931 | 0.983 | 7.122 | 0.029 | 0.029 | 7.115 | 1.433 | 3.169 | 2.513 | 0.020 |
| 680 | 0.944 | 0.987 | 7.151 | 0.029 | 0.029 | 7.144 | 1.433 | 3.178 | 2.533 | 0.020 |
| 690 | 0.958 | 0.991 | 7.180 | 0.029 | 0.029 | 7.173 | 1.433 | 3.187 | 2.553 | 0.020 |
| 700 | 0.972 | 0.994 | 7.202 | 0.022 | 0.029 | 7.202 | 1.433 | 3.196 | 2.573 | 0.020 |
| 710 | 0.986 | 0.997 | 7.224 | 0.022 | 0.022 | 7.224 | 1.433 | 3.202 | 2.588 | 0.015 |
| 720 | 1.000 | 1.000 | 7.245 | 0.022 | 0.022 | 7.245 | 1.433 | 3.209 | 2.603 | 0.015 |

**Table A 16** Design Hyetograph of Tatlım Creek Subbasin (Tr = 50 yr)

| duration (min) | duration / total duration | depth / total depth | cumulative depth (cm) | incremental depth (cm) | ordered depth (cm) | cumulative ordered depth (cm) | cum. initial abstriction, Ia (cm) | cumulative abstriction, Fa (cm) | cumulative excess depth, Pe (cm) | excess depth (cm) |
|---|---|---|---|---|---|---|---|---|---|---|
| 10 | 0.014 | 0.140 | 0.727 | 0.727 | 0.016 | 0.016 | 0.016 | 0.000 | 0.000 | 0.000 |
| 20 | 0.028 | 0.225 | 1.168 | 0.441 | 0.021 | 0.036 | 0.036 | 0.000 | 0.000 | 0.000 |
| 30 | 0.042 | 0.283 | 1.469 | 0.301 | 0.021 | 0.057 | 0.057 | 0.000 | 0.000 | 0.000 |
| 40 | 0.056 | 0.325 | 1.687 | 0.218 | 0.021 | 0.078 | 0.078 | 0.000 | 0.000 | 0.000 |
| 50 | 0.070 | 0.366 | 1.900 | 0.213 | 0.021 | 0.099 | 0.099 | 0.000 | 0.000 | 0.000 |
| 60 | 0.084 | 0.400 | 2.076 | 0.176 | 0.021 | 0.119 | 0.119 | 0.000 | 0.000 | 0.000 |
| 70 | 0.097 | 0.432 | 2.242 | 0.166 | 0.021 | 0.140 | 0.140 | 0.000 | 0.000 | 0.000 |
| 80 | 0.111 | 0.462 | 2.398 | 0.156 | 0.021 | 0.161 | 0.161 | 0.000 | 0.000 | 0.000 |
| 90 | 0.125 | 0.488 | 2.533 | 0.135 | 0.021 | 0.182 | 0.182 | 0.000 | 0.000 | 0.000 |
| 100 | 0.139 | 0.508 | 2.637 | 0.104 | 0.021 | 0.202 | 0.202 | 0.000 | 0.000 | 0.000 |
| 110 | 0.153 | 0.527 | 2.735 | 0.099 | 0.026 | 0.228 | 0.228 | 0.000 | 0.000 | 0.000 |
| 120 | 0.167 | 0.545 | 2.829 | 0.093 | 0.026 | 0.254 | 0.254 | 0.000 | 0.000 | 0.000 |
| 130 | 0.181 | 0.563 | 2.922 | 0.093 | 0.026 | 0.280 | 0.280 | 0.000 | 0.000 | 0.000 |
| 140 | 0.195 | 0.580 | 3.010 | 0.088 | 0.026 | 0.306 | 0.306 | 0.000 | 0.000 | 0.000 |
| 150 | 0.209 | 0.595 | 3.088 | 0.078 | 0.031 | 0.337 | 0.337 | 0.000 | 0.000 | 0.000 |
| 160 | 0.222 | 0.610 | 3.166 | 0.078 | 0.031 | 0.368 | 0.368 | 0.000 | 0.000 | 0.000 |
| 170 | 0.236 | 0.625 | 3.244 | 0.078 | 0.036 | 0.405 | 0.405 | 0.000 | 0.000 | 0.000 |
| 180 | 0.250 | 0.640 | 3.322 | 0.078 | 0.036 | 0.441 | 0.441 | 0.000 | 0.000 | 0.000 |
| 190 | 0.264 | 0.655 | 3.399 | 0.078 | 0.036 | 0.477 | 0.477 | 0.000 | 0.000 | 0.000 |
| 200 | 0.278 | 0.669 | 3.472 | 0.073 | 0.042 | 0.519 | 0.519 | 0.000 | 0.000 | 0.000 |
| 210 | 0.292 | 0.683 | 3.545 | 0.073 | 0.052 | 0.571 | 0.571 | 0.000 | 0.000 | 0.000 |
| 220 | 0.306 | 0.695 | 3.607 | 0.062 | 0.052 | 0.623 | 0.623 | 0.000 | 0.000 | 0.000 |
| 230 | 0.320 | 0.707 | 3.669 | 0.062 | 0.057 | 0.680 | 0.680 | 0.000 | 0.000 | 0.000 |
| 240 | 0.334 | 0.719 | 3.732 | 0.062 | 0.062 | 0.742 | 0.742 | 0.000 | 0.000 | 0.000 |
| 250 | 0.347 | 0.731 | 3.794 | 0.062 | 0.062 | 0.804 | 0.804 | 0.000 | 0.000 | 0.000 |
| 260 | 0.361 | 0.742 | 3.851 | 0.057 | 0.073 | 0.877 | 0.877 | 0.000 | 0.000 | 0.000 |
| 270 | 0.375 | 0.753 | 3.908 | 0.057 | 0.078 | 0.955 | 0.955 | 0.000 | 0.000 | 0.000 |
| 280 | 0.389 | 0.763 | 3.960 | 0.052 | 0.078 | 1.033 | 1.033 | 0.000 | 0.000 | 0.000 |
| 290 | 0.403 | 0.773 | 4.012 | 0.052 | 0.078 | 1.111 | 1.111 | 0.000 | 0.000 | 0.000 |
| 300 | 0.417 | 0.783 | 4.064 | 0.052 | 0.093 | 1.204 | 1.204 | 0.000 | 0.000 | 0.000 |
| 310 | 0.431 | 0.793 | 4.116 | 0.052 | 0.099 | 1.303 | 1.303 | 0.000 | 0.000 | 0.000 |
| 320 | 0.445 | 0.803 | 4.168 | 0.052 | 0.135 | 1.438 | 1.438 | 0.000 | 0.000 | 0.000 |
| 330 | 0.459 | 0.811 | 4.209 | 0.042 | 0.166 | 1.604 | 1.604 | 0.000 | 0.000 | 0.000 |
| 340 | 0.472 | 0.819 | 4.251 | 0.042 | 0.213 | 1.817 | 1.693 | 0.121 | 0.002 | 0.002 |
| 350 | 0.486 | 0.826 | 4.287 | 0.036 | 0.301 | 2.118 | 1.693 | 0.404 | 0.020 | 0.018 |
| 360 | 0.500 | 0.833 | 4.323 | 0.036 | 0.727 | 2.844 | 1.693 | 1.013 | 0.138 | 0.117 |

**Table A 16** (continued)

| duration (min) | duration / total duration | depth / total depth | cumulative depth (cm) | incremental depth (cm) | ordered depth (cm) | cumulative ordered depth (cm) | cum. initial abstriction, Ia (cm) | cumulative abstriction, Fa (cm) | cumulative excess depth, Pe (cm) | excess depth (cm) |
|---|---|---|---|---|---|---|---|---|---|---|
| 370 | 0.514 | 0.840 | 4.360 | 0.036 | 0.441 | 3.285 | 1.693 | 1.340 | 0.252 | 0.114 |
| 380 | 0.528 | 0.847 | 4.396 | 0.036 | 0.218 | 3.503 | 1.693 | 1.491 | 0.319 | 0.067 |
| 390 | 0.542 | 0.854 | 4.432 | 0.036 | 0.176 | 3.680 | 1.693 | 1.609 | 0.377 | 0.059 |
| 400 | 0.556 | 0.860 | 4.463 | 0.031 | 0.156 | 3.835 | 1.693 | 1.710 | 0.433 | 0.055 |
| 410 | 0.569 | 0.866 | 4.495 | 0.031 | 0.104 | 3.939 | 1.693 | 1.775 | 0.471 | 0.038 |
| 420 | 0.583 | 0.872 | 4.526 | 0.031 | 0.093 | 4.033 | 1.693 | 1.833 | 0.506 | 0.036 |
| 430 | 0.597 | 0.878 | 4.557 | 0.031 | 0.088 | 4.121 | 1.693 | 1.887 | 0.541 | 0.035 |
| 440 | 0.611 | 0.883 | 4.583 | 0.026 | 0.078 | 4.199 | 1.693 | 1.933 | 0.572 | 0.031 |
| 450 | 0.625 | 0.888 | 4.609 | 0.026 | 0.078 | 4.277 | 1.693 | 1.979 | 0.604 | 0.032 |
| 460 | 0.639 | 0.893 | 4.635 | 0.026 | 0.073 | 4.349 | 1.693 | 2.022 | 0.634 | 0.030 |
| 470 | 0.653 | 0.898 | 4.661 | 0.026 | 0.062 | 4.412 | 1.693 | 2.058 | 0.661 | 0.026 |
| 480 | 0.667 | 0.903 | 4.687 | 0.026 | 0.062 | 4.474 | 1.693 | 2.093 | 0.687 | 0.027 |
| 490 | 0.681 | 0.908 | 4.713 | 0.026 | 0.057 | 4.531 | 1.693 | 2.125 | 0.712 | 0.025 |
| 500 | 0.694 | 0.913 | 4.738 | 0.026 | 0.052 | 4.583 | 1.693 | 2.154 | 0.735 | 0.023 |
| 510 | 0.708 | 0.918 | 4.764 | 0.026 | 0.052 | 4.635 | 1.693 | 2.183 | 0.758 | 0.023 |
| 520 | 0.722 | 0.923 | 4.790 | 0.026 | 0.052 | 4.687 | 1.693 | 2.211 | 0.782 | 0.023 |
| 530 | 0.736 | 0.927 | 4.811 | 0.021 | 0.042 | 4.728 | 1.693 | 2.234 | 0.801 | 0.019 |
| 540 | 0.750 | 0.931 | 4.832 | 0.021 | 0.036 | 4.764 | 1.693 | 2.254 | 0.817 | 0.017 |
| 550 | 0.764 | 0.935 | 4.853 | 0.021 | 0.036 | 4.801 | 1.693 | 2.273 | 0.834 | 0.017 |
| 560 | 0.778 | 0.939 | 4.873 | 0.021 | 0.031 | 4.832 | 1.693 | 2.290 | 0.849 | 0.015 |
| 570 | 0.792 | 0.943 | 4.894 | 0.021 | 0.031 | 4.863 | 1.693 | 2.306 | 0.863 | 0.015 |
| 580 | 0.806 | 0.947 | 4.915 | 0.021 | 0.026 | 4.889 | 1.693 | 2.320 | 0.876 | 0.012 |
| 590 | 0.819 | 0.951 | 4.936 | 0.021 | 0.026 | 4.915 | 1.693 | 2.334 | 0.888 | 0.012 |
| 600 | 0.833 | 0.955 | 4.956 | 0.021 | 0.026 | 4.941 | 1.693 | 2.347 | 0.900 | 0.012 |
| 610 | 0.847 | 0.959 | 4.977 | 0.021 | 0.026 | 4.967 | 1.693 | 2.361 | 0.913 | 0.012 |
| 620 | 0.861 | 0.963 | 4.998 | 0.021 | 0.026 | 4.993 | 1.693 | 2.374 | 0.925 | 0.012 |
| 630 | 0.875 | 0.967 | 5.019 | 0.021 | 0.021 | 5.014 | 1.693 | 2.385 | 0.935 | 0.010 |
| 640 | 0.889 | 0.971 | 5.039 | 0.021 | 0.021 | 5.034 | 1.693 | 2.396 | 0.945 | 0.010 |
| 650 | 0.903 | 0.975 | 5.060 | 0.021 | 0.021 | 5.055 | 1.693 | 2.406 | 0.955 | 0.010 |
| 660 | 0.917 | 0.979 | 5.081 | 0.021 | 0.021 | 5.076 | 1.693 | 2.417 | 0.966 | 0.010 |
| 670 | 0.931 | 0.983 | 5.102 | 0.021 | 0.021 | 5.097 | 1.693 | 2.427 | 0.976 | 0.010 |
| 680 | 0.944 | 0.987 | 5.123 | 0.021 | 0.021 | 5.117 | 1.693 | 2.438 | 0.986 | 0.010 |
| 690 | 0.958 | 0.991 | 5.143 | 0.021 | 0.021 | 5.138 | 1.693 | 2.449 | 0.996 | 0.010 |
| 700 | 0.972 | 0.994 | 5.159 | 0.016 | 0.021 | 5.159 | 1.693 | 2.459 | 1.007 | 0.010 |
| 710 | 0.986 | 0.997 | 5.174 | 0.016 | 0.016 | 5.174 | 1.693 | 2.467 | 1.014 | 0.008 |
| 720 | 1.000 | 1.000 | 5.190 | 0.016 | 0.016 | 5.190 | 1.693 | 2.475 | 1.022 | 0.008 |

**Table A 17** Design Hyetograph of Tatlım Creek Subbasin (Tr = 100 yr)

| duration (min) | duration / total duration | depth / total depth | cumulative depth (cm) | incremental depth (cm) | ordered depth (cm) | cumulative ordered depth (cm) | cum. initial abstriction, Ia (cm) | cumulative abstriction, Fa (cm) | cumulative excess depth, Pe (cm) | excess depth (cm) |
|---|---|---|---|---|---|---|---|---|---|---|
| 10 | 0.014 | 0.140 | 0.814 | 0.814 | 0.017 | 0.017 | 0.017 | 0.000 | 0.000 | 0.000 |
| 20 | 0.028 | 0.225 | 1.308 | 0.494 | 0.023 | 0.041 | 0.041 | 0.000 | 0.000 | 0.000 |
| 30 | 0.042 | 0.283 | 1.645 | 0.337 | 0.023 | 0.064 | 0.064 | 0.000 | 0.000 | 0.000 |
| 40 | 0.056 | 0.325 | 1.889 | 0.244 | 0.023 | 0.087 | 0.087 | 0.000 | 0.000 | 0.000 |
| 50 | 0.070 | 0.366 | 2.127 | 0.238 | 0.023 | 0.110 | 0.110 | 0.000 | 0.000 | 0.000 |
| 60 | 0.084 | 0.400 | 2.325 | 0.198 | 0.023 | 0.134 | 0.134 | 0.000 | 0.000 | 0.000 |
| 70 | 0.097 | 0.432 | 2.511 | 0.186 | 0.023 | 0.157 | 0.157 | 0.000 | 0.000 | 0.000 |
| 80 | 0.111 | 0.462 | 2.686 | 0.174 | 0.023 | 0.180 | 0.180 | 0.000 | 0.000 | 0.000 |
| 90 | 0.125 | 0.488 | 2.837 | 0.151 | 0.023 | 0.203 | 0.203 | 0.000 | 0.000 | 0.000 |
| 100 | 0.139 | 0.508 | 2.953 | 0.116 | 0.023 | 0.227 | 0.227 | 0.000 | 0.000 | 0.000 |
| 110 | 0.153 | 0.527 | 3.063 | 0.110 | 0.029 | 0.256 | 0.256 | 0.000 | 0.000 | 0.000 |
| 120 | 0.167 | 0.545 | 3.168 | 0.105 | 0.029 | 0.285 | 0.285 | 0.000 | 0.000 | 0.000 |
| 130 | 0.181 | 0.563 | 3.273 | 0.105 | 0.029 | 0.314 | 0.314 | 0.000 | 0.000 | 0.000 |
| 140 | 0.195 | 0.580 | 3.371 | 0.099 | 0.029 | 0.343 | 0.343 | 0.000 | 0.000 | 0.000 |
| 150 | 0.209 | 0.595 | 3.459 | 0.087 | 0.035 | 0.378 | 0.378 | 0.000 | 0.000 | 0.000 |
| 160 | 0.222 | 0.610 | 3.546 | 0.087 | 0.035 | 0.413 | 0.413 | 0.000 | 0.000 | 0.000 |
| 170 | 0.236 | 0.625 | 3.633 | 0.087 | 0.041 | 0.453 | 0.453 | 0.000 | 0.000 | 0.000 |
| 180 | 0.250 | 0.640 | 3.720 | 0.087 | 0.041 | 0.494 | 0.494 | 0.000 | 0.000 | 0.000 |
| 190 | 0.264 | 0.655 | 3.807 | 0.087 | 0.041 | 0.535 | 0.535 | 0.000 | 0.000 | 0.000 |
| 200 | 0.278 | 0.669 | 3.889 | 0.081 | 0.047 | 0.581 | 0.581 | 0.000 | 0.000 | 0.000 |
| 210 | 0.292 | 0.683 | 3.970 | 0.081 | 0.058 | 0.639 | 0.639 | 0.000 | 0.000 | 0.000 |
| 220 | 0.306 | 0.695 | 4.040 | 0.070 | 0.058 | 0.698 | 0.698 | 0.000 | 0.000 | 0.000 |
| 230 | 0.320 | 0.707 | 4.110 | 0.070 | 0.064 | 0.761 | 0.761 | 0.000 | 0.000 | 0.000 |
| 240 | 0.334 | 0.719 | 4.179 | 0.070 | 0.070 | 0.831 | 0.831 | 0.000 | 0.000 | 0.000 |
| 250 | 0.347 | 0.731 | 4.249 | 0.070 | 0.070 | 0.901 | 0.901 | 0.000 | 0.000 | 0.000 |
| 260 | 0.361 | 0.742 | 4.313 | 0.064 | 0.081 | 0.982 | 0.982 | 0.000 | 0.000 | 0.000 |
| 270 | 0.375 | 0.753 | 4.377 | 0.064 | 0.087 | 1.070 | 1.070 | 0.000 | 0.000 | 0.000 |
| 280 | 0.389 | 0.763 | 4.435 | 0.058 | 0.087 | 1.157 | 1.157 | 0.000 | 0.000 | 0.000 |
| 290 | 0.403 | 0.773 | 4.493 | 0.058 | 0.087 | 1.244 | 1.244 | 0.000 | 0.000 | 0.000 |
| 300 | 0.417 | 0.783 | 4.551 | 0.058 | 0.105 | 1.349 | 1.349 | 0.000 | 0.000 | 0.000 |
| 310 | 0.431 | 0.793 | 4.610 | 0.058 | 0.110 | 1.459 | 1.459 | 0.000 | 0.000 | 0.000 |
| 320 | 0.445 | 0.803 | 4.668 | 0.058 | 0.151 | 1.610 | 1.610 | 0.000 | 0.000 | 0.000 |
| 330 | 0.459 | 0.811 | 4.714 | 0.047 | 0.186 | 1.796 | 1.693 | 0.102 | 0.001 | 0.001 |
| 340 | 0.472 | 0.819 | 4.761 | 0.047 | 0.238 | 2.034 | 1.693 | 0.328 | 0.013 | 0.012 |
| 350 | 0.486 | 0.826 | 4.801 | 0.041 | 0.337 | 2.372 | 1.693 | 0.628 | 0.050 | 0.037 |
| 360 | 0.500 | 0.833 | 4.842 | 0.041 | 0.814 | 3.185 | 1.693 | 1.269 | 0.224 | 0.173 |

**Table A 17** (continued)

| duration (min) | duration / total duration | depth / total depth | cumulative depth (cm) | incremental depth (cm) | ordered depth (cm) | cumulative ordered depth (cm) | cum. initial abstriction, Ia (cm) | cumulative abstriction, Fa (cm) | cumulative excess depth, Pe (cm) | excess depth (cm) |
|---|---|---|---|---|---|---|---|---|---|---|
| 370 | 0.514 | 0.840 | 4.883 | 0.041 | 0.494 | 3.680 | 1.693 | 1.609 | 0.377 | 0.154 |
| 380 | 0.528 | 0.847 | 4.923 | 0.041 | 0.244 | 3.924 | 1.693 | 1.765 | 0.465 | 0.088 |
| 390 | 0.542 | 0.854 | 4.964 | 0.041 | 0.198 | 4.121 | 1.693 | 1.887 | 0.541 | 0.076 |
| 400 | 0.556 | 0.860 | 4.999 | 0.035 | 0.174 | 4.296 | 1.693 | 1.991 | 0.612 | 0.071 |
| 410 | 0.569 | 0.866 | 5.034 | 0.035 | 0.116 | 4.412 | 1.693 | 2.058 | 0.661 | 0.049 |
| 420 | 0.583 | 0.872 | 5.069 | 0.035 | 0.105 | 4.517 | 1.693 | 2.117 | 0.706 | 0.045 |
| 430 | 0.597 | 0.878 | 5.104 | 0.035 | 0.099 | 4.615 | 1.693 | 2.172 | 0.750 | 0.044 |
| 440 | 0.611 | 0.883 | 5.133 | 0.029 | 0.087 | 4.703 | 1.693 | 2.220 | 0.789 | 0.039 |
| 450 | 0.625 | 0.888 | 5.162 | 0.029 | 0.087 | 4.790 | 1.693 | 2.267 | 0.829 | 0.040 |
| 460 | 0.639 | 0.893 | 5.191 | 0.029 | 0.081 | 4.871 | 1.693 | 2.311 | 0.867 | 0.038 |
| 470 | 0.653 | 0.898 | 5.220 | 0.029 | 0.070 | 4.941 | 1.693 | 2.347 | 0.900 | 0.033 |
| 480 | 0.667 | 0.903 | 5.249 | 0.029 | 0.070 | 5.011 | 1.693 | 2.383 | 0.934 | 0.034 |
| 490 | 0.681 | 0.908 | 5.278 | 0.029 | 0.064 | 5.075 | 1.693 | 2.416 | 0.965 | 0.031 |
| 500 | 0.694 | 0.913 | 5.307 | 0.029 | 0.058 | 5.133 | 1.693 | 2.446 | 0.994 | 0.029 |
| 510 | 0.708 | 0.918 | 5.336 | 0.029 | 0.058 | 5.191 | 1.693 | 2.475 | 1.022 | 0.029 |
| 520 | 0.722 | 0.923 | 5.365 | 0.029 | 0.058 | 5.249 | 1.693 | 2.504 | 1.052 | 0.029 |
| 530 | 0.736 | 0.927 | 5.388 | 0.023 | 0.047 | 5.295 | 1.693 | 2.527 | 1.075 | 0.024 |
| 540 | 0.750 | 0.931 | 5.412 | 0.023 | 0.041 | 5.336 | 1.693 | 2.547 | 1.096 | 0.021 |
| 550 | 0.764 | 0.935 | 5.435 | 0.023 | 0.041 | 5.377 | 1.693 | 2.567 | 1.117 | 0.021 |
| 560 | 0.778 | 0.939 | 5.458 | 0.023 | 0.035 | 5.412 | 1.693 | 2.584 | 1.135 | 0.018 |
| 570 | 0.792 | 0.943 | 5.481 | 0.023 | 0.035 | 5.447 | 1.693 | 2.600 | 1.153 | 0.018 |
| 580 | 0.806 | 0.947 | 5.505 | 0.023 | 0.029 | 5.476 | 1.693 | 2.614 | 1.168 | 0.015 |
| 590 | 0.819 | 0.951 | 5.528 | 0.023 | 0.029 | 5.505 | 1.693 | 2.628 | 1.183 | 0.015 |
| 600 | 0.833 | 0.955 | 5.551 | 0.023 | 0.029 | 5.534 | 1.693 | 2.642 | 1.198 | 0.015 |
| 610 | 0.847 | 0.959 | 5.574 | 0.023 | 0.029 | 5.563 | 1.693 | 2.656 | 1.214 | 0.015 |
| 620 | 0.861 | 0.963 | 5.598 | 0.023 | 0.029 | 5.592 | 1.693 | 2.669 | 1.229 | 0.015 |
| 630 | 0.875 | 0.967 | 5.621 | 0.023 | 0.023 | 5.615 | 1.693 | 2.680 | 1.242 | 0.012 |
| 640 | 0.889 | 0.971 | 5.644 | 0.023 | 0.023 | 5.638 | 1.693 | 2.691 | 1.254 | 0.012 |
| 650 | 0.903 | 0.975 | 5.667 | 0.023 | 0.023 | 5.662 | 1.693 | 2.702 | 1.266 | 0.012 |
| 660 | 0.917 | 0.979 | 5.691 | 0.023 | 0.023 | 5.685 | 1.693 | 2.713 | 1.279 | 0.012 |
| 670 | 0.931 | 0.983 | 5.714 | 0.023 | 0.023 | 5.708 | 1.693 | 2.723 | 1.291 | 0.013 |
| 680 | 0.944 | 0.987 | 5.737 | 0.023 | 0.023 | 5.731 | 1.693 | 2.734 | 1.304 | 0.013 |
| 690 | 0.958 | 0.991 | 5.760 | 0.023 | 0.023 | 5.755 | 1.693 | 2.745 | 1.317 | 0.013 |
| 700 | 0.972 | 0.994 | 5.778 | 0.017 | 0.023 | 5.778 | 1.693 | 2.755 | 1.329 | 0.013 |
| 710 | 0.986 | 0.997 | 5.795 | 0.017 | 0.017 | 5.795 | 1.693 | 2.763 | 1.339 | 0.010 |
| 720 | 1.000 | 1.000 | 5.813 | 0.017 | 0.017 | 5.813 | 1.693 | 2.771 | 1.348 | 0.010 |

**Table A 18** Design Hyetograph of Tatlım Creek Subbasin (Tr = 500 yr)

| duration (min) | duration / total duration | depth / total depth | cumulative depth (cm) | incremental depth (cm) | ordered depth (cm) | cumulative ordered depth (cm) | cum. initial abstriction, Ia (cm) | cumulative abstriction, Fa (cm) | cumulative excess depth, Pe (cm) | excess depth (cm) |
|---|---|---|---|---|---|---|---|---|---|---|
| 10 | 0.014 | 0.140 | 1.014 | 1.014 | 0.022 | 0.022 | 0.022 | 0.000 | 0.000 | 0.000 |
| 20 | 0.028 | 0.225 | 1.630 | 0.616 | 0.029 | 0.051 | 0.051 | 0.000 | 0.000 | 0.000 |
| 30 | 0.042 | 0.283 | 2.050 | 0.420 | 0.029 | 0.080 | 0.080 | 0.000 | 0.000 | 0.000 |
| 40 | 0.056 | 0.325 | 2.355 | 0.304 | 0.029 | 0.109 | 0.109 | 0.000 | 0.000 | 0.000 |
| 50 | 0.070 | 0.366 | 2.652 | 0.297 | 0.029 | 0.138 | 0.138 | 0.000 | 0.000 | 0.000 |
| 60 | 0.084 | 0.400 | 2.898 | 0.246 | 0.029 | 0.167 | 0.167 | 0.000 | 0.000 | 0.000 |
| 70 | 0.097 | 0.432 | 3.130 | 0.232 | 0.029 | 0.196 | 0.196 | 0.000 | 0.000 | 0.000 |
| 80 | 0.111 | 0.462 | 3.347 | 0.217 | 0.029 | 0.225 | 0.225 | 0.000 | 0.000 | 0.000 |
| 90 | 0.125 | 0.488 | 3.536 | 0.188 | 0.029 | 0.254 | 0.254 | 0.000 | 0.000 | 0.000 |
| 100 | 0.139 | 0.508 | 3.681 | 0.145 | 0.029 | 0.283 | 0.283 | 0.000 | 0.000 | 0.000 |
| 110 | 0.153 | 0.527 | 3.818 | 0.138 | 0.036 | 0.319 | 0.319 | 0.000 | 0.000 | 0.000 |
| 120 | 0.167 | 0.545 | 3.949 | 0.130 | 0.036 | 0.355 | 0.355 | 0.000 | 0.000 | 0.000 |
| 130 | 0.181 | 0.563 | 4.079 | 0.130 | 0.036 | 0.391 | 0.391 | 0.000 | 0.000 | 0.000 |
| 140 | 0.195 | 0.580 | 4.202 | 0.123 | 0.036 | 0.427 | 0.427 | 0.000 | 0.000 | 0.000 |
| 150 | 0.209 | 0.595 | 4.311 | 0.109 | 0.043 | 0.471 | 0.471 | 0.000 | 0.000 | 0.000 |
| 160 | 0.222 | 0.610 | 4.420 | 0.109 | 0.043 | 0.514 | 0.514 | 0.000 | 0.000 | 0.000 |
| 170 | 0.236 | 0.625 | 4.528 | 0.109 | 0.051 | 0.565 | 0.565 | 0.000 | 0.000 | 0.000 |
| 180 | 0.250 | 0.640 | 4.637 | 0.109 | 0.051 | 0.616 | 0.616 | 0.000 | 0.000 | 0.000 |
| 190 | 0.264 | 0.655 | 4.746 | 0.109 | 0.051 | 0.667 | 0.667 | 0.000 | 0.000 | 0.000 |
| 200 | 0.278 | 0.669 | 4.847 | 0.101 | 0.058 | 0.725 | 0.725 | 0.000 | 0.000 | 0.000 |
| 210 | 0.292 | 0.683 | 4.948 | 0.101 | 0.072 | 0.797 | 0.797 | 0.000 | 0.000 | 0.000 |
| 220 | 0.306 | 0.695 | 5.035 | 0.087 | 0.072 | 0.869 | 0.869 | 0.000 | 0.000 | 0.000 |
| 230 | 0.320 | 0.707 | 5.122 | 0.087 | 0.080 | 0.949 | 0.949 | 0.000 | 0.000 | 0.000 |
| 240 | 0.334 | 0.719 | 5.209 | 0.087 | 0.087 | 1.036 | 1.036 | 0.000 | 0.000 | 0.000 |
| 250 | 0.347 | 0.731 | 5.296 | 0.087 | 0.087 | 1.123 | 1.123 | 0.000 | 0.000 | 0.000 |
| 260 | 0.361 | 0.742 | 5.376 | 0.080 | 0.101 | 1.224 | 1.224 | 0.000 | 0.000 | 0.000 |
| 270 | 0.375 | 0.753 | 5.456 | 0.080 | 0.109 | 1.333 | 1.333 | 0.000 | 0.000 | 0.000 |
| 280 | 0.389 | 0.763 | 5.528 | 0.072 | 0.109 | 1.442 | 1.442 | 0.000 | 0.000 | 0.000 |
| 290 | 0.403 | 0.773 | 5.601 | 0.072 | 0.109 | 1.550 | 1.550 | 0.000 | 0.000 | 0.000 |
| 300 | 0.417 | 0.783 | 5.673 | 0.072 | 0.130 | 1.681 | 1.681 | 0.000 | 0.000 | 0.000 |
| 310 | 0.431 | 0.793 | 5.745 | 0.072 | 0.138 | 1.819 | 1.693 | 0.123 | 0.002 | 0.002 |
| 320 | 0.445 | 0.803 | 5.818 | 0.072 | 0.188 | 2.007 | 1.693 | 0.302 | 0.011 | 0.009 |
| 330 | 0.459 | 0.811 | 5.876 | 0.058 | 0.232 | 2.239 | 1.693 | 0.512 | 0.033 | 0.022 |
| 340 | 0.472 | 0.819 | 5.934 | 0.058 | 0.297 | 2.536 | 1.693 | 0.766 | 0.076 | 0.043 |
| 350 | 0.486 | 0.826 | 5.985 | 0.051 | 0.420 | 2.956 | 1.693 | 1.099 | 0.164 | 0.088 |
| 360 | 0.500 | 0.833 | 6.035 | 0.051 | 1.014 | 3.970 | 1.693 | 1.794 | 0.483 | 0.319 |

**Table A 18** (continued)

| duration (min) | duration / total duration | depth / total depth | cumulative depth (cm) | incremental depth (cm) | ordered depth (cm) | cumulative ordered depth (cm) | cum. initial abstriction, Ia (cm) | cumulative abstriction, Fa (cm) | cumulative excess depth, Pe (cm) | excess depth (cm) |
|---|---|---|---|---|---|---|---|---|---|---|
| 370 | 0.514 | 0.840 | 6.086 | 0.051 | 0.616 | 4.586 | 1.693 | 2.156 | 0.737 | 0.254 |
| 380 | 0.528 | 0.847 | 6.137 | 0.051 | 0.304 | 4.891 | 1.693 | 2.321 | 0.876 | 0.140 |
| 390 | 0.542 | 0.854 | 6.187 | 0.051 | 0.246 | 5.137 | 1.693 | 2.448 | 0.996 | 0.119 |
| 400 | 0.556 | 0.860 | 6.231 | 0.043 | 0.217 | 5.354 | 1.693 | 2.556 | 1.105 | 0.109 |
| 410 | 0.569 | 0.866 | 6.274 | 0.043 | 0.145 | 5.499 | 1.693 | 2.626 | 1.180 | 0.075 |
| 420 | 0.583 | 0.872 | 6.318 | 0.043 | 0.130 | 5.630 | 1.693 | 2.687 | 1.249 | 0.069 |
| 430 | 0.597 | 0.878 | 6.361 | 0.043 | 0.123 | 5.753 | 1.693 | 2.744 | 1.316 | 0.066 |
| 440 | 0.611 | 0.883 | 6.398 | 0.036 | 0.109 | 5.861 | 1.693 | 2.793 | 1.375 | 0.059 |
| 450 | 0.625 | 0.888 | 6.434 | 0.036 | 0.109 | 5.970 | 1.693 | 2.841 | 1.435 | 0.060 |
| 460 | 0.639 | 0.893 | 6.470 | 0.036 | 0.101 | 6.072 | 1.693 | 2.886 | 1.492 | 0.057 |
| 470 | 0.653 | 0.898 | 6.506 | 0.036 | 0.087 | 6.158 | 1.693 | 2.923 | 1.542 | 0.049 |
| 480 | 0.667 | 0.903 | 6.542 | 0.036 | 0.087 | 6.245 | 1.693 | 2.960 | 1.592 | 0.050 |
| 490 | 0.681 | 0.908 | 6.579 | 0.036 | 0.080 | 6.325 | 1.693 | 2.994 | 1.638 | 0.046 |
| 500 | 0.694 | 0.913 | 6.615 | 0.036 | 0.072 | 6.398 | 1.693 | 3.024 | 1.680 | 0.042 |
| 510 | 0.708 | 0.918 | 6.651 | 0.036 | 0.072 | 6.470 | 1.693 | 3.054 | 1.723 | 0.043 |
| 520 | 0.722 | 0.923 | 6.687 | 0.036 | 0.072 | 6.542 | 1.693 | 3.083 | 1.766 | 0.043 |
| 530 | 0.736 | 0.927 | 6.716 | 0.029 | 0.058 | 6.600 | 1.693 | 3.107 | 1.800 | 0.035 |
| 540 | 0.750 | 0.931 | 6.745 | 0.029 | 0.051 | 6.651 | 1.693 | 3.127 | 1.831 | 0.030 |
| 550 | 0.764 | 0.935 | 6.774 | 0.029 | 0.051 | 6.702 | 1.693 | 3.147 | 1.862 | 0.031 |
| 560 | 0.778 | 0.939 | 6.803 | 0.029 | 0.043 | 6.745 | 1.693 | 3.164 | 1.888 | 0.026 |
| 570 | 0.792 | 0.943 | 6.832 | 0.029 | 0.043 | 6.789 | 1.693 | 3.181 | 1.914 | 0.026 |
| 580 | 0.806 | 0.947 | 6.861 | 0.029 | 0.036 | 6.825 | 1.693 | 3.195 | 1.937 | 0.022 |
| 590 | 0.819 | 0.951 | 6.890 | 0.029 | 0.036 | 6.861 | 1.693 | 3.209 | 1.959 | 0.022 |
| 600 | 0.833 | 0.955 | 6.919 | 0.029 | 0.036 | 6.897 | 1.693 | 3.223 | 1.981 | 0.022 |
| 610 | 0.847 | 0.959 | 6.948 | 0.029 | 0.036 | 6.934 | 1.693 | 3.237 | 2.003 | 0.022 |
| 620 | 0.861 | 0.963 | 6.977 | 0.029 | 0.036 | 6.970 | 1.693 | 3.251 | 2.026 | 0.022 |
| 630 | 0.875 | 0.967 | 7.006 | 0.029 | 0.029 | 6.999 | 1.693 | 3.262 | 2.044 | 0.018 |
| 640 | 0.889 | 0.971 | 7.035 | 0.029 | 0.029 | 7.028 | 1.693 | 3.273 | 2.062 | 0.018 |
| 650 | 0.903 | 0.975 | 7.064 | 0.029 | 0.029 | 7.057 | 1.693 | 3.283 | 2.080 | 0.018 |
| 660 | 0.917 | 0.979 | 7.093 | 0.029 | 0.029 | 7.086 | 1.693 | 3.294 | 2.098 | 0.018 |
| 670 | 0.931 | 0.983 | 7.122 | 0.029 | 0.029 | 7.115 | 1.693 | 3.305 | 2.116 | 0.018 |
| 680 | 0.944 | 0.987 | 7.151 | 0.029 | 0.029 | 7.144 | 1.693 | 3.316 | 2.135 | 0.018 |
| 690 | 0.958 | 0.991 | 7.180 | 0.029 | 0.029 | 7.173 | 1.693 | 3.327 | 2.153 | 0.018 |
| 700 | 0.972 | 0.994 | 7.202 | 0.022 | 0.029 | 7.202 | 1.693 | 3.337 | 2.171 | 0.018 |
| 710 | 0.986 | 0.997 | 7.224 | 0.022 | 0.022 | 7.224 | 1.693 | 3.345 | 2.185 | 0.014 |
| 720 | 1.000 | 1.000 | 7.245 | 0.022 | 0.022 | 7.245 | 1.693 | 3.353 | 2.199 | 0.014 |

**Table A 19** Design Hyetograph of Burcupınar Creek Subbasin (Tr = 50 yr)

| duration (min) | duration / total duration | depth / total depth | cumulative depth (cm) | incremental depth (cm) | ordered depth (cm) | cumulative ordered depth (cm) | cum. initial abstriction, Ia (cm) | cumulative abstriction, Fa (cm) | cumulative excess depth, Pe (cm) | excess depth (cm) |
|---|---|---|---|---|---|---|---|---|---|---|
| 10 | 0.014 | 0.140 | 0.727 | 0.727 | 0.016 | 0.016 | 0.016 | 0.000 | 0.000 | 0.000 |
| 20 | 0.028 | 0.225 | 1.168 | 0.441 | 0.021 | 0.036 | 0.036 | 0.000 | 0.000 | 0.000 |
| 30 | 0.042 | 0.283 | 1.469 | 0.301 | 0.021 | 0.057 | 0.057 | 0.000 | 0.000 | 0.000 |
| 40 | 0.056 | 0.325 | 1.687 | 0.218 | 0.021 | 0.078 | 0.078 | 0.000 | 0.000 | 0.000 |
| 50 | 0.070 | 0.366 | 1.900 | 0.213 | 0.021 | 0.099 | 0.099 | 0.000 | 0.000 | 0.000 |
| 60 | 0.084 | 0.400 | 2.076 | 0.176 | 0.021 | 0.119 | 0.119 | 0.000 | 0.000 | 0.000 |
| 70 | 0.097 | 0.432 | 2.242 | 0.166 | 0.021 | 0.140 | 0.140 | 0.000 | 0.000 | 0.000 |
| 80 | 0.111 | 0.462 | 2.398 | 0.156 | 0.021 | 0.161 | 0.161 | 0.000 | 0.000 | 0.000 |
| 90 | 0.125 | 0.488 | 2.533 | 0.135 | 0.021 | 0.182 | 0.182 | 0.000 | 0.000 | 0.000 |
| 100 | 0.139 | 0.508 | 2.637 | 0.104 | 0.021 | 0.202 | 0.202 | 0.000 | 0.000 | 0.000 |
| 110 | 0.153 | 0.527 | 2.735 | 0.099 | 0.026 | 0.228 | 0.228 | 0.000 | 0.000 | 0.000 |
| 120 | 0.167 | 0.545 | 2.829 | 0.093 | 0.026 | 0.254 | 0.254 | 0.000 | 0.000 | 0.000 |
| 130 | 0.181 | 0.563 | 2.922 | 0.093 | 0.026 | 0.280 | 0.280 | 0.000 | 0.000 | 0.000 |
| 140 | 0.195 | 0.580 | 3.010 | 0.088 | 0.026 | 0.306 | 0.306 | 0.000 | 0.000 | 0.000 |
| 150 | 0.209 | 0.595 | 3.088 | 0.078 | 0.031 | 0.337 | 0.337 | 0.000 | 0.000 | 0.000 |
| 160 | 0.222 | 0.610 | 3.166 | 0.078 | 0.031 | 0.368 | 0.368 | 0.000 | 0.000 | 0.000 |
| 170 | 0.236 | 0.625 | 3.244 | 0.078 | 0.036 | 0.405 | 0.405 | 0.000 | 0.000 | 0.000 |
| 180 | 0.250 | 0.640 | 3.322 | 0.078 | 0.036 | 0.441 | 0.441 | 0.000 | 0.000 | 0.000 |
| 190 | 0.264 | 0.655 | 3.399 | 0.078 | 0.036 | 0.477 | 0.477 | 0.000 | 0.000 | 0.000 |
| 200 | 0.278 | 0.669 | 3.472 | 0.073 | 0.042 | 0.519 | 0.519 | 0.000 | 0.000 | 0.000 |
| 210 | 0.292 | 0.683 | 3.545 | 0.073 | 0.052 | 0.571 | 0.571 | 0.000 | 0.000 | 0.000 |
| 220 | 0.306 | 0.695 | 3.607 | 0.062 | 0.052 | 0.623 | 0.623 | 0.000 | 0.000 | 0.000 |
| 230 | 0.320 | 0.707 | 3.669 | 0.062 | 0.057 | 0.680 | 0.680 | 0.000 | 0.000 | 0.000 |
| 240 | 0.334 | 0.719 | 3.732 | 0.062 | 0.062 | 0.742 | 0.742 | 0.000 | 0.000 | 0.000 |
| 250 | 0.347 | 0.731 | 3.794 | 0.062 | 0.062 | 0.804 | 0.804 | 0.000 | 0.000 | 0.000 |
| 260 | 0.361 | 0.742 | 3.851 | 0.057 | 0.073 | 0.877 | 0.877 | 0.000 | 0.000 | 0.000 |
| 270 | 0.375 | 0.753 | 3.908 | 0.057 | 0.078 | 0.955 | 0.955 | 0.000 | 0.000 | 0.000 |
| 280 | 0.389 | 0.763 | 3.960 | 0.052 | 0.078 | 1.033 | 1.033 | 0.000 | 0.000 | 0.000 |
| 290 | 0.403 | 0.773 | 4.012 | 0.052 | 0.078 | 1.111 | 1.111 | 0.000 | 0.000 | 0.000 |
| 300 | 0.417 | 0.783 | 4.064 | 0.052 | 0.093 | 1.204 | 1.153 | 0.051 | 0.000 | 0.000 |
| 310 | 0.431 | 0.793 | 4.116 | 0.052 | 0.099 | 1.303 | 1.153 | 0.146 | 0.004 | 0.003 |
| 320 | 0.445 | 0.803 | 4.168 | 0.052 | 0.135 | 1.438 | 1.153 | 0.271 | 0.013 | 0.010 |
| 330 | 0.459 | 0.811 | 4.209 | 0.042 | 0.166 | 1.604 | 1.153 | 0.418 | 0.033 | 0.019 |
| 340 | 0.472 | 0.819 | 4.251 | 0.042 | 0.213 | 1.817 | 1.153 | 0.595 | 0.068 | 0.036 |
| 350 | 0.486 | 0.826 | 4.287 | 0.036 | 0.301 | 2.118 | 1.153 | 0.826 | 0.138 | 0.070 |
| 360 | 0.500 | 0.833 | 4.323 | 0.036 | 0.727 | 2.844 | 1.153 | 1.308 | 0.383 | 0.245 |

**Table A 19** (continued)

| duration (min) | duration / total duration | depth / total depth | cumulative depth (cm) | incremental depth (cm) | ordered depth (cm) | cumulative ordered depth (cm) | cum. initial abstriction, Ia (cm) | cumulative abstriction, Fa (cm) | cumulative excess depth, Pe (cm) | excess depth (cm) |
|---|---|---|---|---|---|---|---|---|---|---|
| 370 | 0.514 | 0.840 | 4.360 | 0.036 | 0.441 | 3.285 | 1.153 | 1.557 | 0.576 | 0.192 |
| 380 | 0.528 | 0.847 | 4.396 | 0.036 | 0.218 | 3.503 | 1.153 | 1.670 | 0.681 | 0.105 |
| 390 | 0.542 | 0.854 | 4.432 | 0.036 | 0.176 | 3.680 | 1.153 | 1.757 | 0.770 | 0.089 |
| 400 | 0.556 | 0.860 | 4.463 | 0.031 | 0.156 | 3.835 | 1.153 | 1.831 | 0.852 | 0.082 |
| 410 | 0.569 | 0.866 | 4.495 | 0.031 | 0.104 | 3.939 | 1.153 | 1.878 | 0.908 | 0.056 |
| 420 | 0.583 | 0.872 | 4.526 | 0.031 | 0.093 | 4.033 | 1.153 | 1.920 | 0.959 | 0.051 |
| 430 | 0.597 | 0.878 | 4.557 | 0.031 | 0.088 | 4.121 | 1.153 | 1.959 | 1.008 | 0.049 |
| 440 | 0.611 | 0.883 | 4.583 | 0.026 | 0.078 | 4.199 | 1.153 | 1.993 | 1.053 | 0.044 |
| 450 | 0.625 | 0.888 | 4.609 | 0.026 | 0.078 | 4.277 | 1.153 | 2.026 | 1.098 | 0.045 |
| 460 | 0.639 | 0.893 | 4.635 | 0.026 | 0.073 | 4.349 | 1.153 | 2.056 | 1.140 | 0.042 |
| 470 | 0.653 | 0.898 | 4.661 | 0.026 | 0.062 | 4.412 | 1.153 | 2.082 | 1.177 | 0.037 |
| 480 | 0.667 | 0.903 | 4.687 | 0.026 | 0.062 | 4.474 | 1.153 | 2.107 | 1.214 | 0.037 |
| 490 | 0.681 | 0.908 | 4.713 | 0.026 | 0.057 | 4.531 | 1.153 | 2.130 | 1.248 | 0.034 |
| 500 | 0.694 | 0.913 | 4.738 | 0.026 | 0.052 | 4.583 | 1.153 | 2.150 | 1.279 | 0.031 |
| 510 | 0.708 | 0.918 | 4.764 | 0.026 | 0.052 | 4.635 | 1.153 | 2.171 | 1.311 | 0.032 |
| 520 | 0.722 | 0.923 | 4.790 | 0.026 | 0.052 | 4.687 | 1.153 | 2.191 | 1.343 | 0.032 |
| 530 | 0.736 | 0.927 | 4.811 | 0.021 | 0.042 | 4.728 | 1.153 | 2.207 | 1.368 | 0.026 |
| 540 | 0.750 | 0.931 | 4.832 | 0.021 | 0.036 | 4.764 | 1.153 | 2.220 | 1.391 | 0.023 |
| 550 | 0.764 | 0.935 | 4.853 | 0.021 | 0.036 | 4.801 | 1.153 | 2.234 | 1.413 | 0.023 |
| 560 | 0.778 | 0.939 | 4.873 | 0.021 | 0.031 | 4.832 | 1.153 | 2.246 | 1.433 | 0.019 |
| 570 | 0.792 | 0.943 | 4.894 | 0.021 | 0.031 | 4.863 | 1.153 | 2.257 | 1.453 | 0.020 |
| 580 | 0.806 | 0.947 | 4.915 | 0.021 | 0.026 | 4.889 | 1.153 | 2.267 | 1.469 | 0.016 |
| 590 | 0.819 | 0.951 | 4.936 | 0.021 | 0.026 | 4.915 | 1.153 | 2.276 | 1.485 | 0.016 |
| 600 | 0.833 | 0.955 | 4.956 | 0.021 | 0.026 | 4.941 | 1.153 | 2.286 | 1.502 | 0.016 |
| 610 | 0.847 | 0.959 | 4.977 | 0.021 | 0.026 | 4.967 | 1.153 | 2.295 | 1.518 | 0.017 |
| 620 | 0.861 | 0.963 | 4.998 | 0.021 | 0.026 | 4.993 | 1.153 | 2.305 | 1.535 | 0.017 |
| 630 | 0.875 | 0.967 | 5.019 | 0.021 | 0.021 | 5.014 | 1.153 | 2.312 | 1.548 | 0.013 |
| 640 | 0.889 | 0.971 | 5.039 | 0.021 | 0.021 | 5.034 | 1.153 | 2.320 | 1.561 | 0.013 |
| 650 | 0.903 | 0.975 | 5.060 | 0.021 | 0.021 | 5.055 | 1.153 | 2.327 | 1.575 | 0.013 |
| 660 | 0.917 | 0.979 | 5.081 | 0.021 | 0.021 | 5.076 | 1.153 | 2.334 | 1.588 | 0.013 |
| 670 | 0.931 | 0.983 | 5.102 | 0.021 | 0.021 | 5.097 | 1.153 | 2.342 | 1.602 | 0.013 |
| 680 | 0.944 | 0.987 | 5.123 | 0.021 | 0.021 | 5.117 | 1.153 | 2.349 | 1.615 | 0.013 |
| 690 | 0.958 | 0.991 | 5.143 | 0.021 | 0.021 | 5.138 | 1.153 | 2.356 | 1.629 | 0.013 |
| 700 | 0.972 | 0.994 | 5.159 | 0.016 | 0.021 | 5.159 | 1.153 | 2.364 | 1.642 | 0.014 |
| 710 | 0.986 | 0.997 | 5.174 | 0.016 | 0.016 | 5.174 | 1.153 | 2.369 | 1.652 | 0.010 |
| 720 | 1.000 | 1.000 | 5.190 | 0.016 | 0.016 | 5.190 | 1.153 | 2.374 | 1.662 | 0.010 |

**Table A 20** Design Hyetograph of Burcupınar Creek Subbasin (Tr = 100 yr)

| duration (min) | duration / total duration | depth / total depth | cumulative depth (cm) | incremental depth (cm) | ordered depth (cm) | cumulative ordered depth (cm) | cum. initial abstriction, Ia (cm) | cumulative abstriction, Fa (cm) | cumulative excess depth, Pe (cm) | excess depth (cm) |
|---|---|---|---|---|---|---|---|---|---|---|
| 10 | 0.014 | 0.140 | 0.814 | 0.814 | 0.017 | 0.017 | 0.017 | 0.000 | 0.000 | 0.000 |
| 20 | 0.028 | 0.225 | 1.308 | 0.494 | 0.023 | 0.041 | 0.041 | 0.000 | 0.000 | 0.000 |
| 30 | 0.042 | 0.283 | 1.645 | 0.337 | 0.023 | 0.064 | 0.064 | 0.000 | 0.000 | 0.000 |
| 40 | 0.056 | 0.325 | 1.889 | 0.244 | 0.023 | 0.087 | 0.087 | 0.000 | 0.000 | 0.000 |
| 50 | 0.070 | 0.366 | 2.127 | 0.238 | 0.023 | 0.110 | 0.110 | 0.000 | 0.000 | 0.000 |
| 60 | 0.084 | 0.400 | 2.325 | 0.198 | 0.023 | 0.134 | 0.134 | 0.000 | 0.000 | 0.000 |
| 70 | 0.097 | 0.432 | 2.511 | 0.186 | 0.023 | 0.157 | 0.157 | 0.000 | 0.000 | 0.000 |
| 80 | 0.111 | 0.462 | 2.686 | 0.174 | 0.023 | 0.180 | 0.180 | 0.000 | 0.000 | 0.000 |
| 90 | 0.125 | 0.488 | 2.837 | 0.151 | 0.023 | 0.203 | 0.203 | 0.000 | 0.000 | 0.000 |
| 100 | 0.139 | 0.508 | 2.953 | 0.116 | 0.023 | 0.227 | 0.227 | 0.000 | 0.000 | 0.000 |
| 110 | 0.153 | 0.527 | 3.063 | 0.110 | 0.029 | 0.256 | 0.256 | 0.000 | 0.000 | 0.000 |
| 120 | 0.167 | 0.545 | 3.168 | 0.105 | 0.029 | 0.285 | 0.285 | 0.000 | 0.000 | 0.000 |
| 130 | 0.181 | 0.563 | 3.273 | 0.105 | 0.029 | 0.314 | 0.314 | 0.000 | 0.000 | 0.000 |
| 140 | 0.195 | 0.580 | 3.371 | 0.099 | 0.029 | 0.343 | 0.343 | 0.000 | 0.000 | 0.000 |
| 150 | 0.209 | 0.595 | 3.459 | 0.087 | 0.035 | 0.378 | 0.378 | 0.000 | 0.000 | 0.000 |
| 160 | 0.222 | 0.610 | 3.546 | 0.087 | 0.035 | 0.413 | 0.413 | 0.000 | 0.000 | 0.000 |
| 170 | 0.236 | 0.625 | 3.633 | 0.087 | 0.041 | 0.453 | 0.453 | 0.000 | 0.000 | 0.000 |
| 180 | 0.250 | 0.640 | 3.720 | 0.087 | 0.041 | 0.494 | 0.494 | 0.000 | 0.000 | 0.000 |
| 190 | 0.264 | 0.655 | 3.807 | 0.087 | 0.041 | 0.535 | 0.535 | 0.000 | 0.000 | 0.000 |
| 200 | 0.278 | 0.669 | 3.889 | 0.081 | 0.047 | 0.581 | 0.581 | 0.000 | 0.000 | 0.000 |
| 210 | 0.292 | 0.683 | 3.970 | 0.081 | 0.058 | 0.639 | 0.639 | 0.000 | 0.000 | 0.000 |
| 220 | 0.306 | 0.695 | 4.040 | 0.070 | 0.058 | 0.698 | 0.698 | 0.000 | 0.000 | 0.000 |
| 230 | 0.320 | 0.707 | 4.110 | 0.070 | 0.064 | 0.761 | 0.761 | 0.000 | 0.000 | 0.000 |
| 240 | 0.334 | 0.719 | 4.179 | 0.070 | 0.070 | 0.831 | 0.831 | 0.000 | 0.000 | 0.000 |
| 250 | 0.347 | 0.731 | 4.249 | 0.070 | 0.070 | 0.901 | 0.901 | 0.000 | 0.000 | 0.000 |
| 260 | 0.361 | 0.742 | 4.313 | 0.064 | 0.081 | 0.982 | 0.982 | 0.000 | 0.000 | 0.000 |
| 270 | 0.375 | 0.753 | 4.377 | 0.064 | 0.087 | 1.070 | 1.070 | 0.000 | 0.000 | 0.000 |
| 280 | 0.389 | 0.763 | 4.435 | 0.058 | 0.087 | 1.157 | 1.153 | 0.004 | 0.000 | 0.000 |
| 290 | 0.403 | 0.773 | 4.493 | 0.058 | 0.087 | 1.244 | 1.153 | 0.089 | 0.001 | 0.001 |
| 300 | 0.417 | 0.783 | 4.551 | 0.058 | 0.105 | 1.349 | 1.153 | 0.189 | 0.006 | 0.005 |
| 310 | 0.431 | 0.793 | 4.610 | 0.058 | 0.110 | 1.459 | 1.153 | 0.290 | 0.015 | 0.009 |
| 320 | 0.445 | 0.803 | 4.668 | 0.058 | 0.151 | 1.610 | 1.153 | 0.423 | 0.034 | 0.018 |
| 330 | 0.459 | 0.811 | 4.714 | 0.047 | 0.186 | 1.796 | 1.153 | 0.579 | 0.065 | 0.031 |
| 340 | 0.472 | 0.819 | 4.761 | 0.047 | 0.238 | 2.034 | 1.153 | 0.764 | 0.117 | 0.052 |
| 350 | 0.486 | 0.826 | 4.801 | 0.041 | 0.337 | 2.372 | 1.153 | 1.006 | 0.213 | 0.096 |
| 360 | 0.500 | 0.833 | 4.842 | 0.041 | 0.814 | 3.185 | 1.153 | 1.503 | 0.530 | 0.317 |

**Table A 20** (continued)

| duration (min) | duration / total duration | depth / total depth | cumulative depth (cm) | incremental depth (cm) | ordered depth (cm) | cumulative ordered depth (cm) | cum. initial abstriction, Ia (cm) | cumulative abstriction, Fa (cm) | cumulative excess depth, Pe (cm) | excess depth (cm) |
|---|---|---|---|---|---|---|---|---|---|---|
| 370 | 0.514 | 0.840 | 4.883 | 0.041 | 0.494 | 3.680 | 1.153 | 1.757 | 0.770 | 0.240 |
| 380 | 0.528 | 0.847 | 4.923 | 0.041 | 0.244 | 3.924 | 1.153 | 1.871 | 0.899 | 0.129 |
| 390 | 0.542 | 0.854 | 4.964 | 0.041 | 0.198 | 4.121 | 1.153 | 1.959 | 1.009 | 0.110 |
| 400 | 0.556 | 0.860 | 4.999 | 0.035 | 0.174 | 4.296 | 1.153 | 2.034 | 1.109 | 0.100 |
| 410 | 0.569 | 0.866 | 5.034 | 0.035 | 0.116 | 4.412 | 1.153 | 2.082 | 1.177 | 0.068 |
| 420 | 0.583 | 0.872 | 5.069 | 0.035 | 0.105 | 4.517 | 1.153 | 2.124 | 1.239 | 0.062 |
| 430 | 0.597 | 0.878 | 5.104 | 0.035 | 0.099 | 4.615 | 1.153 | 2.163 | 1.299 | 0.060 |
| 440 | 0.611 | 0.883 | 5.133 | 0.029 | 0.087 | 4.703 | 1.153 | 2.197 | 1.352 | 0.053 |
| 450 | 0.625 | 0.888 | 5.162 | 0.029 | 0.087 | 4.790 | 1.153 | 2.230 | 1.407 | 0.054 |
| 460 | 0.639 | 0.893 | 5.191 | 0.029 | 0.081 | 4.871 | 1.153 | 2.260 | 1.458 | 0.051 |
| 470 | 0.653 | 0.898 | 5.220 | 0.029 | 0.070 | 4.941 | 1.153 | 2.286 | 1.502 | 0.044 |
| 480 | 0.667 | 0.903 | 5.249 | 0.029 | 0.070 | 5.011 | 1.153 | 2.311 | 1.546 | 0.045 |
| 490 | 0.681 | 0.908 | 5.278 | 0.029 | 0.064 | 5.075 | 1.153 | 2.334 | 1.587 | 0.041 |
| 500 | 0.694 | 0.913 | 5.307 | 0.029 | 0.058 | 5.133 | 1.153 | 2.354 | 1.625 | 0.038 |
| 510 | 0.708 | 0.918 | 5.336 | 0.029 | 0.058 | 5.191 | 1.153 | 2.375 | 1.663 | 0.038 |
| 520 | 0.722 | 0.923 | 5.365 | 0.029 | 0.058 | 5.249 | 1.153 | 2.395 | 1.701 | 0.038 |
| 530 | 0.736 | 0.927 | 5.388 | 0.023 | 0.047 | 5.295 | 1.153 | 2.411 | 1.732 | 0.031 |
| 540 | 0.750 | 0.931 | 5.412 | 0.023 | 0.041 | 5.336 | 1.153 | 2.424 | 1.759 | 0.027 |
| 550 | 0.764 | 0.935 | 5.435 | 0.023 | 0.041 | 5.377 | 1.153 | 2.438 | 1.786 | 0.027 |
| 560 | 0.778 | 0.939 | 5.458 | 0.023 | 0.035 | 5.412 | 1.153 | 2.449 | 1.809 | 0.023 |
| 570 | 0.792 | 0.943 | 5.481 | 0.023 | 0.035 | 5.447 | 1.153 | 2.461 | 1.833 | 0.023 |
| 580 | 0.806 | 0.947 | 5.505 | 0.023 | 0.029 | 5.476 | 1.153 | 2.470 | 1.852 | 0.020 |
| 590 | 0.819 | 0.951 | 5.528 | 0.023 | 0.029 | 5.505 | 1.153 | 2.480 | 1.872 | 0.020 |
| 600 | 0.833 | 0.955 | 5.551 | 0.023 | 0.029 | 5.534 | 1.153 | 2.489 | 1.891 | 0.020 |
| 610 | 0.847 | 0.959 | 5.574 | 0.023 | 0.029 | 5.563 | 1.153 | 2.499 | 1.911 | 0.020 |
| 620 | 0.861 | 0.963 | 5.598 | 0.023 | 0.029 | 5.592 | 1.153 | 2.508 | 1.931 | 0.020 |
| 630 | 0.875 | 0.967 | 5.621 | 0.023 | 0.023 | 5.615 | 1.153 | 2.515 | 1.947 | 0.016 |
| 640 | 0.889 | 0.971 | 5.644 | 0.023 | 0.023 | 5.638 | 1.153 | 2.523 | 1.963 | 0.016 |
| 650 | 0.903 | 0.975 | 5.667 | 0.023 | 0.023 | 5.662 | 1.153 | 2.530 | 1.978 | 0.016 |
| 660 | 0.917 | 0.979 | 5.691 | 0.023 | 0.023 | 5.685 | 1.153 | 2.537 | 1.994 | 0.016 |
| 670 | 0.931 | 0.983 | 5.714 | 0.023 | 0.023 | 5.708 | 1.153 | 2.545 | 2.010 | 0.016 |
| 680 | 0.944 | 0.987 | 5.737 | 0.023 | 0.023 | 5.731 | 1.153 | 2.552 | 2.026 | 0.016 |
| 690 | 0.958 | 0.991 | 5.760 | 0.023 | 0.023 | 5.755 | 1.153 | 2.559 | 2.042 | 0.016 |
| 700 | 0.972 | 0.994 | 5.778 | 0.017 | 0.023 | 5.778 | 1.153 | 2.566 | 2.058 | 0.016 |
| 710 | 0.986 | 0.997 | 5.795 | 0.017 | 0.017 | 5.795 | 1.153 | 2.572 | 2.071 | 0.012 |
| 720 | 1.000 | 1.000 | 5.813 | 0.017 | 0.017 | 5.813 | 1.153 | 2.577 | 2.083 | 0.012 |

**Table A 21** Design Hyetograph of Burcupınar Creek Subbasin (Tr = 500 yr)

| duration (min) | duration / total duration | depth / total depth | cumulative depth (cm) | incremental depth (cm) | ordered depth (cm) | cumulative ordered depth (cm) | cum. initial abstriction, Ia (cm) | cumulative abstriction, Fa (cm) | cumulative excess depth, Pe (cm) | excess depth (cm) |
|---|---|---|---|---|---|---|---|---|---|---|
| 10 | 0.014 | 0.140 | 1.014 | 1.014 | 0.022 | 0.022 | 0.022 | 0.000 | 0.000 | 0.000 |
| 20 | 0.028 | 0.225 | 1.630 | 0.616 | 0.029 | 0.051 | 0.051 | 0.000 | 0.000 | 0.000 |
| 30 | 0.042 | 0.283 | 2.050 | 0.420 | 0.029 | 0.080 | 0.080 | 0.000 | 0.000 | 0.000 |
| 40 | 0.056 | 0.325 | 2.355 | 0.304 | 0.029 | 0.109 | 0.109 | 0.000 | 0.000 | 0.000 |
| 50 | 0.070 | 0.366 | 2.652 | 0.297 | 0.029 | 0.138 | 0.138 | 0.000 | 0.000 | 0.000 |
| 60 | 0.084 | 0.400 | 2.898 | 0.246 | 0.029 | 0.167 | 0.167 | 0.000 | 0.000 | 0.000 |
| 70 | 0.097 | 0.432 | 3.130 | 0.232 | 0.029 | 0.196 | 0.196 | 0.000 | 0.000 | 0.000 |
| 80 | 0.111 | 0.462 | 3.347 | 0.217 | 0.029 | 0.225 | 0.225 | 0.000 | 0.000 | 0.000 |
| 90 | 0.125 | 0.488 | 3.536 | 0.188 | 0.029 | 0.254 | 0.254 | 0.000 | 0.000 | 0.000 |
| 100 | 0.139 | 0.508 | 3.681 | 0.145 | 0.029 | 0.283 | 0.283 | 0.000 | 0.000 | 0.000 |
| 110 | 0.153 | 0.527 | 3.818 | 0.138 | 0.036 | 0.319 | 0.319 | 0.000 | 0.000 | 0.000 |
| 120 | 0.167 | 0.545 | 3.949 | 0.130 | 0.036 | 0.355 | 0.355 | 0.000 | 0.000 | 0.000 |
| 130 | 0.181 | 0.563 | 4.079 | 0.130 | 0.036 | 0.391 | 0.391 | 0.000 | 0.000 | 0.000 |
| 140 | 0.195 | 0.580 | 4.202 | 0.123 | 0.036 | 0.427 | 0.427 | 0.000 | 0.000 | 0.000 |
| 150 | 0.209 | 0.595 | 4.311 | 0.109 | 0.043 | 0.471 | 0.471 | 0.000 | 0.000 | 0.000 |
| 160 | 0.222 | 0.610 | 4.420 | 0.109 | 0.043 | 0.514 | 0.514 | 0.000 | 0.000 | 0.000 |
| 170 | 0.236 | 0.625 | 4.528 | 0.109 | 0.051 | 0.565 | 0.565 | 0.000 | 0.000 | 0.000 |
| 180 | 0.250 | 0.640 | 4.637 | 0.109 | 0.051 | 0.616 | 0.616 | 0.000 | 0.000 | 0.000 |
| 190 | 0.264 | 0.655 | 4.746 | 0.109 | 0.051 | 0.667 | 0.667 | 0.000 | 0.000 | 0.000 |
| 200 | 0.278 | 0.669 | 4.847 | 0.101 | 0.058 | 0.725 | 0.725 | 0.000 | 0.000 | 0.000 |
| 210 | 0.292 | 0.683 | 4.948 | 0.101 | 0.072 | 0.797 | 0.797 | 0.000 | 0.000 | 0.000 |
| 220 | 0.306 | 0.695 | 5.035 | 0.087 | 0.072 | 0.869 | 0.869 | 0.000 | 0.000 | 0.000 |
| 230 | 0.320 | 0.707 | 5.122 | 0.087 | 0.080 | 0.949 | 0.949 | 0.000 | 0.000 | 0.000 |
| 240 | 0.334 | 0.719 | 5.209 | 0.087 | 0.087 | 1.036 | 1.036 | 0.000 | 0.000 | 0.000 |
| 250 | 0.347 | 0.731 | 5.296 | 0.087 | 0.087 | 1.123 | 1.123 | 0.000 | 0.000 | 0.000 |
| 260 | 0.361 | 0.742 | 5.376 | 0.080 | 0.101 | 1.224 | 1.153 | 0.070 | 0.001 | 0.001 |
| 270 | 0.375 | 0.753 | 5.456 | 0.080 | 0.109 | 1.333 | 1.153 | 0.175 | 0.005 | 0.005 |
| 280 | 0.389 | 0.763 | 5.528 | 0.072 | 0.109 | 1.442 | 1.153 | 0.275 | 0.014 | 0.008 |
| 290 | 0.403 | 0.773 | 5.601 | 0.072 | 0.109 | 1.550 | 1.153 | 0.372 | 0.026 | 0.012 |
| 300 | 0.417 | 0.783 | 5.673 | 0.072 | 0.130 | 1.681 | 1.153 | 0.484 | 0.044 | 0.019 |
| 310 | 0.431 | 0.793 | 5.745 | 0.072 | 0.138 | 1.819 | 1.153 | 0.597 | 0.069 | 0.025 |
| 320 | 0.445 | 0.803 | 5.818 | 0.072 | 0.188 | 2.007 | 1.153 | 0.744 | 0.110 | 0.041 |
| 330 | 0.459 | 0.811 | 5.876 | 0.058 | 0.232 | 2.239 | 1.153 | 0.914 | 0.172 | 0.062 |
| 340 | 0.472 | 0.819 | 5.934 | 0.058 | 0.297 | 2.536 | 1.153 | 1.115 | 0.267 | 0.095 |
| 350 | 0.486 | 0.826 | 5.985 | 0.051 | 0.420 | 2.956 | 1.153 | 1.373 | 0.429 | 0.162 |
| 360 | 0.500 | 0.833 | 6.035 | 0.051 | 1.014 | 3.970 | 1.153 | 1.893 | 0.925 | 0.495 |

**Table A 21** (continued)

| duration (min) | duration / total duration | depth / total depth | cumulative depth (cm) | incremental depth (cm) | ordered depth (cm) | cumulative ordered depth (cm) | cum. initial abstriction, Ia (cm) | cumulative abstriction, Fa (cm) | cumulative excess depth, Pe (cm) | excess depth (cm) |
|---|---|---|---|---|---|---|---|---|---|---|
| 370 | 0.514 | 0.840 | 6.086 | 0.051 | 0.616 | 4.586 | 1.153 | 2.152 | 1.281 | 0.357 |
| 380 | 0.528 | 0.847 | 6.137 | 0.051 | 0.304 | 4.891 | 1.153 | 2.268 | 1.470 | 0.189 |
| 390 | 0.542 | 0.854 | 6.187 | 0.051 | 0.246 | 5.137 | 1.153 | 2.356 | 1.628 | 0.158 |
| 400 | 0.556 | 0.860 | 6.231 | 0.043 | 0.217 | 5.354 | 1.153 | 2.430 | 1.771 | 0.143 |
| 410 | 0.569 | 0.866 | 6.274 | 0.043 | 0.145 | 5.499 | 1.153 | 2.478 | 1.868 | 0.097 |
| 420 | 0.583 | 0.872 | 6.318 | 0.043 | 0.130 | 5.630 | 1.153 | 2.520 | 1.956 | 0.089 |
| 430 | 0.597 | 0.878 | 6.361 | 0.043 | 0.123 | 5.753 | 1.153 | 2.559 | 2.041 | 0.085 |
| 440 | 0.611 | 0.883 | 6.398 | 0.036 | 0.109 | 5.861 | 1.153 | 2.592 | 2.116 | 0.075 |
| 450 | 0.625 | 0.888 | 6.434 | 0.036 | 0.109 | 5.970 | 1.153 | 2.624 | 2.193 | 0.076 |
| 460 | 0.639 | 0.893 | 6.470 | 0.036 | 0.101 | 6.072 | 1.153 | 2.654 | 2.264 | 0.072 |
| 470 | 0.653 | 0.898 | 6.506 | 0.036 | 0.087 | 6.158 | 1.153 | 2.679 | 2.326 | 0.062 |
| 480 | 0.667 | 0.903 | 6.542 | 0.036 | 0.087 | 6.245 | 1.153 | 2.704 | 2.388 | 0.062 |
| 490 | 0.681 | 0.908 | 6.579 | 0.036 | 0.080 | 6.325 | 1.153 | 2.726 | 2.446 | 0.057 |
| 500 | 0.694 | 0.913 | 6.615 | 0.036 | 0.072 | 6.398 | 1.153 | 2.746 | 2.498 | 0.052 |
| 510 | 0.708 | 0.918 | 6.651 | 0.036 | 0.072 | 6.470 | 1.153 | 2.766 | 2.551 | 0.053 |
| 520 | 0.722 | 0.923 | 6.687 | 0.036 | 0.072 | 6.542 | 1.153 | 2.786 | 2.604 | 0.053 |
| 530 | 0.736 | 0.927 | 6.716 | 0.029 | 0.058 | 6.600 | 1.153 | 2.801 | 2.646 | 0.043 |
| 540 | 0.750 | 0.931 | 6.745 | 0.029 | 0.051 | 6.651 | 1.153 | 2.814 | 2.684 | 0.037 |
| 550 | 0.764 | 0.935 | 6.774 | 0.029 | 0.051 | 6.702 | 1.153 | 2.828 | 2.721 | 0.037 |
| 560 | 0.778 | 0.939 | 6.803 | 0.029 | 0.043 | 6.745 | 1.153 | 2.839 | 2.753 | 0.032 |
| 570 | 0.792 | 0.943 | 6.832 | 0.029 | 0.043 | 6.789 | 1.153 | 2.850 | 2.786 | 0.032 |
| 580 | 0.806 | 0.947 | 6.861 | 0.029 | 0.036 | 6.825 | 1.153 | 2.859 | 2.813 | 0.027 |
| 590 | 0.819 | 0.951 | 6.890 | 0.029 | 0.036 | 6.861 | 1.153 | 2.868 | 2.840 | 0.027 |
| 600 | 0.833 | 0.955 | 6.919 | 0.029 | 0.036 | 6.897 | 1.153 | 2.877 | 2.867 | 0.027 |
| 610 | 0.847 | 0.959 | 6.948 | 0.029 | 0.036 | 6.934 | 1.153 | 2.887 | 2.894 | 0.027 |
| 620 | 0.861 | 0.963 | 6.977 | 0.029 | 0.036 | 6.970 | 1.153 | 2.896 | 2.921 | 0.027 |
| 630 | 0.875 | 0.967 | 7.006 | 0.029 | 0.029 | 6.999 | 1.153 | 2.903 | 2.943 | 0.022 |
| 640 | 0.889 | 0.971 | 7.035 | 0.029 | 0.029 | 7.028 | 1.153 | 2.910 | 2.965 | 0.022 |
| 650 | 0.903 | 0.975 | 7.064 | 0.029 | 0.029 | 7.057 | 1.153 | 2.917 | 2.987 | 0.022 |
| 660 | 0.917 | 0.979 | 7.093 | 0.029 | 0.029 | 7.086 | 1.153 | 2.924 | 3.009 | 0.022 |
| 670 | 0.931 | 0.983 | 7.122 | 0.029 | 0.029 | 7.115 | 1.153 | 2.931 | 3.031 | 0.022 |
| 680 | 0.944 | 0.987 | 7.151 | 0.029 | 0.029 | 7.144 | 1.153 | 2.938 | 3.053 | 0.022 |
| 690 | 0.958 | 0.991 | 7.180 | 0.029 | 0.029 | 7.173 | 1.153 | 2.945 | 3.075 | 0.022 |
| 700 | 0.972 | 0.994 | 7.202 | 0.022 | 0.029 | 7.202 | 1.153 | 2.952 | 3.097 | 0.022 |
| 710 | 0.986 | 0.997 | 7.224 | 0.022 | 0.022 | 7.224 | 1.153 | 2.957 | 3.113 | 0.017 |
| 720 | 1.000 | 1.000 | 7.245 | 0.022 | 0.022 | 7.245 | 1.153 | 2.962 | 3.130 | 0.017 |

**Table A 22** Design Hyetograph of Intermediate Zones (Tr = 50 yr)

| duration (min) | duration / total duration | depth / total depth | cumulative depth (cm) | incremental depth (cm) | ordered depth (cm) | cumulative ordered depth (cm) | cum. initial abstriction, Ia (cm) | cumulative abstriction, Fa (cm) | cumulative excess depth, Pe (cm) | excess depth (cm) |
|---|---|---|---|---|---|---|---|---|---|---|
| 10 | 0.014 | 0.140 | 0.727 | 0.727 | 0.016 | 0.016 | 0.016 | 0.000 | 0.000 | 0.000 |
| 20 | 0.028 | 0.225 | 1.168 | 0.441 | 0.021 | 0.036 | 0.036 | 0.000 | 0.000 | 0.000 |
| 30 | 0.042 | 0.283 | 1.469 | 0.301 | 0.021 | 0.057 | 0.057 | 0.000 | 0.000 | 0.000 |
| 40 | 0.056 | 0.325 | 1.687 | 0.218 | 0.021 | 0.078 | 0.078 | 0.000 | 0.000 | 0.000 |
| 50 | 0.070 | 0.366 | 1.900 | 0.213 | 0.021 | 0.099 | 0.099 | 0.000 | 0.000 | 0.000 |
| 60 | 0.084 | 0.400 | 2.076 | 0.176 | 0.021 | 0.119 | 0.119 | 0.000 | 0.000 | 0.000 |
| 70 | 0.097 | 0.432 | 2.242 | 0.166 | 0.021 | 0.140 | 0.140 | 0.000 | 0.000 | 0.000 |
| 80 | 0.111 | 0.462 | 2.398 | 0.156 | 0.021 | 0.161 | 0.161 | 0.000 | 0.000 | 0.000 |
| 90 | 0.125 | 0.488 | 2.533 | 0.135 | 0.021 | 0.182 | 0.182 | 0.000 | 0.000 | 0.000 |
| 100 | 0.139 | 0.508 | 2.637 | 0.104 | 0.021 | 0.202 | 0.202 | 0.000 | 0.000 | 0.000 |
| 110 | 0.153 | 0.527 | 2.735 | 0.099 | 0.026 | 0.228 | 0.228 | 0.000 | 0.000 | 0.000 |
| 120 | 0.167 | 0.545 | 2.829 | 0.093 | 0.026 | 0.254 | 0.254 | 0.000 | 0.000 | 0.000 |
| 130 | 0.181 | 0.563 | 2.922 | 0.093 | 0.026 | 0.280 | 0.280 | 0.000 | 0.000 | 0.000 |
| 140 | 0.195 | 0.580 | 3.010 | 0.088 | 0.026 | 0.306 | 0.306 | 0.000 | 0.000 | 0.000 |
| 150 | 0.209 | 0.595 | 3.088 | 0.078 | 0.031 | 0.337 | 0.337 | 0.000 | 0.000 | 0.000 |
| 160 | 0.222 | 0.610 | 3.166 | 0.078 | 0.031 | 0.368 | 0.368 | 0.000 | 0.000 | 0.000 |
| 170 | 0.236 | 0.625 | 3.244 | 0.078 | 0.036 | 0.405 | 0.405 | 0.000 | 0.000 | 0.000 |
| 180 | 0.250 | 0.640 | 3.322 | 0.078 | 0.036 | 0.441 | 0.441 | 0.000 | 0.000 | 0.000 |
| 190 | 0.264 | 0.655 | 3.399 | 0.078 | 0.036 | 0.477 | 0.477 | 0.000 | 0.000 | 0.000 |
| 200 | 0.278 | 0.669 | 3.472 | 0.073 | 0.042 | 0.519 | 0.519 | 0.000 | 0.000 | 0.000 |
| 210 | 0.292 | 0.683 | 3.545 | 0.073 | 0.052 | 0.571 | 0.571 | 0.000 | 0.000 | 0.000 |
| 220 | 0.306 | 0.695 | 3.607 | 0.062 | 0.052 | 0.623 | 0.623 | 0.000 | 0.000 | 0.000 |
| 230 | 0.320 | 0.707 | 3.669 | 0.062 | 0.057 | 0.680 | 0.680 | 0.000 | 0.000 | 0.000 |
| 240 | 0.334 | 0.719 | 3.732 | 0.062 | 0.062 | 0.742 | 0.742 | 0.000 | 0.000 | 0.000 |
| 250 | 0.347 | 0.731 | 3.794 | 0.062 | 0.062 | 0.804 | 0.804 | 0.000 | 0.000 | 0.000 |
| 260 | 0.361 | 0.742 | 3.851 | 0.057 | 0.073 | 0.877 | 0.877 | 0.000 | 0.000 | 0.000 |
| 270 | 0.375 | 0.753 | 3.908 | 0.057 | 0.078 | 0.955 | 0.955 | 0.000 | 0.000 | 0.000 |
| 280 | 0.389 | 0.763 | 3.960 | 0.052 | 0.078 | 1.033 | 1.033 | 0.000 | 0.000 | 0.000 |
| 290 | 0.403 | 0.773 | 4.012 | 0.052 | 0.078 | 1.111 | 1.111 | 0.000 | 0.000 | 0.000 |
| 300 | 0.417 | 0.783 | 4.064 | 0.052 | 0.093 | 1.204 | 1.204 | 0.000 | 0.000 | 0.000 |
| 310 | 0.431 | 0.793 | 4.116 | 0.052 | 0.099 | 1.303 | 1.224 | 0.078 | 0.001 | 0.001 |
| 320 | 0.445 | 0.803 | 4.168 | 0.052 | 0.135 | 1.438 | 1.224 | 0.207 | 0.007 | 0.006 |
| 330 | 0.459 | 0.811 | 4.209 | 0.042 | 0.166 | 1.604 | 1.224 | 0.358 | 0.022 | 0.015 |
| 340 | 0.472 | 0.819 | 4.251 | 0.042 | 0.213 | 1.817 | 1.224 | 0.541 | 0.052 | 0.030 |
| 350 | 0.486 | 0.826 | 4.287 | 0.036 | 0.301 | 2.118 | 1.224 | 0.780 | 0.114 | 0.062 |
| 360 | 0.500 | 0.833 | 4.323 | 0.036 | 0.727 | 2.844 | 1.224 | 1.281 | 0.339 | 0.225 |

**Table A 22** (continued)

| duration (min) | duration / total duration | depth / total depth | cumulative depth (cm) | incremental depth (cm) | ordered depth (cm) | cumulative ordered depth (cm) | cum. initial abstriction, Ia (cm) | cumulative abstriction, Fa (cm) | cumulative excess depth, Pe (cm) | excess depth (cm) |
|---|---|---|---|---|---|---|---|---|---|---|
| 370 | 0.514 | 0.840 | 4.360 | 0.036 | 0.441 | 3.285 | 1.224 | 1.542 | 0.520 | 0.180 |
| 380 | 0.528 | 0.847 | 4.396 | 0.036 | 0.218 | 3.503 | 1.224 | 1.661 | 0.619 | 0.099 |
| 390 | 0.542 | 0.854 | 4.432 | 0.036 | 0.176 | 3.680 | 1.224 | 1.753 | 0.704 | 0.085 |
| 400 | 0.556 | 0.860 | 4.463 | 0.031 | 0.156 | 3.835 | 1.224 | 1.830 | 0.781 | 0.078 |
| 410 | 0.569 | 0.866 | 4.495 | 0.031 | 0.104 | 3.939 | 1.224 | 1.881 | 0.835 | 0.053 |
| 420 | 0.583 | 0.872 | 4.526 | 0.031 | 0.093 | 4.033 | 1.224 | 1.925 | 0.884 | 0.049 |
| 430 | 0.597 | 0.878 | 4.557 | 0.031 | 0.088 | 4.121 | 1.224 | 1.966 | 0.931 | 0.047 |
| 440 | 0.611 | 0.883 | 4.583 | 0.026 | 0.078 | 4.199 | 1.224 | 2.002 | 0.973 | 0.042 |
| 450 | 0.625 | 0.888 | 4.609 | 0.026 | 0.078 | 4.277 | 1.224 | 2.037 | 1.016 | 0.043 |
| 460 | 0.639 | 0.893 | 4.635 | 0.026 | 0.073 | 4.349 | 1.224 | 2.069 | 1.057 | 0.041 |
| 470 | 0.653 | 0.898 | 4.661 | 0.026 | 0.062 | 4.412 | 1.224 | 2.096 | 1.092 | 0.035 |
| 480 | 0.667 | 0.903 | 4.687 | 0.026 | 0.062 | 4.474 | 1.224 | 2.123 | 1.128 | 0.036 |
| 490 | 0.681 | 0.908 | 4.713 | 0.026 | 0.057 | 4.531 | 1.224 | 2.147 | 1.161 | 0.033 |
| 500 | 0.694 | 0.913 | 4.738 | 0.026 | 0.052 | 4.583 | 1.224 | 2.168 | 1.191 | 0.030 |
| 510 | 0.708 | 0.918 | 4.764 | 0.026 | 0.052 | 4.635 | 1.224 | 2.190 | 1.221 | 0.030 |
| 520 | 0.722 | 0.923 | 4.790 | 0.026 | 0.052 | 4.687 | 1.224 | 2.211 | 1.252 | 0.031 |
| 530 | 0.736 | 0.927 | 4.811 | 0.021 | 0.042 | 4.728 | 1.224 | 2.228 | 1.276 | 0.025 |
| 540 | 0.750 | 0.931 | 4.832 | 0.021 | 0.036 | 4.764 | 1.224 | 2.243 | 1.298 | 0.022 |
| 550 | 0.764 | 0.935 | 4.853 | 0.021 | 0.036 | 4.801 | 1.224 | 2.257 | 1.320 | 0.022 |
| 560 | 0.778 | 0.939 | 4.873 | 0.021 | 0.031 | 4.832 | 1.224 | 2.270 | 1.339 | 0.019 |
| 570 | 0.792 | 0.943 | 4.894 | 0.021 | 0.031 | 4.863 | 1.224 | 2.282 | 1.358 | 0.019 |
| 580 | 0.806 | 0.947 | 4.915 | 0.021 | 0.026 | 4.889 | 1.224 | 2.292 | 1.373 | 0.016 |
| 590 | 0.819 | 0.951 | 4.936 | 0.021 | 0.026 | 4.915 | 1.224 | 2.302 | 1.389 | 0.016 |
| 600 | 0.833 | 0.955 | 4.956 | 0.021 | 0.026 | 4.941 | 1.224 | 2.312 | 1.405 | 0.016 |
| 610 | 0.847 | 0.959 | 4.977 | 0.021 | 0.026 | 4.967 | 1.224 | 2.322 | 1.421 | 0.016 |
| 620 | 0.861 | 0.963 | 4.998 | 0.021 | 0.026 | 4.993 | 1.224 | 2.332 | 1.437 | 0.016 |
| 630 | 0.875 | 0.967 | 5.019 | 0.021 | 0.021 | 5.014 | 1.224 | 2.340 | 1.450 | 0.013 |
| 640 | 0.889 | 0.971 | 5.039 | 0.021 | 0.021 | 5.034 | 1.224 | 2.348 | 1.463 | 0.013 |
| 650 | 0.903 | 0.975 | 5.060 | 0.021 | 0.021 | 5.055 | 1.224 | 2.356 | 1.476 | 0.013 |
| 660 | 0.917 | 0.979 | 5.081 | 0.021 | 0.021 | 5.076 | 1.224 | 2.364 | 1.489 | 0.013 |
| 670 | 0.931 | 0.983 | 5.102 | 0.021 | 0.021 | 5.097 | 1.224 | 2.372 | 1.501 | 0.013 |
| 680 | 0.944 | 0.987 | 5.123 | 0.021 | 0.021 | 5.117 | 1.224 | 2.379 | 1.514 | 0.013 |
| 690 | 0.958 | 0.991 | 5.143 | 0.021 | 0.021 | 5.138 | 1.224 | 2.387 | 1.527 | 0.013 |
| 700 | 0.972 | 0.994 | 5.159 | 0.016 | 0.021 | 5.159 | 1.224 | 2.395 | 1.541 | 0.013 |
| 710 | 0.986 | 0.997 | 5.174 | 0.016 | 0.016 | 5.174 | 1.224 | 2.401 | 1.550 | 0.010 |
| 720 | 1.000 | 1.000 | 5.190 | 0.016 | 0.016 | 5.190 | 1.224 | 2.406 | 1.560 | 0.010 |

**Table A 23** Design Hyetograph of Intermediate Zones (Tr = 100 yr)

| duration (min) | duration / total duration | depth / total depth | cumulative depth (cm) | incremental depth (cm) | ordered depth (cm) | cumulative ordered depth (cm) | cum. initial abstriction, Ia (cm) | cumulative abstriction, Fa (cm) | cumulative excess depth, Pe (cm) | excess depth (cm) |
|---|---|---|---|---|---|---|---|---|---|---|
| 10 | 0.014 | 0.140 | 0.814 | 0.814 | 0.017 | 0.017 | 0.017 | 0.000 | 0.000 | 0.000 |
| 20 | 0.028 | 0.225 | 1.308 | 0.494 | 0.023 | 0.041 | 0.041 | 0.000 | 0.000 | 0.000 |
| 30 | 0.042 | 0.283 | 1.645 | 0.337 | 0.023 | 0.064 | 0.064 | 0.000 | 0.000 | 0.000 |
| 40 | 0.056 | 0.325 | 1.889 | 0.244 | 0.023 | 0.087 | 0.087 | 0.000 | 0.000 | 0.000 |
| 50 | 0.070 | 0.366 | 2.127 | 0.238 | 0.023 | 0.110 | 0.110 | 0.000 | 0.000 | 0.000 |
| 60 | 0.084 | 0.400 | 2.325 | 0.198 | 0.023 | 0.134 | 0.134 | 0.000 | 0.000 | 0.000 |
| 70 | 0.097 | 0.432 | 2.511 | 0.186 | 0.023 | 0.157 | 0.157 | 0.000 | 0.000 | 0.000 |
| 80 | 0.111 | 0.462 | 2.686 | 0.174 | 0.023 | 0.180 | 0.180 | 0.000 | 0.000 | 0.000 |
| 90 | 0.125 | 0.488 | 2.837 | 0.151 | 0.023 | 0.203 | 0.203 | 0.000 | 0.000 | 0.000 |
| 100 | 0.139 | 0.508 | 2.953 | 0.116 | 0.023 | 0.227 | 0.227 | 0.000 | 0.000 | 0.000 |
| 110 | 0.153 | 0.527 | 3.063 | 0.110 | 0.029 | 0.256 | 0.256 | 0.000 | 0.000 | 0.000 |
| 120 | 0.167 | 0.545 | 3.168 | 0.105 | 0.029 | 0.285 | 0.285 | 0.000 | 0.000 | 0.000 |
| 130 | 0.181 | 0.563 | 3.273 | 0.105 | 0.029 | 0.314 | 0.314 | 0.000 | 0.000 | 0.000 |
| 140 | 0.195 | 0.580 | 3.371 | 0.099 | 0.029 | 0.343 | 0.343 | 0.000 | 0.000 | 0.000 |
| 150 | 0.209 | 0.595 | 3.459 | 0.087 | 0.035 | 0.378 | 0.378 | 0.000 | 0.000 | 0.000 |
| 160 | 0.222 | 0.610 | 3.546 | 0.087 | 0.035 | 0.413 | 0.413 | 0.000 | 0.000 | 0.000 |
| 170 | 0.236 | 0.625 | 3.633 | 0.087 | 0.041 | 0.453 | 0.453 | 0.000 | 0.000 | 0.000 |
| 180 | 0.250 | 0.640 | 3.720 | 0.087 | 0.041 | 0.494 | 0.494 | 0.000 | 0.000 | 0.000 |
| 190 | 0.264 | 0.655 | 3.807 | 0.087 | 0.041 | 0.535 | 0.535 | 0.000 | 0.000 | 0.000 |
| 200 | 0.278 | 0.669 | 3.889 | 0.081 | 0.047 | 0.581 | 0.581 | 0.000 | 0.000 | 0.000 |
| 210 | 0.292 | 0.683 | 3.970 | 0.081 | 0.058 | 0.639 | 0.639 | 0.000 | 0.000 | 0.000 |
| 220 | 0.306 | 0.695 | 4.040 | 0.070 | 0.058 | 0.698 | 0.698 | 0.000 | 0.000 | 0.000 |
| 230 | 0.320 | 0.707 | 4.110 | 0.070 | 0.064 | 0.761 | 0.761 | 0.000 | 0.000 | 0.000 |
| 240 | 0.334 | 0.719 | 4.179 | 0.070 | 0.070 | 0.831 | 0.831 | 0.000 | 0.000 | 0.000 |
| 250 | 0.347 | 0.731 | 4.249 | 0.070 | 0.070 | 0.901 | 0.901 | 0.000 | 0.000 | 0.000 |
| 260 | 0.361 | 0.742 | 4.313 | 0.064 | 0.081 | 0.982 | 0.982 | 0.000 | 0.000 | 0.000 |
| 270 | 0.375 | 0.753 | 4.377 | 0.064 | 0.087 | 1.070 | 1.070 | 0.000 | 0.000 | 0.000 |
| 280 | 0.389 | 0.763 | 4.435 | 0.058 | 0.087 | 1.157 | 1.157 | 0.000 | 0.000 | 0.000 |
| 290 | 0.403 | 0.773 | 4.493 | 0.058 | 0.087 | 1.244 | 1.224 | 0.020 | 0.000 | 0.000 |
| 300 | 0.417 | 0.783 | 4.551 | 0.058 | 0.105 | 1.349 | 1.224 | 0.123 | 0.003 | 0.002 |
| 310 | 0.431 | 0.793 | 4.610 | 0.058 | 0.110 | 1.459 | 1.224 | 0.227 | 0.009 | 0.006 |
| 320 | 0.445 | 0.803 | 4.668 | 0.058 | 0.151 | 1.610 | 1.224 | 0.364 | 0.023 | 0.014 |
| 330 | 0.459 | 0.811 | 4.714 | 0.047 | 0.186 | 1.796 | 1.224 | 0.524 | 0.049 | 0.026 |
| 340 | 0.472 | 0.819 | 4.761 | 0.047 | 0.238 | 2.034 | 1.224 | 0.716 | 0.095 | 0.046 |
| 350 | 0.486 | 0.826 | 4.801 | 0.041 | 0.337 | 2.372 | 1.224 | 0.967 | 0.181 | 0.087 |
| 360 | 0.500 | 0.833 | 4.842 | 0.041 | 0.814 | 3.185 | 1.224 | 1.485 | 0.476 | 0.295 |

**Table A 23** (continued)

| duration (min) | duration / total duration | depth / total depth | cumulative depth (cm) | incremental depth (cm) | ordered depth (cm) | cumulative ordered depth (cm) | cum. initial abstriction, Ia (cm) | cumulative abstriction, Fa (cm) | cumulative excess depth, Pe (cm) | excess depth (cm) |
|---|---|---|---|---|---|---|---|---|---|---|
| 370 | 0.514 | 0.840 | 4.883 | 0.041 | 0.494 | 3.680 | 1.224 | 1.752 | 0.704 | 0.227 |
| 380 | 0.528 | 0.847 | 4.923 | 0.041 | 0.244 | 3.924 | 1.224 | 1.873 | 0.827 | 0.123 |
| 390 | 0.542 | 0.854 | 4.964 | 0.041 | 0.198 | 4.121 | 1.224 | 1.966 | 0.931 | 0.105 |
| 400 | 0.556 | 0.860 | 4.999 | 0.035 | 0.174 | 4.296 | 1.224 | 2.045 | 1.027 | 0.096 |
| 410 | 0.569 | 0.866 | 5.034 | 0.035 | 0.116 | 4.412 | 1.224 | 2.096 | 1.092 | 0.065 |
| 420 | 0.583 | 0.872 | 5.069 | 0.035 | 0.105 | 4.517 | 1.224 | 2.141 | 1.152 | 0.060 |
| 430 | 0.597 | 0.878 | 5.104 | 0.035 | 0.099 | 4.615 | 1.224 | 2.182 | 1.210 | 0.057 |
| 440 | 0.611 | 0.883 | 5.133 | 0.029 | 0.087 | 4.703 | 1.224 | 2.218 | 1.261 | 0.051 |
| 450 | 0.625 | 0.888 | 5.162 | 0.029 | 0.087 | 4.790 | 1.224 | 2.253 | 1.313 | 0.052 |
| 460 | 0.639 | 0.893 | 5.191 | 0.029 | 0.081 | 4.871 | 1.224 | 2.285 | 1.362 | 0.049 |
| 470 | 0.653 | 0.898 | 5.220 | 0.029 | 0.070 | 4.941 | 1.224 | 2.312 | 1.405 | 0.043 |
| 480 | 0.667 | 0.903 | 5.249 | 0.029 | 0.070 | 5.011 | 1.224 | 2.339 | 1.448 | 0.043 |
| 490 | 0.681 | 0.908 | 5.278 | 0.029 | 0.064 | 5.075 | 1.224 | 2.363 | 1.488 | 0.040 |
| 500 | 0.694 | 0.913 | 5.307 | 0.029 | 0.058 | 5.133 | 1.224 | 2.385 | 1.524 | 0.036 |
| 510 | 0.708 | 0.918 | 5.336 | 0.029 | 0.058 | 5.191 | 1.224 | 2.407 | 1.561 | 0.037 |
| 520 | 0.722 | 0.923 | 5.365 | 0.029 | 0.058 | 5.249 | 1.224 | 2.428 | 1.598 | 0.037 |
| 530 | 0.736 | 0.927 | 5.388 | 0.023 | 0.047 | 5.295 | 1.224 | 2.445 | 1.627 | 0.030 |
| 540 | 0.750 | 0.931 | 5.412 | 0.023 | 0.041 | 5.336 | 1.224 | 2.459 | 1.653 | 0.026 |
| 550 | 0.764 | 0.935 | 5.435 | 0.023 | 0.041 | 5.377 | 1.224 | 2.474 | 1.680 | 0.026 |
| 560 | 0.778 | 0.939 | 5.458 | 0.023 | 0.035 | 5.412 | 1.224 | 2.486 | 1.702 | 0.023 |
| 570 | 0.792 | 0.943 | 5.481 | 0.023 | 0.035 | 5.447 | 1.224 | 2.498 | 1.725 | 0.023 |
| 580 | 0.806 | 0.947 | 5.505 | 0.023 | 0.029 | 5.476 | 1.224 | 2.509 | 1.744 | 0.019 |
| 590 | 0.819 | 0.951 | 5.528 | 0.023 | 0.029 | 5.505 | 1.224 | 2.519 | 1.763 | 0.019 |
| 600 | 0.833 | 0.955 | 5.551 | 0.023 | 0.029 | 5.534 | 1.224 | 2.529 | 1.782 | 0.019 |
| 610 | 0.847 | 0.959 | 5.574 | 0.023 | 0.029 | 5.563 | 1.224 | 2.539 | 1.801 | 0.019 |
| 620 | 0.861 | 0.963 | 5.598 | 0.023 | 0.029 | 5.592 | 1.224 | 2.549 | 1.820 | 0.019 |
| 630 | 0.875 | 0.967 | 5.621 | 0.023 | 0.023 | 5.615 | 1.224 | 2.556 | 1.835 | 0.015 |
| 640 | 0.889 | 0.971 | 5.644 | 0.023 | 0.023 | 5.638 | 1.224 | 2.564 | 1.851 | 0.015 |
| 650 | 0.903 | 0.975 | 5.667 | 0.023 | 0.023 | 5.662 | 1.224 | 2.572 | 1.866 | 0.015 |
| 660 | 0.917 | 0.979 | 5.691 | 0.023 | 0.023 | 5.685 | 1.224 | 2.580 | 1.881 | 0.015 |
| 670 | 0.931 | 0.983 | 5.714 | 0.023 | 0.023 | 5.708 | 1.224 | 2.588 | 1.897 | 0.015 |
| 680 | 0.944 | 0.987 | 5.737 | 0.023 | 0.023 | 5.731 | 1.224 | 2.595 | 1.912 | 0.016 |
| 690 | 0.958 | 0.991 | 5.760 | 0.023 | 0.023 | 5.755 | 1.224 | 2.603 | 1.928 | 0.016 |
| 700 | 0.972 | 0.994 | 5.778 | 0.017 | 0.023 | 5.778 | 1.224 | 2.611 | 1.944 | 0.016 |
| 710 | 0.986 | 0.997 | 5.795 | 0.017 | 0.017 | 5.795 | 1.224 | 2.616 | 1.955 | 0.012 |
| 720 | 1.000 | 1.000 | 5.813 | 0.017 | 0.017 | 5.813 | 1.224 | 2.622 | 1.967 | 0.012 |

**Table A 24** Design Hyetograph of Intermediate Zones (Tr = 500 yr)

| duration (min) | duration / total duration | depth / total depth | cumulative depth (cm) | incremental depth (cm) | ordered depth (cm) | cumulative ordered depth (cm) | cum. initial abstriction, Ia (cm) | cumulative abstriction, Fa (cm) | cumulative excess depth, Pe (cm) | excess depth (cm) |
|---|---|---|---|---|---|---|---|---|---|---|
| 10 | 0.014 | 0.140 | 1.014 | 1.014 | 0.022 | 0.022 | 0.022 | 0.000 | 0.000 | 0.000 |
| 20 | 0.028 | 0.225 | 1.630 | 0.616 | 0.029 | 0.051 | 0.051 | 0.000 | 0.000 | 0.000 |
| 30 | 0.042 | 0.283 | 2.050 | 0.420 | 0.029 | 0.080 | 0.080 | 0.000 | 0.000 | 0.000 |
| 40 | 0.056 | 0.325 | 2.355 | 0.304 | 0.029 | 0.109 | 0.109 | 0.000 | 0.000 | 0.000 |
| 50 | 0.070 | 0.366 | 2.652 | 0.297 | 0.029 | 0.138 | 0.138 | 0.000 | 0.000 | 0.000 |
| 60 | 0.084 | 0.400 | 2.898 | 0.246 | 0.029 | 0.167 | 0.167 | 0.000 | 0.000 | 0.000 |
| 70 | 0.097 | 0.432 | 3.130 | 0.232 | 0.029 | 0.196 | 0.196 | 0.000 | 0.000 | 0.000 |
| 80 | 0.111 | 0.462 | 3.347 | 0.217 | 0.029 | 0.225 | 0.225 | 0.000 | 0.000 | 0.000 |
| 90 | 0.125 | 0.488 | 3.536 | 0.188 | 0.029 | 0.254 | 0.254 | 0.000 | 0.000 | 0.000 |
| 100 | 0.139 | 0.508 | 3.681 | 0.145 | 0.029 | 0.283 | 0.283 | 0.000 | 0.000 | 0.000 |
| 110 | 0.153 | 0.527 | 3.818 | 0.138 | 0.036 | 0.319 | 0.319 | 0.000 | 0.000 | 0.000 |
| 120 | 0.167 | 0.545 | 3.949 | 0.130 | 0.036 | 0.355 | 0.355 | 0.000 | 0.000 | 0.000 |
| 130 | 0.181 | 0.563 | 4.079 | 0.130 | 0.036 | 0.391 | 0.391 | 0.000 | 0.000 | 0.000 |
| 140 | 0.195 | 0.580 | 4.202 | 0.123 | 0.036 | 0.427 | 0.427 | 0.000 | 0.000 | 0.000 |
| 150 | 0.209 | 0.595 | 4.311 | 0.109 | 0.043 | 0.471 | 0.471 | 0.000 | 0.000 | 0.000 |
| 160 | 0.222 | 0.610 | 4.420 | 0.109 | 0.043 | 0.514 | 0.514 | 0.000 | 0.000 | 0.000 |
| 170 | 0.236 | 0.625 | 4.528 | 0.109 | 0.051 | 0.565 | 0.565 | 0.000 | 0.000 | 0.000 |
| 180 | 0.250 | 0.640 | 4.637 | 0.109 | 0.051 | 0.616 | 0.616 | 0.000 | 0.000 | 0.000 |
| 190 | 0.264 | 0.655 | 4.746 | 0.109 | 0.051 | 0.667 | 0.667 | 0.000 | 0.000 | 0.000 |
| 200 | 0.278 | 0.669 | 4.847 | 0.101 | 0.058 | 0.725 | 0.725 | 0.000 | 0.000 | 0.000 |
| 210 | 0.292 | 0.683 | 4.948 | 0.101 | 0.072 | 0.797 | 0.797 | 0.000 | 0.000 | 0.000 |
| 220 | 0.306 | 0.695 | 5.035 | 0.087 | 0.072 | 0.869 | 0.869 | 0.000 | 0.000 | 0.000 |
| 230 | 0.320 | 0.707 | 5.122 | 0.087 | 0.080 | 0.949 | 0.949 | 0.000 | 0.000 | 0.000 |
| 240 | 0.334 | 0.719 | 5.209 | 0.087 | 0.087 | 1.036 | 1.036 | 0.000 | 0.000 | 0.000 |
| 250 | 0.347 | 0.731 | 5.296 | 0.087 | 0.087 | 1.123 | 1.123 | 0.000 | 0.000 | 0.000 |
| 260 | 0.361 | 0.742 | 5.376 | 0.080 | 0.101 | 1.224 | 1.224 | 0.001 | 0.000 | 0.000 |
| 270 | 0.375 | 0.753 | 5.456 | 0.080 | 0.109 | 1.333 | 1.224 | 0.108 | 0.002 | 0.002 |
| 280 | 0.389 | 0.763 | 5.528 | 0.072 | 0.109 | 1.442 | 1.224 | 0.211 | 0.008 | 0.006 |
| 290 | 0.403 | 0.773 | 5.601 | 0.072 | 0.109 | 1.550 | 1.224 | 0.310 | 0.017 | 0.009 |
| 300 | 0.417 | 0.783 | 5.673 | 0.072 | 0.130 | 1.681 | 1.224 | 0.426 | 0.032 | 0.015 |
| 310 | 0.431 | 0.793 | 5.745 | 0.072 | 0.138 | 1.819 | 1.224 | 0.542 | 0.053 | 0.021 |
| 320 | 0.445 | 0.803 | 5.818 | 0.072 | 0.188 | 2.007 | 1.224 | 0.694 | 0.089 | 0.036 |
| 330 | 0.459 | 0.811 | 5.876 | 0.058 | 0.232 | 2.239 | 1.224 | 0.871 | 0.145 | 0.056 |
| 340 | 0.472 | 0.819 | 5.934 | 0.058 | 0.297 | 2.536 | 1.224 | 1.081 | 0.232 | 0.087 |
| 350 | 0.486 | 0.826 | 5.985 | 0.051 | 0.420 | 2.956 | 1.224 | 1.350 | 0.382 | 0.151 |
| 360 | 0.500 | 0.833 | 6.035 | 0.051 | 1.014 | 3.970 | 1.224 | 1.896 | 0.851 | 0.469 |

**Table A 24** (continued)

| duration (min) | duration / total duration | depth / total depth | cumulative depth (cm) | incremental depth (cm) | ordered depth (cm) | cumulative ordered depth (cm) | cum. initial abstriction, Ia (cm) | cumulative abstriction, Fa (cm) | cumulative excess depth, Pe (cm) | excess depth (cm) |
|---|---|---|---|---|---|---|---|---|---|---|
| 370 | 0.514 | 0.840 | 6.086 | 0.051 | 0.616 | 4.586 | 1.224 | 2.170 | 1.193 | 0.342 |
| 380 | 0.528 | 0.847 | 6.137 | 0.051 | 0.304 | 4.891 | 1.224 | 2.293 | 1.374 | 0.182 |
| 390 | 0.542 | 0.854 | 6.187 | 0.051 | 0.246 | 5.137 | 1.224 | 2.387 | 1.527 | 0.152 |
| 400 | 0.556 | 0.860 | 6.231 | 0.043 | 0.217 | 5.354 | 1.224 | 2.466 | 1.665 | 0.138 |
| 410 | 0.569 | 0.866 | 6.274 | 0.043 | 0.145 | 5.499 | 1.224 | 2.517 | 1.759 | 0.094 |
| 420 | 0.583 | 0.872 | 6.318 | 0.043 | 0.130 | 5.630 | 1.224 | 2.561 | 1.845 | 0.086 |
| 430 | 0.597 | 0.878 | 6.361 | 0.043 | 0.123 | 5.753 | 1.224 | 2.602 | 1.927 | 0.082 |
| 440 | 0.611 | 0.883 | 6.398 | 0.036 | 0.109 | 5.861 | 1.224 | 2.638 | 2.000 | 0.073 |
| 450 | 0.625 | 0.888 | 6.434 | 0.036 | 0.109 | 5.970 | 1.224 | 2.673 | 2.074 | 0.074 |
| 460 | 0.639 | 0.893 | 6.470 | 0.036 | 0.101 | 6.072 | 1.224 | 2.705 | 2.143 | 0.070 |
| 470 | 0.653 | 0.898 | 6.506 | 0.036 | 0.087 | 6.158 | 1.224 | 2.731 | 2.203 | 0.060 |
| 480 | 0.667 | 0.903 | 6.542 | 0.036 | 0.087 | 6.245 | 1.224 | 2.758 | 2.264 | 0.061 |
| 490 | 0.681 | 0.908 | 6.579 | 0.036 | 0.080 | 6.325 | 1.224 | 2.782 | 2.320 | 0.056 |
| 500 | 0.694 | 0.913 | 6.615 | 0.036 | 0.072 | 6.398 | 1.224 | 2.803 | 2.371 | 0.051 |
| 510 | 0.708 | 0.918 | 6.651 | 0.036 | 0.072 | 6.470 | 1.224 | 2.824 | 2.422 | 0.051 |
| 520 | 0.722 | 0.923 | 6.687 | 0.036 | 0.072 | 6.542 | 1.224 | 2.845 | 2.474 | 0.052 |
| 530 | 0.736 | 0.927 | 6.716 | 0.029 | 0.058 | 6.600 | 1.224 | 2.862 | 2.515 | 0.041 |
| 540 | 0.750 | 0.931 | 6.745 | 0.029 | 0.051 | 6.651 | 1.224 | 2.876 | 2.552 | 0.036 |
| 550 | 0.764 | 0.935 | 6.774 | 0.029 | 0.051 | 6.702 | 1.224 | 2.890 | 2.588 | 0.037 |
| 560 | 0.778 | 0.939 | 6.803 | 0.029 | 0.043 | 6.745 | 1.224 | 2.902 | 2.620 | 0.031 |
| 570 | 0.792 | 0.943 | 6.832 | 0.029 | 0.043 | 6.789 | 1.224 | 2.914 | 2.651 | 0.032 |
| 580 | 0.806 | 0.947 | 6.861 | 0.029 | 0.036 | 6.825 | 1.224 | 2.924 | 2.677 | 0.026 |
| 590 | 0.819 | 0.951 | 6.890 | 0.029 | 0.036 | 6.861 | 1.224 | 2.934 | 2.704 | 0.026 |
| 600 | 0.833 | 0.955 | 6.919 | 0.029 | 0.036 | 6.897 | 1.224 | 2.944 | 2.730 | 0.026 |
| 610 | 0.847 | 0.959 | 6.948 | 0.029 | 0.036 | 6.934 | 1.224 | 2.953 | 2.757 | 0.027 |
| 620 | 0.861 | 0.963 | 6.977 | 0.029 | 0.036 | 6.970 | 1.224 | 2.963 | 2.783 | 0.027 |
| 630 | 0.875 | 0.967 | 7.006 | 0.029 | 0.029 | 6.999 | 1.224 | 2.971 | 2.805 | 0.021 |
| 640 | 0.889 | 0.971 | 7.035 | 0.029 | 0.029 | 7.028 | 1.224 | 2.978 | 2.826 | 0.021 |
| 650 | 0.903 | 0.975 | 7.064 | 0.029 | 0.029 | 7.057 | 1.224 | 2.986 | 2.847 | 0.021 |
| 660 | 0.917 | 0.979 | 7.093 | 0.029 | 0.029 | 7.086 | 1.224 | 2.994 | 2.869 | 0.021 |
| 670 | 0.931 | 0.983 | 7.122 | 0.029 | 0.029 | 7.115 | 1.224 | 3.001 | 2.890 | 0.021 |
| 680 | 0.944 | 0.987 | 7.151 | 0.029 | 0.029 | 7.144 | 1.224 | 3.009 | 2.912 | 0.021 |
| 690 | 0.958 | 0.991 | 7.180 | 0.029 | 0.029 | 7.173 | 1.224 | 3.016 | 2.933 | 0.022 |
| 700 | 0.972 | 0.994 | 7.202 | 0.022 | 0.029 | 7.202 | 1.224 | 3.024 | 2.955 | 0.022 |
| 710 | 0.986 | 0.997 | 7.224 | 0.022 | 0.022 | 7.224 | 1.224 | 3.029 | 2.971 | 0.016 |
| 720 | 1.000 | 1.000 | 7.245 | 0.022 | 0.022 | 7.245 | 1.224 | 3.035 | 2.987 | 0.016 |

**Table A 25** Design Hyetograph of Upstream of Lake Mogan Subbasin (Tr = 50 yr)

| duration (min) | duration / total duration | depth / total depth | cumulative depth (cm) | incremental depth (cm) | ordered depth (cm) | cumulative ordered depth (cm) | cum. initial abstriction, Ia (cm) | cumulative abstriction, Fa (cm) | cumulative excess depth, Pe (cm) | excess depth (cm) |
|---|---|---|---|---|---|---|---|---|---|---|
| 10 | 0.014 | 0.140 | 0.727 | 0.727 | 0.016 | 0.016 | 0.016 | 0.000 | 0.000 | 0.000 |
| 20 | 0.028 | 0.225 | 1.168 | 0.441 | 0.021 | 0.036 | 0.036 | 0.000 | 0.000 | 0.000 |
| 30 | 0.042 | 0.283 | 1.469 | 0.301 | 0.021 | 0.057 | 0.057 | 0.000 | 0.000 | 0.000 |
| 40 | 0.056 | 0.325 | 1.687 | 0.218 | 0.021 | 0.078 | 0.078 | 0.000 | 0.000 | 0.000 |
| 50 | 0.070 | 0.366 | 1.900 | 0.213 | 0.021 | 0.099 | 0.099 | 0.000 | 0.000 | 0.000 |
| 60 | 0.084 | 0.400 | 2.076 | 0.176 | 0.021 | 0.119 | 0.119 | 0.000 | 0.000 | 0.000 |
| 70 | 0.097 | 0.432 | 2.242 | 0.166 | 0.021 | 0.140 | 0.140 | 0.000 | 0.000 | 0.000 |
| 80 | 0.111 | 0.462 | 2.398 | 0.156 | 0.021 | 0.161 | 0.161 | 0.000 | 0.000 | 0.000 |
| 90 | 0.125 | 0.488 | 2.533 | 0.135 | 0.021 | 0.182 | 0.182 | 0.000 | 0.000 | 0.000 |
| 100 | 0.139 | 0.508 | 2.637 | 0.104 | 0.021 | 0.202 | 0.202 | 0.000 | 0.000 | 0.000 |
| 110 | 0.153 | 0.527 | 2.735 | 0.099 | 0.026 | 0.228 | 0.228 | 0.000 | 0.000 | 0.000 |
| 120 | 0.167 | 0.545 | 2.829 | 0.093 | 0.026 | 0.254 | 0.254 | 0.000 | 0.000 | 0.000 |
| 130 | 0.181 | 0.563 | 2.922 | 0.093 | 0.026 | 0.280 | 0.280 | 0.000 | 0.000 | 0.000 |
| 140 | 0.195 | 0.580 | 3.010 | 0.088 | 0.026 | 0.306 | 0.306 | 0.000 | 0.000 | 0.000 |
| 150 | 0.209 | 0.595 | 3.088 | 0.078 | 0.031 | 0.337 | 0.337 | 0.000 | 0.000 | 0.000 |
| 160 | 0.222 | 0.610 | 3.166 | 0.078 | 0.031 | 0.368 | 0.368 | 0.000 | 0.000 | 0.000 |
| 170 | 0.236 | 0.625 | 3.244 | 0.078 | 0.036 | 0.405 | 0.405 | 0.000 | 0.000 | 0.000 |
| 180 | 0.250 | 0.640 | 3.322 | 0.078 | 0.036 | 0.441 | 0.441 | 0.000 | 0.000 | 0.000 |
| 190 | 0.264 | 0.655 | 3.399 | 0.078 | 0.036 | 0.477 | 0.477 | 0.000 | 0.000 | 0.000 |
| 200 | 0.278 | 0.669 | 3.472 | 0.073 | 0.042 | 0.519 | 0.519 | 0.000 | 0.000 | 0.000 |
| 210 | 0.292 | 0.683 | 3.545 | 0.073 | 0.052 | 0.571 | 0.571 | 0.000 | 0.000 | 0.000 |
| 220 | 0.306 | 0.695 | 3.607 | 0.062 | 0.052 | 0.623 | 0.623 | 0.000 | 0.000 | 0.000 |
| 230 | 0.320 | 0.707 | 3.669 | 0.062 | 0.057 | 0.680 | 0.680 | 0.000 | 0.000 | 0.000 |
| 240 | 0.334 | 0.719 | 3.732 | 0.062 | 0.062 | 0.742 | 0.742 | 0.000 | 0.000 | 0.000 |
| 250 | 0.347 | 0.731 | 3.794 | 0.062 | 0.062 | 0.804 | 0.804 | 0.000 | 0.000 | 0.000 |
| 260 | 0.361 | 0.742 | 3.851 | 0.057 | 0.073 | 0.877 | 0.877 | 0.000 | 0.000 | 0.000 |
| 270 | 0.375 | 0.753 | 3.908 | 0.057 | 0.078 | 0.955 | 0.955 | 0.000 | 0.000 | 0.000 |
| 280 | 0.389 | 0.763 | 3.960 | 0.052 | 0.078 | 1.033 | 1.033 | 0.000 | 0.000 | 0.000 |
| 290 | 0.403 | 0.773 | 4.012 | 0.052 | 0.078 | 1.111 | 1.111 | 0.000 | 0.000 | 0.000 |
| 300 | 0.417 | 0.783 | 4.064 | 0.052 | 0.093 | 1.204 | 1.204 | 0.000 | 0.000 | 0.000 |
| 310 | 0.431 | 0.793 | 4.116 | 0.052 | 0.099 | 1.303 | 1.303 | 0.000 | 0.000 | 0.000 |
| 320 | 0.445 | 0.803 | 4.168 | 0.052 | 0.135 | 1.438 | 1.438 | 0.000 | 0.000 | 0.000 |
| 330 | 0.459 | 0.811 | 4.209 | 0.042 | 0.166 | 1.604 | 1.604 | 0.000 | 0.000 | 0.000 |
| 340 | 0.472 | 0.819 | 4.251 | 0.042 | 0.213 | 1.817 | 1.648 | 0.165 | 0.003 | 0.003 |
| 350 | 0.486 | 0.826 | 4.287 | 0.036 | 0.301 | 2.118 | 1.648 | 0.444 | 0.025 | 0.022 |
| 360 | 0.500 | 0.833 | 4.323 | 0.036 | 0.727 | 2.844 | 1.648 | 1.044 | 0.151 | 0.126 |

**Table A 25** (continued)

| duration (min) | duration / total duration | depth / total depth | cumulative depth (cm) | incremental depth (cm) | ordered depth (cm) | cumulative ordered depth (cm) | cum. initial abstriction, Ia (cm) | cumulative abstriction, Fa (cm) | cumulative excess depth, Pe (cm) | excess depth (cm) |
|---|---|---|---|---|---|---|---|---|---|---|
| 370 | 0.514 | 0.840 | 4.360 | 0.036 | 0.441 | 3.285 | 1.648 | 1.366 | 0.271 | 0.120 |
| 380 | 0.528 | 0.847 | 4.396 | 0.036 | 0.218 | 3.503 | 1.648 | 1.514 | 0.341 | 0.070 |
| 390 | 0.542 | 0.854 | 4.432 | 0.036 | 0.176 | 3.680 | 1.648 | 1.630 | 0.402 | 0.061 |
| 400 | 0.556 | 0.860 | 4.463 | 0.031 | 0.156 | 3.835 | 1.648 | 1.728 | 0.459 | 0.057 |
| 410 | 0.569 | 0.866 | 4.495 | 0.031 | 0.104 | 3.939 | 1.648 | 1.793 | 0.498 | 0.040 |
| 420 | 0.583 | 0.872 | 4.526 | 0.031 | 0.093 | 4.033 | 1.648 | 1.849 | 0.535 | 0.037 |
| 430 | 0.597 | 0.878 | 4.557 | 0.031 | 0.088 | 4.121 | 1.648 | 1.902 | 0.570 | 0.036 |
| 440 | 0.611 | 0.883 | 4.583 | 0.026 | 0.078 | 4.199 | 1.648 | 1.948 | 0.603 | 0.032 |
| 450 | 0.625 | 0.888 | 4.609 | 0.026 | 0.078 | 4.277 | 1.648 | 1.993 | 0.635 | 0.033 |
| 460 | 0.639 | 0.893 | 4.635 | 0.026 | 0.073 | 4.349 | 1.648 | 2.034 | 0.667 | 0.031 |
| 470 | 0.653 | 0.898 | 4.661 | 0.026 | 0.062 | 4.412 | 1.648 | 2.069 | 0.694 | 0.027 |
| 480 | 0.667 | 0.903 | 4.687 | 0.026 | 0.062 | 4.474 | 1.648 | 2.104 | 0.721 | 0.028 |
| 490 | 0.681 | 0.908 | 4.713 | 0.026 | 0.057 | 4.531 | 1.648 | 2.136 | 0.747 | 0.026 |
| 500 | 0.694 | 0.913 | 4.738 | 0.026 | 0.052 | 4.583 | 1.648 | 2.164 | 0.770 | 0.024 |
| 510 | 0.708 | 0.918 | 4.764 | 0.026 | 0.052 | 4.635 | 1.648 | 2.192 | 0.794 | 0.024 |
| 520 | 0.722 | 0.923 | 4.790 | 0.026 | 0.052 | 4.687 | 1.648 | 2.220 | 0.818 | 0.024 |
| 530 | 0.736 | 0.927 | 4.811 | 0.021 | 0.042 | 4.728 | 1.648 | 2.242 | 0.838 | 0.019 |
| 540 | 0.750 | 0.931 | 4.832 | 0.021 | 0.036 | 4.764 | 1.648 | 2.261 | 0.855 | 0.017 |
| 550 | 0.764 | 0.935 | 4.853 | 0.021 | 0.036 | 4.801 | 1.648 | 2.280 | 0.872 | 0.017 |
| 560 | 0.778 | 0.939 | 4.873 | 0.021 | 0.031 | 4.832 | 1.648 | 2.296 | 0.887 | 0.015 |
| 570 | 0.792 | 0.943 | 4.894 | 0.021 | 0.031 | 4.863 | 1.648 | 2.313 | 0.902 | 0.015 |
| 580 | 0.806 | 0.947 | 4.915 | 0.021 | 0.026 | 4.889 | 1.648 | 2.326 | 0.914 | 0.013 |
| 590 | 0.819 | 0.951 | 4.936 | 0.021 | 0.026 | 4.915 | 1.648 | 2.339 | 0.927 | 0.013 |
| 600 | 0.833 | 0.955 | 4.956 | 0.021 | 0.026 | 4.941 | 1.648 | 2.353 | 0.940 | 0.013 |
| 610 | 0.847 | 0.959 | 4.977 | 0.021 | 0.026 | 4.967 | 1.648 | 2.366 | 0.952 | 0.013 |
| 620 | 0.861 | 0.963 | 4.998 | 0.021 | 0.026 | 4.993 | 1.648 | 2.379 | 0.965 | 0.013 |
| 630 | 0.875 | 0.967 | 5.019 | 0.021 | 0.021 | 5.014 | 1.648 | 2.390 | 0.976 | 0.010 |
| 640 | 0.889 | 0.971 | 5.039 | 0.021 | 0.021 | 5.034 | 1.648 | 2.400 | 0.986 | 0.010 |
| 650 | 0.903 | 0.975 | 5.060 | 0.021 | 0.021 | 5.055 | 1.648 | 2.410 | 0.996 | 0.010 |
| 660 | 0.917 | 0.979 | 5.081 | 0.021 | 0.021 | 5.076 | 1.648 | 2.421 | 1.007 | 0.010 |
| 670 | 0.931 | 0.983 | 5.102 | 0.021 | 0.021 | 5.097 | 1.648 | 2.431 | 1.017 | 0.010 |
| 680 | 0.944 | 0.987 | 5.123 | 0.021 | 0.021 | 5.117 | 1.648 | 2.441 | 1.027 | 0.010 |
| 690 | 0.958 | 0.991 | 5.143 | 0.021 | 0.021 | 5.138 | 1.648 | 2.452 | 1.038 | 0.010 |
| 700 | 0.972 | 0.994 | 5.159 | 0.016 | 0.021 | 5.159 | 1.648 | 2.462 | 1.048 | 0.011 |
| 710 | 0.986 | 0.997 | 5.174 | 0.016 | 0.016 | 5.174 | 1.648 | 2.470 | 1.056 | 0.008 |
| 720 | 1.000 | 1.000 | 5.190 | 0.016 | 0.016 | 5.190 | 1.648 | 2.477 | 1.064 | 0.008 |

**Table A 26** Design Hyetograph of Upstream of Lake Mogan Subbasin (Tr=100 yr)

| duration (min) | duration / total duration | depth / total depth | cumulative depth (cm) | incremental depth (cm) | ordered depth (cm) | cumulative ordered depth (cm) | cum. initial abstriction, Ia (cm) | cumulative abstriction, Fa (cm) | cumulative excess depth, Pe (cm) | excess depth (cm) |
|---|---|---|---|---|---|---|---|---|---|---|
| 10 | 0.014 | 0.140 | 0.814 | 0.814 | 0.017 | 0.017 | 0.017 | 0.000 | 0.000 | 0.000 |
| 20 | 0.028 | 0.225 | 1.308 | 0.494 | 0.023 | 0.041 | 0.041 | 0.000 | 0.000 | 0.000 |
| 30 | 0.042 | 0.283 | 1.645 | 0.337 | 0.023 | 0.064 | 0.064 | 0.000 | 0.000 | 0.000 |
| 40 | 0.056 | 0.325 | 1.889 | 0.244 | 0.023 | 0.087 | 0.087 | 0.000 | 0.000 | 0.000 |
| 50 | 0.070 | 0.366 | 2.127 | 0.238 | 0.023 | 0.110 | 0.110 | 0.000 | 0.000 | 0.000 |
| 60 | 0.084 | 0.400 | 2.325 | 0.198 | 0.023 | 0.134 | 0.134 | 0.000 | 0.000 | 0.000 |
| 70 | 0.097 | 0.432 | 2.511 | 0.186 | 0.023 | 0.157 | 0.157 | 0.000 | 0.000 | 0.000 |
| 80 | 0.111 | 0.462 | 2.686 | 0.174 | 0.023 | 0.180 | 0.180 | 0.000 | 0.000 | 0.000 |
| 90 | 0.125 | 0.488 | 2.837 | 0.151 | 0.023 | 0.203 | 0.203 | 0.000 | 0.000 | 0.000 |
| 100 | 0.139 | 0.508 | 2.953 | 0.116 | 0.023 | 0.227 | 0.227 | 0.000 | 0.000 | 0.000 |
| 110 | 0.153 | 0.527 | 3.063 | 0.110 | 0.029 | 0.256 | 0.256 | 0.000 | 0.000 | 0.000 |
| 120 | 0.167 | 0.545 | 3.168 | 0.105 | 0.029 | 0.285 | 0.285 | 0.000 | 0.000 | 0.000 |
| 130 | 0.181 | 0.563 | 3.273 | 0.105 | 0.029 | 0.314 | 0.314 | 0.000 | 0.000 | 0.000 |
| 140 | 0.195 | 0.580 | 3.371 | 0.099 | 0.029 | 0.343 | 0.343 | 0.000 | 0.000 | 0.000 |
| 150 | 0.209 | 0.595 | 3.459 | 0.087 | 0.035 | 0.378 | 0.378 | 0.000 | 0.000 | 0.000 |
| 160 | 0.222 | 0.610 | 3.546 | 0.087 | 0.035 | 0.413 | 0.413 | 0.000 | 0.000 | 0.000 |
| 170 | 0.236 | 0.625 | 3.633 | 0.087 | 0.041 | 0.453 | 0.453 | 0.000 | 0.000 | 0.000 |
| 180 | 0.250 | 0.640 | 3.720 | 0.087 | 0.041 | 0.494 | 0.494 | 0.000 | 0.000 | 0.000 |
| 190 | 0.264 | 0.655 | 3.807 | 0.087 | 0.041 | 0.535 | 0.535 | 0.000 | 0.000 | 0.000 |
| 200 | 0.278 | 0.669 | 3.889 | 0.081 | 0.047 | 0.581 | 0.581 | 0.000 | 0.000 | 0.000 |
| 210 | 0.292 | 0.683 | 3.970 | 0.081 | 0.058 | 0.639 | 0.639 | 0.000 | 0.000 | 0.000 |
| 220 | 0.306 | 0.695 | 4.040 | 0.070 | 0.058 | 0.698 | 0.698 | 0.000 | 0.000 | 0.000 |
| 230 | 0.320 | 0.707 | 4.110 | 0.070 | 0.064 | 0.761 | 0.761 | 0.000 | 0.000 | 0.000 |
| 240 | 0.334 | 0.719 | 4.179 | 0.070 | 0.070 | 0.831 | 0.831 | 0.000 | 0.000 | 0.000 |
| 250 | 0.347 | 0.731 | 4.249 | 0.070 | 0.070 | 0.901 | 0.901 | 0.000 | 0.000 | 0.000 |
| 260 | 0.361 | 0.742 | 4.313 | 0.064 | 0.081 | 0.982 | 0.982 | 0.000 | 0.000 | 0.000 |
| 270 | 0.375 | 0.753 | 4.377 | 0.064 | 0.087 | 1.070 | 1.070 | 0.000 | 0.000 | 0.000 |
| 280 | 0.389 | 0.763 | 4.435 | 0.058 | 0.087 | 1.157 | 1.157 | 0.000 | 0.000 | 0.000 |
| 290 | 0.403 | 0.773 | 4.493 | 0.058 | 0.087 | 1.244 | 1.244 | 0.000 | 0.000 | 0.000 |
| 300 | 0.417 | 0.783 | 4.551 | 0.058 | 0.105 | 1.349 | 1.349 | 0.000 | 0.000 | 0.000 |
| 310 | 0.431 | 0.793 | 4.610 | 0.058 | 0.110 | 1.459 | 1.459 | 0.000 | 0.000 | 0.000 |
| 320 | 0.445 | 0.803 | 4.668 | 0.058 | 0.151 | 1.610 | 1.610 | 0.000 | 0.000 | 0.000 |
| 330 | 0.459 | 0.811 | 4.714 | 0.047 | 0.186 | 1.796 | 1.648 | 0.145 | 0.003 | 0.003 |
| 340 | 0.472 | 0.819 | 4.761 | 0.047 | 0.238 | 2.034 | 1.648 | 0.369 | 0.017 | 0.015 |
| 350 | 0.486 | 0.826 | 4.801 | 0.041 | 0.337 | 2.372 | 1.648 | 0.665 | 0.058 | 0.041 |
| 360 | 0.500 | 0.833 | 4.842 | 0.041 | 0.814 | 3.185 | 1.648 | 1.295 | 0.242 | 0.183 |

**Table A 26** (continued)

| duration (min) | duration / total duration | depth / total depth | cumulative depth (cm) | incremental depth (cm) | ordered depth (cm) | cumulative ordered depth (cm) | cum. initial abstriction, Ia (cm) | cumulative abstriction, Fa (cm) | cumulative excess depth, Pe (cm) | excess depth (cm) |
|---|---|---|---|---|---|---|---|---|---|---|
| 370 | 0.514 | 0.840 | 4.883 | 0.041 | 0.494 | 3.680 | 1.648 | 1.629 | 0.402 | 0.160 |
| 380 | 0.528 | 0.847 | 4.923 | 0.041 | 0.244 | 3.924 | 1.648 | 1.783 | 0.492 | 0.091 |
| 390 | 0.542 | 0.854 | 4.964 | 0.041 | 0.198 | 4.121 | 1.648 | 1.902 | 0.571 | 0.078 |
| 400 | 0.556 | 0.860 | 4.999 | 0.035 | 0.174 | 4.296 | 1.648 | 2.004 | 0.644 | 0.073 |
| 410 | 0.569 | 0.866 | 5.034 | 0.035 | 0.116 | 4.412 | 1.648 | 2.070 | 0.694 | 0.050 |
| 420 | 0.583 | 0.872 | 5.069 | 0.035 | 0.105 | 4.517 | 1.648 | 2.128 | 0.740 | 0.046 |
| 430 | 0.597 | 0.878 | 5.104 | 0.035 | 0.099 | 4.615 | 1.648 | 2.182 | 0.785 | 0.045 |
| 440 | 0.611 | 0.883 | 5.133 | 0.029 | 0.087 | 4.703 | 1.648 | 2.228 | 0.826 | 0.040 |
| 450 | 0.625 | 0.888 | 5.162 | 0.029 | 0.087 | 4.790 | 1.648 | 2.274 | 0.867 | 0.041 |
| 460 | 0.639 | 0.893 | 5.191 | 0.029 | 0.081 | 4.871 | 1.648 | 2.317 | 0.906 | 0.039 |
| 470 | 0.653 | 0.898 | 5.220 | 0.029 | 0.070 | 4.941 | 1.648 | 2.353 | 0.940 | 0.034 |
| 480 | 0.667 | 0.903 | 5.249 | 0.029 | 0.070 | 5.011 | 1.648 | 2.388 | 0.974 | 0.034 |
| 490 | 0.681 | 0.908 | 5.278 | 0.029 | 0.064 | 5.075 | 1.648 | 2.420 | 1.006 | 0.032 |
| 500 | 0.694 | 0.913 | 5.307 | 0.029 | 0.058 | 5.133 | 1.648 | 2.449 | 1.035 | 0.029 |
| 510 | 0.708 | 0.918 | 5.336 | 0.029 | 0.058 | 5.191 | 1.648 | 2.478 | 1.065 | 0.030 |
| 520 | 0.722 | 0.923 | 5.365 | 0.029 | 0.058 | 5.249 | 1.648 | 2.506 | 1.095 | 0.030 |
| 530 | 0.736 | 0.927 | 5.388 | 0.023 | 0.047 | 5.295 | 1.648 | 2.528 | 1.119 | 0.024 |
| 540 | 0.750 | 0.931 | 5.412 | 0.023 | 0.041 | 5.336 | 1.648 | 2.548 | 1.140 | 0.021 |
| 550 | 0.764 | 0.935 | 5.435 | 0.023 | 0.041 | 5.377 | 1.648 | 2.567 | 1.161 | 0.021 |
| 560 | 0.778 | 0.939 | 5.458 | 0.023 | 0.035 | 5.412 | 1.648 | 2.584 | 1.180 | 0.018 |
| 570 | 0.792 | 0.943 | 5.481 | 0.023 | 0.035 | 5.447 | 1.648 | 2.600 | 1.198 | 0.018 |
| 580 | 0.806 | 0.947 | 5.505 | 0.023 | 0.029 | 5.476 | 1.648 | 2.614 | 1.214 | 0.015 |
| 590 | 0.819 | 0.951 | 5.528 | 0.023 | 0.029 | 5.505 | 1.648 | 2.627 | 1.229 | 0.016 |
| 600 | 0.833 | 0.955 | 5.551 | 0.023 | 0.029 | 5.534 | 1.648 | 2.641 | 1.245 | 0.016 |
| 610 | 0.847 | 0.959 | 5.574 | 0.023 | 0.029 | 5.563 | 1.648 | 2.654 | 1.260 | 0.016 |
| 620 | 0.861 | 0.963 | 5.598 | 0.023 | 0.029 | 5.592 | 1.648 | 2.667 | 1.276 | 0.016 |
| 630 | 0.875 | 0.967 | 5.621 | 0.023 | 0.023 | 5.615 | 1.648 | 2.678 | 1.289 | 0.013 |
| 640 | 0.889 | 0.971 | 5.644 | 0.023 | 0.023 | 5.638 | 1.648 | 2.688 | 1.301 | 0.013 |
| 650 | 0.903 | 0.975 | 5.667 | 0.023 | 0.023 | 5.662 | 1.648 | 2.699 | 1.314 | 0.013 |
| 660 | 0.917 | 0.979 | 5.691 | 0.023 | 0.023 | 5.685 | 1.648 | 2.710 | 1.327 | 0.013 |
| 670 | 0.931 | 0.983 | 5.714 | 0.023 | 0.023 | 5.708 | 1.648 | 2.720 | 1.340 | 0.013 |
| 680 | 0.944 | 0.987 | 5.737 | 0.023 | 0.023 | 5.731 | 1.648 | 2.730 | 1.353 | 0.013 |
| 690 | 0.958 | 0.991 | 5.760 | 0.023 | 0.023 | 5.755 | 1.648 | 2.741 | 1.365 | 0.013 |
| 700 | 0.972 | 0.994 | 5.778 | 0.017 | 0.023 | 5.778 | 1.648 | 2.751 | 1.378 | 0.013 |
| 710 | 0.986 | 0.997 | 5.795 | 0.017 | 0.017 | 5.795 | 1.648 | 2.759 | 1.388 | 0.010 |
| 720 | 1.000 | 1.000 | 5.813 | 0.017 | 0.017 | 5.813 | 1.648 | 2.767 | 1.398 | 0.010 |

**Table A 27** Design Hyetograph of Upstream of Lake Mogan Subbasin (Tr=500 yr)

| duration (min) | duration / total duration | depth / total depth | cumulative depth (cm) | incremental depth (cm) | ordered depth (cm) | cumulative ordered depth (cm) | cum. initial abstriction, Ia (cm) | cumulative abstriction, Fa (cm) | cumulative excess depth, Pe (cm) | excess depth (cm) |
|---|---|---|---|---|---|---|---|---|---|---|
| 10 | 0.014 | 0.140 | 1.014 | 1.014 | 0.022 | 0.022 | 0.022 | 0.000 | 0.000 | 0.000 |
| 20 | 0.028 | 0.225 | 1.630 | 0.616 | 0.029 | 0.051 | 0.051 | 0.000 | 0.000 | 0.000 |
| 30 | 0.042 | 0.283 | 2.050 | 0.420 | 0.029 | 0.080 | 0.080 | 0.000 | 0.000 | 0.000 |
| 40 | 0.056 | 0.325 | 2.355 | 0.304 | 0.029 | 0.109 | 0.109 | 0.000 | 0.000 | 0.000 |
| 50 | 0.070 | 0.366 | 2.652 | 0.297 | 0.029 | 0.138 | 0.138 | 0.000 | 0.000 | 0.000 |
| 60 | 0.084 | 0.400 | 2.898 | 0.246 | 0.029 | 0.167 | 0.167 | 0.000 | 0.000 | 0.000 |
| 70 | 0.097 | 0.432 | 3.130 | 0.232 | 0.029 | 0.196 | 0.196 | 0.000 | 0.000 | 0.000 |
| 80 | 0.111 | 0.462 | 3.347 | 0.217 | 0.029 | 0.225 | 0.225 | 0.000 | 0.000 | 0.000 |
| 90 | 0.125 | 0.488 | 3.536 | 0.188 | 0.029 | 0.254 | 0.254 | 0.000 | 0.000 | 0.000 |
| 100 | 0.139 | 0.508 | 3.681 | 0.145 | 0.029 | 0.283 | 0.283 | 0.000 | 0.000 | 0.000 |
| 110 | 0.153 | 0.527 | 3.818 | 0.138 | 0.036 | 0.319 | 0.319 | 0.000 | 0.000 | 0.000 |
| 120 | 0.167 | 0.545 | 3.949 | 0.130 | 0.036 | 0.355 | 0.355 | 0.000 | 0.000 | 0.000 |
| 130 | 0.181 | 0.563 | 4.079 | 0.130 | 0.036 | 0.391 | 0.391 | 0.000 | 0.000 | 0.000 |
| 140 | 0.195 | 0.580 | 4.202 | 0.123 | 0.036 | 0.427 | 0.427 | 0.000 | 0.000 | 0.000 |
| 150 | 0.209 | 0.595 | 4.311 | 0.109 | 0.043 | 0.471 | 0.471 | 0.000 | 0.000 | 0.000 |
| 160 | 0.222 | 0.610 | 4.420 | 0.109 | 0.043 | 0.514 | 0.514 | 0.000 | 0.000 | 0.000 |
| 170 | 0.236 | 0.625 | 4.528 | 0.109 | 0.051 | 0.565 | 0.565 | 0.000 | 0.000 | 0.000 |
| 180 | 0.250 | 0.640 | 4.637 | 0.109 | 0.051 | 0.616 | 0.616 | 0.000 | 0.000 | 0.000 |
| 190 | 0.264 | 0.655 | 4.746 | 0.109 | 0.051 | 0.667 | 0.667 | 0.000 | 0.000 | 0.000 |
| 200 | 0.278 | 0.669 | 4.847 | 0.101 | 0.058 | 0.725 | 0.725 | 0.000 | 0.000 | 0.000 |
| 210 | 0.292 | 0.683 | 4.948 | 0.101 | 0.072 | 0.797 | 0.797 | 0.000 | 0.000 | 0.000 |
| 220 | 0.306 | 0.695 | 5.035 | 0.087 | 0.072 | 0.869 | 0.869 | 0.000 | 0.000 | 0.000 |
| 230 | 0.320 | 0.707 | 5.122 | 0.087 | 0.080 | 0.949 | 0.949 | 0.000 | 0.000 | 0.000 |
| 240 | 0.334 | 0.719 | 5.209 | 0.087 | 0.087 | 1.036 | 1.036 | 0.000 | 0.000 | 0.000 |
| 250 | 0.347 | 0.731 | 5.296 | 0.087 | 0.087 | 1.123 | 1.123 | 0.000 | 0.000 | 0.000 |
| 260 | 0.361 | 0.742 | 5.376 | 0.080 | 0.101 | 1.224 | 1.224 | 0.000 | 0.000 | 0.000 |
| 270 | 0.375 | 0.753 | 5.456 | 0.080 | 0.109 | 1.333 | 1.333 | 0.000 | 0.000 | 0.000 |
| 280 | 0.389 | 0.763 | 5.528 | 0.072 | 0.109 | 1.442 | 1.442 | 0.000 | 0.000 | 0.000 |
| 290 | 0.403 | 0.773 | 5.601 | 0.072 | 0.109 | 1.550 | 1.550 | 0.000 | 0.000 | 0.000 |
| 300 | 0.417 | 0.783 | 5.673 | 0.072 | 0.130 | 1.681 | 1.648 | 0.032 | 0.000 | 0.000 |
| 310 | 0.431 | 0.793 | 5.745 | 0.072 | 0.138 | 1.819 | 1.648 | 0.167 | 0.003 | 0.003 |
| 320 | 0.445 | 0.803 | 5.818 | 0.072 | 0.188 | 2.007 | 1.648 | 0.344 | 0.015 | 0.012 |
| 330 | 0.459 | 0.811 | 5.876 | 0.058 | 0.232 | 2.239 | 1.648 | 0.551 | 0.039 | 0.025 |
| 340 | 0.472 | 0.819 | 5.934 | 0.058 | 0.297 | 2.536 | 1.648 | 0.801 | 0.086 | 0.047 |
| 350 | 0.486 | 0.826 | 5.985 | 0.051 | 0.420 | 2.956 | 1.648 | 1.129 | 0.179 | 0.093 |
| 360 | 0.500 | 0.833 | 6.035 | 0.051 | 1.014 | 3.970 | 1.648 | 1.812 | 0.510 | 0.331 |

**Table A 27** (continued)

| duration (min) | duration / total duration | depth / total depth | cumulative depth (cm) | incremental depth (cm) | ordered depth (cm) | cumulative ordered depth (cm) | cum. initial abstriction, Ia (cm) | cumulative abstriction, Fa (cm) | cumulative excess depth, Pe (cm) | excess depth (cm) |
|---|---|---|---|---|---|---|---|---|---|---|
| 370 | 0.514 | 0.840 | 6.086 | 0.051 | 0.616 | 4.586 | 1.648 | 2.166 | 0.772 | 0.262 |
| 380 | 0.528 | 0.847 | 6.137 | 0.051 | 0.304 | 4.891 | 1.648 | 2.327 | 0.915 | 0.143 |
| 390 | 0.542 | 0.854 | 6.187 | 0.051 | 0.246 | 5.137 | 1.648 | 2.451 | 1.037 | 0.122 |
| 400 | 0.556 | 0.860 | 6.231 | 0.043 | 0.217 | 5.354 | 1.648 | 2.556 | 1.149 | 0.112 |
| 410 | 0.569 | 0.866 | 6.274 | 0.043 | 0.145 | 5.499 | 1.648 | 2.625 | 1.226 | 0.077 |
| 420 | 0.583 | 0.872 | 6.318 | 0.043 | 0.130 | 5.630 | 1.648 | 2.684 | 1.297 | 0.070 |
| 430 | 0.597 | 0.878 | 6.361 | 0.043 | 0.123 | 5.753 | 1.648 | 2.740 | 1.364 | 0.068 |
| 440 | 0.611 | 0.883 | 6.398 | 0.036 | 0.109 | 5.861 | 1.648 | 2.788 | 1.425 | 0.061 |
| 450 | 0.625 | 0.888 | 6.434 | 0.036 | 0.109 | 5.970 | 1.648 | 2.835 | 1.486 | 0.061 |
| 460 | 0.639 | 0.893 | 6.470 | 0.036 | 0.101 | 6.072 | 1.648 | 2.878 | 1.545 | 0.058 |
| 470 | 0.653 | 0.898 | 6.506 | 0.036 | 0.087 | 6.158 | 1.648 | 2.915 | 1.595 | 0.050 |
| 480 | 0.667 | 0.903 | 6.542 | 0.036 | 0.087 | 6.245 | 1.648 | 2.951 | 1.646 | 0.051 |
| 490 | 0.681 | 0.908 | 6.579 | 0.036 | 0.080 | 6.325 | 1.648 | 2.984 | 1.693 | 0.047 |
| 500 | 0.694 | 0.913 | 6.615 | 0.036 | 0.072 | 6.398 | 1.648 | 3.013 | 1.736 | 0.043 |
| 510 | 0.708 | 0.918 | 6.651 | 0.036 | 0.072 | 6.470 | 1.648 | 3.042 | 1.779 | 0.043 |
| 520 | 0.722 | 0.923 | 6.687 | 0.036 | 0.072 | 6.542 | 1.648 | 3.071 | 1.823 | 0.044 |
| 530 | 0.736 | 0.927 | 6.716 | 0.029 | 0.058 | 6.600 | 1.648 | 3.093 | 1.858 | 0.035 |
| 540 | 0.750 | 0.931 | 6.745 | 0.029 | 0.051 | 6.651 | 1.648 | 3.113 | 1.889 | 0.031 |
| 550 | 0.764 | 0.935 | 6.774 | 0.029 | 0.051 | 6.702 | 1.648 | 3.133 | 1.921 | 0.031 |
| 560 | 0.778 | 0.939 | 6.803 | 0.029 | 0.043 | 6.745 | 1.648 | 3.149 | 1.947 | 0.027 |
| 570 | 0.792 | 0.943 | 6.832 | 0.029 | 0.043 | 6.789 | 1.648 | 3.166 | 1.974 | 0.027 |
| 580 | 0.806 | 0.947 | 6.861 | 0.029 | 0.036 | 6.825 | 1.648 | 3.180 | 1.997 | 0.023 |
| 590 | 0.819 | 0.951 | 6.890 | 0.029 | 0.036 | 6.861 | 1.648 | 3.193 | 2.020 | 0.023 |
| 600 | 0.833 | 0.955 | 6.919 | 0.029 | 0.036 | 6.897 | 1.648 | 3.207 | 2.042 | 0.023 |
| 610 | 0.847 | 0.959 | 6.948 | 0.029 | 0.036 | 6.934 | 1.648 | 3.220 | 2.065 | 0.023 |
| 620 | 0.861 | 0.963 | 6.977 | 0.029 | 0.036 | 6.970 | 1.648 | 3.234 | 2.088 | 0.023 |
| 630 | 0.875 | 0.967 | 7.006 | 0.029 | 0.029 | 6.999 | 1.648 | 3.244 | 2.106 | 0.018 |
| 640 | 0.889 | 0.971 | 7.035 | 0.029 | 0.029 | 7.028 | 1.648 | 3.255 | 2.124 | 0.018 |
| 650 | 0.903 | 0.975 | 7.064 | 0.029 | 0.029 | 7.057 | 1.648 | 3.266 | 2.143 | 0.018 |
| 660 | 0.917 | 0.979 | 7.093 | 0.029 | 0.029 | 7.086 | 1.648 | 3.276 | 2.161 | 0.018 |
| 670 | 0.931 | 0.983 | 7.122 | 0.029 | 0.029 | 7.115 | 1.648 | 3.287 | 2.180 | 0.018 |
| 680 | 0.944 | 0.987 | 7.151 | 0.029 | 0.029 | 7.144 | 1.648 | 3.297 | 2.198 | 0.019 |
| 690 | 0.958 | 0.991 | 7.180 | 0.029 | 0.029 | 7.173 | 1.648 | 3.308 | 2.217 | 0.019 |
| 700 | 0.972 | 0.994 | 7.202 | 0.022 | 0.029 | 7.202 | 1.648 | 3.318 | 2.235 | 0.019 |
| 710 | 0.986 | 0.997 | 7.224 | 0.022 | 0.022 | 7.224 | 1.648 | 3.326 | 2.249 | 0.014 |
| 720 | 1.000 | 1.000 | 7.245 | 0.022 | 0.022 | 7.245 | 1.648 | 3.333 | 2.263 | 0.014 |

**Table A 28** Design Hyetograph of Lake Eymir Basin (Tr = 50 yr)

| duration (min) | duration / total duration | depth / total depth | cumulative depth (cm) | incremental depth (cm) | ordered depth (cm) | cumulative ordered depth (cm) | cum. initial abstriction, Ia (cm) | cumulative abstriction, Fa (cm) | cumulative excess depth, Pe (cm) | excess depth (cm) |
|---|---|---|---|---|---|---|---|---|---|---|
| 10 | 0.014 | 0.140 | 0.727 | 0.727 | 0.016 | 0.016 | 0.016 | 0.000 | 0.000 | 0.000 |
| 20 | 0.028 | 0.225 | 1.168 | 0.441 | 0.021 | 0.036 | 0.036 | 0.000 | 0.000 | 0.000 |
| 30 | 0.042 | 0.283 | 1.469 | 0.301 | 0.021 | 0.057 | 0.057 | 0.000 | 0.000 | 0.000 |
| 40 | 0.056 | 0.325 | 1.687 | 0.218 | 0.021 | 0.078 | 0.078 | 0.000 | 0.000 | 0.000 |
| 50 | 0.070 | 0.366 | 1.900 | 0.213 | 0.021 | 0.099 | 0.099 | 0.000 | 0.000 | 0.000 |
| 60 | 0.084 | 0.400 | 2.076 | 0.176 | 0.021 | 0.119 | 0.119 | 0.000 | 0.000 | 0.000 |
| 70 | 0.097 | 0.432 | 2.242 | 0.166 | 0.021 | 0.140 | 0.140 | 0.000 | 0.000 | 0.000 |
| 80 | 0.111 | 0.462 | 2.398 | 0.156 | 0.021 | 0.161 | 0.161 | 0.000 | 0.000 | 0.000 |
| 90 | 0.125 | 0.488 | 2.533 | 0.135 | 0.021 | 0.182 | 0.182 | 0.000 | 0.000 | 0.000 |
| 100 | 0.139 | 0.508 | 2.637 | 0.104 | 0.021 | 0.202 | 0.202 | 0.000 | 0.000 | 0.000 |
| 110 | 0.153 | 0.527 | 2.735 | 0.099 | 0.026 | 0.228 | 0.228 | 0.000 | 0.000 | 0.000 |
| 120 | 0.167 | 0.545 | 2.829 | 0.093 | 0.026 | 0.254 | 0.254 | 0.000 | 0.000 | 0.000 |
| 130 | 0.181 | 0.563 | 2.922 | 0.093 | 0.026 | 0.280 | 0.280 | 0.000 | 0.000 | 0.000 |
| 140 | 0.195 | 0.580 | 3.010 | 0.088 | 0.026 | 0.306 | 0.306 | 0.000 | 0.000 | 0.000 |
| 150 | 0.209 | 0.595 | 3.088 | 0.078 | 0.031 | 0.337 | 0.337 | 0.000 | 0.000 | 0.000 |
| 160 | 0.222 | 0.610 | 3.166 | 0.078 | 0.031 | 0.368 | 0.368 | 0.000 | 0.000 | 0.000 |
| 170 | 0.236 | 0.625 | 3.244 | 0.078 | 0.036 | 0.405 | 0.405 | 0.000 | 0.000 | 0.000 |
| 180 | 0.250 | 0.640 | 3.322 | 0.078 | 0.036 | 0.441 | 0.441 | 0.000 | 0.000 | 0.000 |
| 190 | 0.264 | 0.655 | 3.399 | 0.078 | 0.036 | 0.477 | 0.477 | 0.000 | 0.000 | 0.000 |
| 200 | 0.278 | 0.669 | 3.472 | 0.073 | 0.042 | 0.519 | 0.519 | 0.000 | 0.000 | 0.000 |
| 210 | 0.292 | 0.683 | 3.545 | 0.073 | 0.052 | 0.571 | 0.571 | 0.000 | 0.000 | 0.000 |
| 220 | 0.306 | 0.695 | 3.607 | 0.062 | 0.052 | 0.623 | 0.623 | 0.000 | 0.000 | 0.000 |
| 230 | 0.320 | 0.707 | 3.669 | 0.062 | 0.057 | 0.680 | 0.680 | 0.000 | 0.000 | 0.000 |
| 240 | 0.334 | 0.719 | 3.732 | 0.062 | 0.062 | 0.742 | 0.742 | 0.000 | 0.000 | 0.000 |
| 250 | 0.347 | 0.731 | 3.794 | 0.062 | 0.062 | 0.804 | 0.804 | 0.000 | 0.000 | 0.000 |
| 260 | 0.361 | 0.742 | 3.851 | 0.057 | 0.073 | 0.877 | 0.877 | 0.000 | 0.000 | 0.000 |
| 270 | 0.375 | 0.753 | 3.908 | 0.057 | 0.078 | 0.955 | 0.955 | 0.000 | 0.000 | 0.000 |
| 280 | 0.389 | 0.763 | 3.960 | 0.052 | 0.078 | 1.033 | 1.033 | 0.000 | 0.000 | 0.000 |
| 290 | 0.403 | 0.773 | 4.012 | 0.052 | 0.078 | 1.111 | 1.111 | 0.000 | 0.000 | 0.000 |
| 300 | 0.417 | 0.783 | 4.064 | 0.052 | 0.093 | 1.204 | 1.204 | 0.000 | 0.000 | 0.000 |
| 310 | 0.431 | 0.793 | 4.116 | 0.052 | 0.099 | 1.303 | 1.303 | 0.000 | 0.000 | 0.000 |
| 320 | 0.445 | 0.803 | 4.168 | 0.052 | 0.135 | 1.438 | 1.422 | 0.016 | 0.000 | 0.000 |
| 330 | 0.459 | 0.811 | 4.209 | 0.042 | 0.166 | 1.604 | 1.422 | 0.177 | 0.005 | 0.004 |
| 340 | 0.472 | 0.819 | 4.251 | 0.042 | 0.213 | 1.817 | 1.422 | 0.374 | 0.021 | 0.016 |
| 350 | 0.486 | 0.826 | 4.287 | 0.036 | 0.301 | 2.118 | 1.422 | 0.634 | 0.062 | 0.041 |
| 360 | 0.500 | 0.833 | 4.323 | 0.036 | 0.727 | 2.844 | 1.422 | 1.185 | 0.237 | 0.175 |

**Table A 28** (continued)

| duration (min) | duration / total duration | depth / total depth | cumulative depth (cm) | incremental depth (cm) | ordered depth (cm) | cumulative ordered depth (cm) | cum. initial abstriction, Ia (cm) | cumulative abstriction, Fa (cm) | cumulative excess depth, Pe (cm) | excess depth (cm) |
|---|---|---|---|---|---|---|---|---|---|---|
| 370 | 0.514 | 0.840 | 4.360 | 0.036 | 0.441 | 3.285 | 1.422 | 1.476 | 0.387 | 0.150 |
| 380 | 0.528 | 0.847 | 4.396 | 0.036 | 0.218 | 3.503 | 1.422 | 1.610 | 0.471 | 0.084 |
| 390 | 0.542 | 0.854 | 4.432 | 0.036 | 0.176 | 3.680 | 1.422 | 1.714 | 0.544 | 0.073 |
| 400 | 0.556 | 0.860 | 4.463 | 0.031 | 0.156 | 3.835 | 1.422 | 1.802 | 0.612 | 0.067 |
| 410 | 0.569 | 0.866 | 4.495 | 0.031 | 0.104 | 3.939 | 1.422 | 1.859 | 0.658 | 0.047 |
| 420 | 0.583 | 0.872 | 4.526 | 0.031 | 0.093 | 4.033 | 1.422 | 1.910 | 0.701 | 0.043 |
| 430 | 0.597 | 0.878 | 4.557 | 0.031 | 0.088 | 4.121 | 1.422 | 1.956 | 0.743 | 0.041 |
| 440 | 0.611 | 0.883 | 4.583 | 0.026 | 0.078 | 4.199 | 1.422 | 1.997 | 0.780 | 0.037 |
| 450 | 0.625 | 0.888 | 4.609 | 0.026 | 0.078 | 4.277 | 1.422 | 2.037 | 0.818 | 0.038 |
| 460 | 0.639 | 0.893 | 4.635 | 0.026 | 0.073 | 4.349 | 1.422 | 2.074 | 0.854 | 0.036 |
| 470 | 0.653 | 0.898 | 4.661 | 0.026 | 0.062 | 4.412 | 1.422 | 2.105 | 0.885 | 0.031 |
| 480 | 0.667 | 0.903 | 4.687 | 0.026 | 0.062 | 4.474 | 1.422 | 2.135 | 0.917 | 0.032 |
| 490 | 0.681 | 0.908 | 4.713 | 0.026 | 0.057 | 4.531 | 1.422 | 2.163 | 0.946 | 0.029 |
| 500 | 0.694 | 0.913 | 4.738 | 0.026 | 0.052 | 4.583 | 1.422 | 2.188 | 0.973 | 0.027 |
| 510 | 0.708 | 0.918 | 4.764 | 0.026 | 0.052 | 4.635 | 1.422 | 2.213 | 1.000 | 0.027 |
| 520 | 0.722 | 0.923 | 4.790 | 0.026 | 0.052 | 4.687 | 1.422 | 2.237 | 1.027 | 0.027 |
| 530 | 0.736 | 0.927 | 4.811 | 0.021 | 0.042 | 4.728 | 1.422 | 2.257 | 1.049 | 0.022 |
| 540 | 0.750 | 0.931 | 4.832 | 0.021 | 0.036 | 4.764 | 1.422 | 2.274 | 1.069 | 0.019 |
| 550 | 0.764 | 0.935 | 4.853 | 0.021 | 0.036 | 4.801 | 1.422 | 2.290 | 1.088 | 0.020 |
| 560 | 0.778 | 0.939 | 4.873 | 0.021 | 0.031 | 4.832 | 1.422 | 2.305 | 1.105 | 0.017 |
| 570 | 0.792 | 0.943 | 4.894 | 0.021 | 0.031 | 4.863 | 1.422 | 2.319 | 1.122 | 0.017 |
| 580 | 0.806 | 0.947 | 4.915 | 0.021 | 0.026 | 4.889 | 1.422 | 2.331 | 1.136 | 0.014 |
| 590 | 0.819 | 0.951 | 4.936 | 0.021 | 0.026 | 4.915 | 1.422 | 2.342 | 1.151 | 0.014 |
| 600 | 0.833 | 0.955 | 4.956 | 0.021 | 0.026 | 4.941 | 1.422 | 2.354 | 1.165 | 0.014 |
| 610 | 0.847 | 0.959 | 4.977 | 0.021 | 0.026 | 4.967 | 1.422 | 2.365 | 1.179 | 0.014 |
| 620 | 0.861 | 0.963 | 4.998 | 0.021 | 0.026 | 4.993 | 1.422 | 2.377 | 1.194 | 0.014 |
| 630 | 0.875 | 0.967 | 5.019 | 0.021 | 0.021 | 5.014 | 1.422 | 2.386 | 1.205 | 0.012 |
| 640 | 0.889 | 0.971 | 5.039 | 0.021 | 0.021 | 5.034 | 1.422 | 2.395 | 1.217 | 0.012 |
| 650 | 0.903 | 0.975 | 5.060 | 0.021 | 0.021 | 5.055 | 1.422 | 2.404 | 1.229 | 0.012 |
| 660 | 0.917 | 0.979 | 5.081 | 0.021 | 0.021 | 5.076 | 1.422 | 2.414 | 1.240 | 0.012 |
| 670 | 0.931 | 0.983 | 5.102 | 0.021 | 0.021 | 5.097 | 1.422 | 2.423 | 1.252 | 0.012 |
| 680 | 0.944 | 0.987 | 5.123 | 0.021 | 0.021 | 5.117 | 1.422 | 2.432 | 1.264 | 0.012 |
| 690 | 0.958 | 0.991 | 5.143 | 0.021 | 0.021 | 5.138 | 1.422 | 2.441 | 1.276 | 0.012 |
| 700 | 0.972 | 0.994 | 5.159 | 0.016 | 0.021 | 5.159 | 1.422 | 2.449 | 1.287 | 0.012 |
| 710 | 0.986 | 0.997 | 5.174 | 0.016 | 0.016 | 5.174 | 1.422 | 2.456 | 1.296 | 0.009 |
| 720 | 1.000 | 1.000 | 5.190 | 0.016 | 0.016 | 5.190 | 1.422 | 2.463 | 1.305 | 0.009 |

**Table A 29** Design Hyetograph of Lake Eymir Basin (Tr = 100 yr)

| duration (min) | duration / total duration | depth / total depth | cumulative depth (cm) | incremental depth (cm) | ordered depth (cm) | cumulative ordered depth (cm) | cum. initial abstriction, Ia (cm) | cumulative abstriction, Fa (cm) | cumulative excess depth, Pe (cm) | excess depth (cm) |
|---|---|---|---|---|---|---|---|---|---|---|
| 10 | 0.014 | 0.140 | 0.814 | 0.814 | 0.017 | 0.017 | 0.017 | 0.000 | 0.000 | 0.000 |
| 20 | 0.028 | 0.225 | 1.308 | 0.494 | 0.023 | 0.041 | 0.041 | 0.000 | 0.000 | 0.000 |
| 30 | 0.042 | 0.283 | 1.645 | 0.337 | 0.023 | 0.064 | 0.064 | 0.000 | 0.000 | 0.000 |
| 40 | 0.056 | 0.325 | 1.889 | 0.244 | 0.023 | 0.087 | 0.087 | 0.000 | 0.000 | 0.000 |
| 50 | 0.070 | 0.366 | 2.127 | 0.238 | 0.023 | 0.110 | 0.110 | 0.000 | 0.000 | 0.000 |
| 60 | 0.084 | 0.400 | 2.325 | 0.198 | 0.023 | 0.134 | 0.134 | 0.000 | 0.000 | 0.000 |
| 70 | 0.097 | 0.432 | 2.511 | 0.186 | 0.023 | 0.157 | 0.157 | 0.000 | 0.000 | 0.000 |
| 80 | 0.111 | 0.462 | 2.686 | 0.174 | 0.023 | 0.180 | 0.180 | 0.000 | 0.000 | 0.000 |
| 90 | 0.125 | 0.488 | 2.837 | 0.151 | 0.023 | 0.203 | 0.203 | 0.000 | 0.000 | 0.000 |
| 100 | 0.139 | 0.508 | 2.953 | 0.116 | 0.023 | 0.227 | 0.227 | 0.000 | 0.000 | 0.000 |
| 110 | 0.153 | 0.527 | 3.063 | 0.110 | 0.029 | 0.256 | 0.256 | 0.000 | 0.000 | 0.000 |
| 120 | 0.167 | 0.545 | 3.168 | 0.105 | 0.029 | 0.285 | 0.285 | 0.000 | 0.000 | 0.000 |
| 130 | 0.181 | 0.563 | 3.273 | 0.105 | 0.029 | 0.314 | 0.314 | 0.000 | 0.000 | 0.000 |
| 140 | 0.195 | 0.580 | 3.371 | 0.099 | 0.029 | 0.343 | 0.343 | 0.000 | 0.000 | 0.000 |
| 150 | 0.209 | 0.595 | 3.459 | 0.087 | 0.035 | 0.378 | 0.378 | 0.000 | 0.000 | 0.000 |
| 160 | 0.222 | 0.610 | 3.546 | 0.087 | 0.035 | 0.413 | 0.413 | 0.000 | 0.000 | 0.000 |
| 170 | 0.236 | 0.625 | 3.633 | 0.087 | 0.041 | 0.453 | 0.453 | 0.000 | 0.000 | 0.000 |
| 180 | 0.250 | 0.640 | 3.720 | 0.087 | 0.041 | 0.494 | 0.494 | 0.000 | 0.000 | 0.000 |
| 190 | 0.264 | 0.655 | 3.807 | 0.087 | 0.041 | 0.535 | 0.535 | 0.000 | 0.000 | 0.000 |
| 200 | 0.278 | 0.669 | 3.889 | 0.081 | 0.047 | 0.581 | 0.581 | 0.000 | 0.000 | 0.000 |
| 210 | 0.292 | 0.683 | 3.970 | 0.081 | 0.058 | 0.639 | 0.639 | 0.000 | 0.000 | 0.000 |
| 220 | 0.306 | 0.695 | 4.040 | 0.070 | 0.058 | 0.698 | 0.698 | 0.000 | 0.000 | 0.000 |
| 230 | 0.320 | 0.707 | 4.110 | 0.070 | 0.064 | 0.761 | 0.761 | 0.000 | 0.000 | 0.000 |
| 240 | 0.334 | 0.719 | 4.179 | 0.070 | 0.070 | 0.831 | 0.831 | 0.000 | 0.000 | 0.000 |
| 250 | 0.347 | 0.731 | 4.249 | 0.070 | 0.070 | 0.901 | 0.901 | 0.000 | 0.000 | 0.000 |
| 260 | 0.361 | 0.742 | 4.313 | 0.064 | 0.081 | 0.982 | 0.982 | 0.000 | 0.000 | 0.000 |
| 270 | 0.375 | 0.753 | 4.377 | 0.064 | 0.087 | 1.070 | 1.070 | 0.000 | 0.000 | 0.000 |
| 280 | 0.389 | 0.763 | 4.435 | 0.058 | 0.087 | 1.157 | 1.157 | 0.000 | 0.000 | 0.000 |
| 290 | 0.403 | 0.773 | 4.493 | 0.058 | 0.087 | 1.244 | 1.244 | 0.000 | 0.000 | 0.000 |
| 300 | 0.417 | 0.783 | 4.551 | 0.058 | 0.105 | 1.349 | 1.349 | 0.000 | 0.000 | 0.000 |
| 310 | 0.431 | 0.793 | 4.610 | 0.058 | 0.110 | 1.459 | 1.422 | 0.037 | 0.000 | 0.000 |
| 320 | 0.445 | 0.803 | 4.668 | 0.058 | 0.151 | 1.610 | 1.422 | 0.183 | 0.005 | 0.005 |
| 330 | 0.459 | 0.811 | 4.714 | 0.047 | 0.186 | 1.796 | 1.422 | 0.355 | 0.019 | 0.014 |
| 340 | 0.472 | 0.819 | 4.761 | 0.047 | 0.238 | 2.034 | 1.422 | 0.564 | 0.049 | 0.030 |
| 350 | 0.486 | 0.826 | 4.801 | 0.041 | 0.337 | 2.372 | 1.422 | 0.838 | 0.112 | 0.063 |
| 360 | 0.500 | 0.833 | 4.842 | 0.041 | 0.814 | 3.185 | 1.422 | 1.413 | 0.350 | 0.239 |

**Table A 29** (continued)

| duration (min) | duration / total duration | depth / total depth | cumulative depth (cm) | incremental depth (cm) | ordered depth (cm) | cumulative ordered depth (cm) | cum. initial abstriction, Ia (cm) | cumulative abstriction, Fa (cm) | cumulative excess depth, Pe (cm) | excess depth (cm) |
|---|---|---|---|---|---|---|---|---|---|---|
| 370 | 0.514 | 0.840 | 4.883 | 0.041 | 0.494 | 3.680 | 1.422 | 1.713 | 0.544 | 0.194 |
| 380 | 0.528 | 0.847 | 4.923 | 0.041 | 0.244 | 3.924 | 1.422 | 1.851 | 0.651 | 0.107 |
| 390 | 0.542 | 0.854 | 4.964 | 0.041 | 0.198 | 4.121 | 1.422 | 1.956 | 0.743 | 0.092 |
| 400 | 0.556 | 0.860 | 4.999 | 0.035 | 0.174 | 4.296 | 1.422 | 2.047 | 0.827 | 0.084 |
| 410 | 0.569 | 0.866 | 5.034 | 0.035 | 0.116 | 4.412 | 1.422 | 2.105 | 0.885 | 0.058 |
| 420 | 0.583 | 0.872 | 5.069 | 0.035 | 0.105 | 4.517 | 1.422 | 2.156 | 0.938 | 0.053 |
| 430 | 0.597 | 0.878 | 5.104 | 0.035 | 0.099 | 4.615 | 1.422 | 2.204 | 0.990 | 0.051 |
| 440 | 0.611 | 0.883 | 5.133 | 0.029 | 0.087 | 4.703 | 1.422 | 2.245 | 1.036 | 0.046 |
| 450 | 0.625 | 0.888 | 5.162 | 0.029 | 0.087 | 4.790 | 1.422 | 2.285 | 1.082 | 0.047 |
| 460 | 0.639 | 0.893 | 5.191 | 0.029 | 0.081 | 4.871 | 1.422 | 2.322 | 1.127 | 0.044 |
| 470 | 0.653 | 0.898 | 5.220 | 0.029 | 0.070 | 4.941 | 1.422 | 2.354 | 1.165 | 0.038 |
| 480 | 0.667 | 0.903 | 5.249 | 0.029 | 0.070 | 5.011 | 1.422 | 2.385 | 1.204 | 0.039 |
| 490 | 0.681 | 0.908 | 5.278 | 0.029 | 0.064 | 5.075 | 1.422 | 2.413 | 1.240 | 0.036 |
| 500 | 0.694 | 0.913 | 5.307 | 0.029 | 0.058 | 5.133 | 1.422 | 2.438 | 1.273 | 0.033 |
| 510 | 0.708 | 0.918 | 5.336 | 0.029 | 0.058 | 5.191 | 1.422 | 2.463 | 1.306 | 0.033 |
| 520 | 0.722 | 0.923 | 5.365 | 0.029 | 0.058 | 5.249 | 1.422 | 2.488 | 1.339 | 0.033 |
| 530 | 0.736 | 0.927 | 5.388 | 0.023 | 0.047 | 5.295 | 1.422 | 2.507 | 1.366 | 0.027 |
| 540 | 0.750 | 0.931 | 5.412 | 0.023 | 0.041 | 5.336 | 1.422 | 2.524 | 1.390 | 0.024 |
| 550 | 0.764 | 0.935 | 5.435 | 0.023 | 0.041 | 5.377 | 1.422 | 2.541 | 1.414 | 0.024 |
| 560 | 0.778 | 0.939 | 5.458 | 0.023 | 0.035 | 5.412 | 1.422 | 2.556 | 1.434 | 0.021 |
| 570 | 0.792 | 0.943 | 5.481 | 0.023 | 0.035 | 5.447 | 1.422 | 2.570 | 1.455 | 0.021 |
| 580 | 0.806 | 0.947 | 5.505 | 0.023 | 0.029 | 5.476 | 1.422 | 2.582 | 1.472 | 0.017 |
| 590 | 0.819 | 0.951 | 5.528 | 0.023 | 0.029 | 5.505 | 1.422 | 2.593 | 1.489 | 0.017 |
| 600 | 0.833 | 0.955 | 5.551 | 0.023 | 0.029 | 5.534 | 1.422 | 2.605 | 1.507 | 0.017 |
| 610 | 0.847 | 0.959 | 5.574 | 0.023 | 0.029 | 5.563 | 1.422 | 2.617 | 1.524 | 0.017 |
| 620 | 0.861 | 0.963 | 5.598 | 0.023 | 0.029 | 5.592 | 1.422 | 2.628 | 1.542 | 0.017 |
| 630 | 0.875 | 0.967 | 5.621 | 0.023 | 0.023 | 5.615 | 1.422 | 2.638 | 1.556 | 0.014 |
| 640 | 0.889 | 0.971 | 5.644 | 0.023 | 0.023 | 5.638 | 1.422 | 2.647 | 1.570 | 0.014 |
| 650 | 0.903 | 0.975 | 5.667 | 0.023 | 0.023 | 5.662 | 1.422 | 2.656 | 1.584 | 0.014 |
| 660 | 0.917 | 0.979 | 5.691 | 0.023 | 0.023 | 5.685 | 1.422 | 2.665 | 1.598 | 0.014 |
| 670 | 0.931 | 0.983 | 5.714 | 0.023 | 0.023 | 5.708 | 1.422 | 2.674 | 1.612 | 0.014 |
| 680 | 0.944 | 0.987 | 5.737 | 0.023 | 0.023 | 5.731 | 1.422 | 2.683 | 1.626 | 0.014 |
| 690 | 0.958 | 0.991 | 5.760 | 0.023 | 0.023 | 5.755 | 1.422 | 2.692 | 1.641 | 0.014 |
| 700 | 0.972 | 0.994 | 5.778 | 0.017 | 0.023 | 5.778 | 1.422 | 2.701 | 1.655 | 0.014 |
| 710 | 0.986 | 0.997 | 5.795 | 0.017 | 0.017 | 5.795 | 1.422 | 2.708 | 1.666 | 0.011 |
| 720 | 1.000 | 1.000 | 5.813 | 0.017 | 0.017 | 5.813 | 1.422 | 2.714 | 1.676 | 0.011 |

**Table A 30** Design Hyetograph of Lake Eymir Basin (Tr = 500 yr)

| duration (min) | duration / total duration | depth / total depth | cumulative depth (cm) | incremental depth (cm) | ordered depth (cm) | cumulative ordered depth (cm) | cum. initial abstriction, Ia (cm) | cumulative abstriction, Fa (cm) | cumulative excess depth, Pe (cm) | excess depth (cm) |
|---|---|---|---|---|---|---|---|---|---|---|
| 10 | 0.014 | 0.140 | 1.014 | 1.014 | 0.022 | 0.022 | 0.022 | 0.000 | 0.000 | 0.000 |
| 20 | 0.028 | 0.225 | 1.630 | 0.616 | 0.029 | 0.051 | 0.051 | 0.000 | 0.000 | 0.000 |
| 30 | 0.042 | 0.283 | 2.050 | 0.420 | 0.029 | 0.080 | 0.080 | 0.000 | 0.000 | 0.000 |
| 40 | 0.056 | 0.325 | 2.355 | 0.304 | 0.029 | 0.109 | 0.109 | 0.000 | 0.000 | 0.000 |
| 50 | 0.070 | 0.366 | 2.652 | 0.297 | 0.029 | 0.138 | 0.138 | 0.000 | 0.000 | 0.000 |
| 60 | 0.084 | 0.400 | 2.898 | 0.246 | 0.029 | 0.167 | 0.167 | 0.000 | 0.000 | 0.000 |
| 70 | 0.097 | 0.432 | 3.130 | 0.232 | 0.029 | 0.196 | 0.196 | 0.000 | 0.000 | 0.000 |
| 80 | 0.111 | 0.462 | 3.347 | 0.217 | 0.029 | 0.225 | 0.225 | 0.000 | 0.000 | 0.000 |
| 90 | 0.125 | 0.488 | 3.536 | 0.188 | 0.029 | 0.254 | 0.254 | 0.000 | 0.000 | 0.000 |
| 100 | 0.139 | 0.508 | 3.681 | 0.145 | 0.029 | 0.283 | 0.283 | 0.000 | 0.000 | 0.000 |
| 110 | 0.153 | 0.527 | 3.818 | 0.138 | 0.036 | 0.319 | 0.319 | 0.000 | 0.000 | 0.000 |
| 120 | 0.167 | 0.545 | 3.949 | 0.130 | 0.036 | 0.355 | 0.355 | 0.000 | 0.000 | 0.000 |
| 130 | 0.181 | 0.563 | 4.079 | 0.130 | 0.036 | 0.391 | 0.391 | 0.000 | 0.000 | 0.000 |
| 140 | 0.195 | 0.580 | 4.202 | 0.123 | 0.036 | 0.427 | 0.427 | 0.000 | 0.000 | 0.000 |
| 150 | 0.209 | 0.595 | 4.311 | 0.109 | 0.043 | 0.471 | 0.471 | 0.000 | 0.000 | 0.000 |
| 160 | 0.222 | 0.610 | 4.420 | 0.109 | 0.043 | 0.514 | 0.514 | 0.000 | 0.000 | 0.000 |
| 170 | 0.236 | 0.625 | 4.528 | 0.109 | 0.051 | 0.565 | 0.565 | 0.000 | 0.000 | 0.000 |
| 180 | 0.250 | 0.640 | 4.637 | 0.109 | 0.051 | 0.616 | 0.616 | 0.000 | 0.000 | 0.000 |
| 190 | 0.264 | 0.655 | 4.746 | 0.109 | 0.051 | 0.667 | 0.667 | 0.000 | 0.000 | 0.000 |
| 200 | 0.278 | 0.669 | 4.847 | 0.101 | 0.058 | 0.725 | 0.725 | 0.000 | 0.000 | 0.000 |
| 210 | 0.292 | 0.683 | 4.948 | 0.101 | 0.072 | 0.797 | 0.797 | 0.000 | 0.000 | 0.000 |
| 220 | 0.306 | 0.695 | 5.035 | 0.087 | 0.072 | 0.869 | 0.869 | 0.000 | 0.000 | 0.000 |
| 230 | 0.320 | 0.707 | 5.122 | 0.087 | 0.080 | 0.949 | 0.949 | 0.000 | 0.000 | 0.000 |
| 240 | 0.334 | 0.719 | 5.209 | 0.087 | 0.087 | 1.036 | 1.036 | 0.000 | 0.000 | 0.000 |
| 250 | 0.347 | 0.731 | 5.296 | 0.087 | 0.087 | 1.123 | 1.123 | 0.000 | 0.000 | 0.000 |
| 260 | 0.361 | 0.742 | 5.376 | 0.080 | 0.101 | 1.224 | 1.224 | 0.000 | 0.000 | 0.000 |
| 270 | 0.375 | 0.753 | 5.456 | 0.080 | 0.109 | 1.333 | 1.333 | 0.000 | 0.000 | 0.000 |
| 280 | 0.389 | 0.763 | 5.528 | 0.072 | 0.109 | 1.442 | 1.422 | 0.020 | 0.000 | 0.000 |
| 290 | 0.403 | 0.773 | 5.601 | 0.072 | 0.109 | 1.550 | 1.422 | 0.126 | 0.002 | 0.002 |
| 300 | 0.417 | 0.783 | 5.673 | 0.072 | 0.130 | 1.681 | 1.422 | 0.250 | 0.009 | 0.007 |
| 310 | 0.431 | 0.793 | 5.745 | 0.072 | 0.138 | 1.819 | 1.422 | 0.376 | 0.021 | 0.012 |
| 320 | 0.445 | 0.803 | 5.818 | 0.072 | 0.188 | 2.007 | 1.422 | 0.540 | 0.044 | 0.024 |
| 330 | 0.459 | 0.811 | 5.876 | 0.058 | 0.232 | 2.239 | 1.422 | 0.733 | 0.084 | 0.040 |
| 340 | 0.472 | 0.819 | 5.934 | 0.058 | 0.297 | 2.536 | 1.422 | 0.963 | 0.151 | 0.067 |
| 350 | 0.486 | 0.826 | 5.985 | 0.051 | 0.420 | 2.956 | 1.422 | 1.262 | 0.272 | 0.121 |
| 360 | 0.500 | 0.833 | 6.035 | 0.051 | 1.014 | 3.970 | 1.422 | 1.876 | 0.672 | 0.400 |

**Table A 30** (continued)

| duration (min) | duration / total duration | depth / total depth | cumulative depth (cm) | incremental depth (cm) | ordered depth (cm) | cumulative ordered depth (cm) | cum. initial abstriction, Ia (cm) | cumulative abstriction, Fa (cm) | cumulative excess depth, Pe (cm) | excess depth (cm) |
|---|---|---|---|---|---|---|---|---|---|---|
| 370 | 0.514 | 0.840 | 6.086 | 0.051 | 0.616 | 4.586 | 1.422 | 2.190 | 0.975 | 0.302 |
| 380 | 0.528 | 0.847 | 6.137 | 0.051 | 0.304 | 4.891 | 1.422 | 2.331 | 1.137 | 0.163 |
| 390 | 0.542 | 0.854 | 6.187 | 0.051 | 0.246 | 5.137 | 1.422 | 2.440 | 1.275 | 0.138 |
| 400 | 0.556 | 0.860 | 6.231 | 0.043 | 0.217 | 5.354 | 1.422 | 2.532 | 1.400 | 0.125 |
| 410 | 0.569 | 0.866 | 6.274 | 0.043 | 0.145 | 5.499 | 1.422 | 2.591 | 1.486 | 0.086 |
| 420 | 0.583 | 0.872 | 6.318 | 0.043 | 0.130 | 5.630 | 1.422 | 2.643 | 1.564 | 0.078 |
| 430 | 0.597 | 0.878 | 6.361 | 0.043 | 0.123 | 5.753 | 1.422 | 2.691 | 1.639 | 0.075 |
| 440 | 0.611 | 0.883 | 6.398 | 0.036 | 0.109 | 5.861 | 1.422 | 2.733 | 1.706 | 0.067 |
| 450 | 0.625 | 0.888 | 6.434 | 0.036 | 0.109 | 5.970 | 1.422 | 2.774 | 1.774 | 0.068 |
| 460 | 0.639 | 0.893 | 6.470 | 0.036 | 0.101 | 6.072 | 1.422 | 2.811 | 1.838 | 0.064 |
| 470 | 0.653 | 0.898 | 6.506 | 0.036 | 0.087 | 6.158 | 1.422 | 2.843 | 1.894 | 0.055 |
| 480 | 0.667 | 0.903 | 6.542 | 0.036 | 0.087 | 6.245 | 1.422 | 2.874 | 1.950 | 0.056 |
| 490 | 0.681 | 0.908 | 6.579 | 0.036 | 0.080 | 6.325 | 1.422 | 2.902 | 2.001 | 0.052 |
| 500 | 0.694 | 0.913 | 6.615 | 0.036 | 0.072 | 6.398 | 1.422 | 2.927 | 2.048 | 0.047 |
| 510 | 0.708 | 0.918 | 6.651 | 0.036 | 0.072 | 6.470 | 1.422 | 2.952 | 2.096 | 0.048 |
| 520 | 0.722 | 0.923 | 6.687 | 0.036 | 0.072 | 6.542 | 1.422 | 2.977 | 2.144 | 0.048 |
| 530 | 0.736 | 0.927 | 6.716 | 0.029 | 0.058 | 6.600 | 1.422 | 2.996 | 2.182 | 0.038 |
| 540 | 0.750 | 0.931 | 6.745 | 0.029 | 0.051 | 6.651 | 1.422 | 3.013 | 2.216 | 0.034 |
| 550 | 0.764 | 0.935 | 6.774 | 0.029 | 0.051 | 6.702 | 1.422 | 3.030 | 2.250 | 0.034 |
| 560 | 0.778 | 0.939 | 6.803 | 0.029 | 0.043 | 6.745 | 1.422 | 3.044 | 2.279 | 0.029 |
| 570 | 0.792 | 0.943 | 6.832 | 0.029 | 0.043 | 6.789 | 1.422 | 3.058 | 2.308 | 0.029 |
| 580 | 0.806 | 0.947 | 6.861 | 0.029 | 0.036 | 6.825 | 1.422 | 3.070 | 2.333 | 0.024 |
| 590 | 0.819 | 0.951 | 6.890 | 0.029 | 0.036 | 6.861 | 1.422 | 3.082 | 2.358 | 0.025 |
| 600 | 0.833 | 0.955 | 6.919 | 0.029 | 0.036 | 6.897 | 1.422 | 3.093 | 2.382 | 0.025 |
| 610 | 0.847 | 0.959 | 6.948 | 0.029 | 0.036 | 6.934 | 1.422 | 3.105 | 2.407 | 0.025 |
| 620 | 0.861 | 0.963 | 6.977 | 0.029 | 0.036 | 6.970 | 1.422 | 3.116 | 2.432 | 0.025 |
| 630 | 0.875 | 0.967 | 7.006 | 0.029 | 0.029 | 6.999 | 1.422 | 3.125 | 2.452 | 0.020 |
| 640 | 0.889 | 0.971 | 7.035 | 0.029 | 0.029 | 7.028 | 1.422 | 3.134 | 2.471 | 0.020 |
| 650 | 0.903 | 0.975 | 7.064 | 0.029 | 0.029 | 7.057 | 1.422 | 3.144 | 2.491 | 0.020 |
| 660 | 0.917 | 0.979 | 7.093 | 0.029 | 0.029 | 7.086 | 1.422 | 3.153 | 2.511 | 0.020 |
| 670 | 0.931 | 0.983 | 7.122 | 0.029 | 0.029 | 7.115 | 1.422 | 3.161 | 2.531 | 0.020 |
| 680 | 0.944 | 0.987 | 7.151 | 0.029 | 0.029 | 7.144 | 1.422 | 3.170 | 2.551 | 0.020 |
| 690 | 0.958 | 0.991 | 7.180 | 0.029 | 0.029 | 7.173 | 1.422 | 3.179 | 2.572 | 0.020 |
| 700 | 0.972 | 0.994 | 7.202 | 0.022 | 0.029 | 7.202 | 1.422 | 3.188 | 2.592 | 0.020 |
| 710 | 0.986 | 0.997 | 7.224 | 0.022 | 0.022 | 7.224 | 1.422 | 3.195 | 2.607 | 0.015 |
| 720 | 1.000 | 1.000 | 7.245 | 0.022 | 0.022 | 7.245 | 1.422 | 3.201 | 2.622 | 0.015 |

**Table A 31** Design Hyetograph of Incesu Detention Pond Basin (Tr = 50 yr)

| duration (min) | duration / total duration | depth / total depth | cumulative depth (cm) | incremental depth (cm) | ordered depth (cm) | cumulative ordered depth (cm) | cum. initial abstriction, Ia (cm) | cumulative abstriction, Fa (cm) | cumulative excess depth, Pe (cm) | excess depth (cm) |
|---|---|---|---|---|---|---|---|---|---|---|
| 10 | 0.014 | 0.140 | 0.727 | 0.727 | 0.016 | 0.016 | 0.016 | 0.000 | 0.000 | 0.000 |
| 20 | 0.028 | 0.225 | 1.168 | 0.441 | 0.021 | 0.036 | 0.036 | 0.000 | 0.000 | 0.000 |
| 30 | 0.042 | 0.283 | 1.469 | 0.301 | 0.021 | 0.057 | 0.057 | 0.000 | 0.000 | 0.000 |
| 40 | 0.056 | 0.325 | 1.687 | 0.218 | 0.021 | 0.078 | 0.078 | 0.000 | 0.000 | 0.000 |
| 50 | 0.070 | 0.366 | 1.900 | 0.213 | 0.021 | 0.099 | 0.099 | 0.000 | 0.000 | 0.000 |
| 60 | 0.084 | 0.400 | 2.076 | 0.176 | 0.021 | 0.119 | 0.119 | 0.000 | 0.000 | 0.000 |
| 70 | 0.097 | 0.432 | 2.242 | 0.166 | 0.021 | 0.140 | 0.140 | 0.000 | 0.000 | 0.000 |
| 80 | 0.111 | 0.462 | 2.398 | 0.156 | 0.021 | 0.161 | 0.161 | 0.000 | 0.000 | 0.000 |
| 90 | 0.125 | 0.488 | 2.533 | 0.135 | 0.021 | 0.182 | 0.182 | 0.000 | 0.000 | 0.000 |
| 100 | 0.139 | 0.508 | 2.637 | 0.104 | 0.021 | 0.202 | 0.202 | 0.000 | 0.000 | 0.000 |
| 110 | 0.153 | 0.527 | 2.735 | 0.099 | 0.026 | 0.228 | 0.228 | 0.000 | 0.000 | 0.000 |
| 120 | 0.167 | 0.545 | 2.829 | 0.093 | 0.026 | 0.254 | 0.254 | 0.000 | 0.000 | 0.000 |
| 130 | 0.181 | 0.563 | 2.922 | 0.093 | 0.026 | 0.280 | 0.280 | 0.000 | 0.000 | 0.000 |
| 140 | 0.195 | 0.580 | 3.010 | 0.088 | 0.026 | 0.306 | 0.306 | 0.000 | 0.000 | 0.000 |
| 150 | 0.209 | 0.595 | 3.088 | 0.078 | 0.031 | 0.337 | 0.337 | 0.000 | 0.000 | 0.000 |
| 160 | 0.222 | 0.610 | 3.166 | 0.078 | 0.031 | 0.368 | 0.368 | 0.000 | 0.000 | 0.000 |
| 170 | 0.236 | 0.625 | 3.244 | 0.078 | 0.036 | 0.405 | 0.405 | 0.000 | 0.000 | 0.000 |
| 180 | 0.250 | 0.640 | 3.322 | 0.078 | 0.036 | 0.441 | 0.441 | 0.000 | 0.000 | 0.000 |
| 190 | 0.264 | 0.655 | 3.399 | 0.078 | 0.036 | 0.477 | 0.477 | 0.000 | 0.000 | 0.000 |
| 200 | 0.278 | 0.669 | 3.472 | 0.073 | 0.042 | 0.519 | 0.519 | 0.000 | 0.000 | 0.000 |
| 210 | 0.292 | 0.683 | 3.545 | 0.073 | 0.052 | 0.571 | 0.571 | 0.000 | 0.000 | 0.000 |
| 220 | 0.306 | 0.695 | 3.607 | 0.062 | 0.052 | 0.623 | 0.623 | 0.000 | 0.000 | 0.000 |
| 230 | 0.320 | 0.707 | 3.669 | 0.062 | 0.057 | 0.680 | 0.680 | 0.000 | 0.000 | 0.000 |
| 240 | 0.334 | 0.719 | 3.732 | 0.062 | 0.062 | 0.742 | 0.742 | 0.000 | 0.000 | 0.000 |
| 250 | 0.347 | 0.731 | 3.794 | 0.062 | 0.062 | 0.804 | 0.804 | 0.000 | 0.000 | 0.000 |
| 260 | 0.361 | 0.742 | 3.851 | 0.057 | 0.073 | 0.877 | 0.877 | 0.000 | 0.000 | 0.000 |
| 270 | 0.375 | 0.753 | 3.908 | 0.057 | 0.078 | 0.955 | 0.955 | 0.000 | 0.000 | 0.000 |
| 280 | 0.389 | 0.763 | 3.960 | 0.052 | 0.078 | 1.033 | 1.033 | 0.000 | 0.000 | 0.000 |
| 290 | 0.403 | 0.773 | 4.012 | 0.052 | 0.078 | 1.111 | 1.111 | 0.000 | 0.000 | 0.000 |
| 300 | 0.417 | 0.783 | 4.064 | 0.052 | 0.093 | 1.204 | 1.204 | 0.000 | 0.000 | 0.000 |
| 310 | 0.431 | 0.793 | 4.116 | 0.052 | 0.099 | 1.303 | 1.303 | 0.000 | 0.000 | 0.000 |
| 320 | 0.445 | 0.803 | 4.168 | 0.052 | 0.135 | 1.438 | 1.438 | 0.000 | 0.000 | 0.000 |
| 330 | 0.459 | 0.811 | 4.209 | 0.042 | 0.166 | 1.604 | 1.604 | 0.000 | 0.000 | 0.000 |
| 340 | 0.472 | 0.819 | 4.251 | 0.042 | 0.213 | 1.817 | 1.638 | 0.175 | 0.004 | 0.004 |
| 350 | 0.486 | 0.826 | 4.287 | 0.036 | 0.301 | 2.118 | 1.638 | 0.453 | 0.027 | 0.023 |
| 360 | 0.500 | 0.833 | 4.323 | 0.036 | 0.727 | 2.844 | 1.638 | 1.051 | 0.155 | 0.128 |

**Table A 31** (continued)

| duration (min) | duration / total duration | depth / total depth | cumulative depth (cm) | incremental depth (cm) | ordered depth (cm) | cumulative ordered depth (cm) | cum. initial abstriction, Ia (cm) | cumulative abstriction, Fa (cm) | cumulative excess depth, Pe (cm) | excess depth (cm) |
|---|---|---|---|---|---|---|---|---|---|---|
| 370 | 0.514 | 0.840 | 4.360 | 0.036 | 0.441 | 3.285 | 1.638 | 1.372 | 0.276 | 0.121 |
| 380 | 0.528 | 0.847 | 4.396 | 0.036 | 0.218 | 3.503 | 1.638 | 1.519 | 0.346 | 0.070 |
| 390 | 0.542 | 0.854 | 4.432 | 0.036 | 0.176 | 3.680 | 1.638 | 1.634 | 0.408 | 0.061 |
| 400 | 0.556 | 0.860 | 4.463 | 0.031 | 0.156 | 3.835 | 1.638 | 1.733 | 0.465 | 0.057 |
| 410 | 0.569 | 0.866 | 4.495 | 0.031 | 0.104 | 3.939 | 1.638 | 1.797 | 0.505 | 0.040 |
| 420 | 0.583 | 0.872 | 4.526 | 0.031 | 0.093 | 4.033 | 1.638 | 1.853 | 0.542 | 0.037 |
| 430 | 0.597 | 0.878 | 4.557 | 0.031 | 0.088 | 4.121 | 1.638 | 1.905 | 0.578 | 0.036 |
| 440 | 0.611 | 0.883 | 4.583 | 0.026 | 0.078 | 4.199 | 1.638 | 1.951 | 0.610 | 0.032 |
| 450 | 0.625 | 0.888 | 4.609 | 0.026 | 0.078 | 4.277 | 1.638 | 1.996 | 0.643 | 0.033 |
| 460 | 0.639 | 0.893 | 4.635 | 0.026 | 0.073 | 4.349 | 1.638 | 2.037 | 0.674 | 0.031 |
| 470 | 0.653 | 0.898 | 4.661 | 0.026 | 0.062 | 4.412 | 1.638 | 2.072 | 0.702 | 0.027 |
| 480 | 0.667 | 0.903 | 4.687 | 0.026 | 0.062 | 4.474 | 1.638 | 2.106 | 0.730 | 0.028 |
| 490 | 0.681 | 0.908 | 4.713 | 0.026 | 0.057 | 4.531 | 1.638 | 2.138 | 0.755 | 0.026 |
| 500 | 0.694 | 0.913 | 4.738 | 0.026 | 0.052 | 4.583 | 1.638 | 2.166 | 0.779 | 0.024 |
| 510 | 0.708 | 0.918 | 4.764 | 0.026 | 0.052 | 4.635 | 1.638 | 2.194 | 0.803 | 0.024 |
| 520 | 0.722 | 0.923 | 4.790 | 0.026 | 0.052 | 4.687 | 1.638 | 2.222 | 0.827 | 0.024 |
| 530 | 0.736 | 0.927 | 4.811 | 0.021 | 0.042 | 4.728 | 1.638 | 2.244 | 0.847 | 0.020 |
| 540 | 0.750 | 0.931 | 4.832 | 0.021 | 0.036 | 4.764 | 1.638 | 2.263 | 0.864 | 0.017 |
| 550 | 0.764 | 0.935 | 4.853 | 0.021 | 0.036 | 4.801 | 1.638 | 2.282 | 0.881 | 0.017 |
| 560 | 0.778 | 0.939 | 4.873 | 0.021 | 0.031 | 4.832 | 1.638 | 2.298 | 0.896 | 0.015 |
| 570 | 0.792 | 0.943 | 4.894 | 0.021 | 0.031 | 4.863 | 1.638 | 2.314 | 0.911 | 0.015 |
| 580 | 0.806 | 0.947 | 4.915 | 0.021 | 0.026 | 4.889 | 1.638 | 2.327 | 0.924 | 0.013 |
| 590 | 0.819 | 0.951 | 4.936 | 0.021 | 0.026 | 4.915 | 1.638 | 2.340 | 0.937 | 0.013 |
| 600 | 0.833 | 0.955 | 4.956 | 0.021 | 0.026 | 4.941 | 1.638 | 2.354 | 0.949 | 0.013 |
| 610 | 0.847 | 0.959 | 4.977 | 0.021 | 0.026 | 4.967 | 1.638 | 2.367 | 0.962 | 0.013 |
| 620 | 0.861 | 0.963 | 4.998 | 0.021 | 0.026 | 4.993 | 1.638 | 2.380 | 0.975 | 0.013 |
| 630 | 0.875 | 0.967 | 5.019 | 0.021 | 0.021 | 5.014 | 1.638 | 2.390 | 0.985 | 0.010 |
| 640 | 0.889 | 0.971 | 5.039 | 0.021 | 0.021 | 5.034 | 1.638 | 2.401 | 0.996 | 0.010 |
| 650 | 0.903 | 0.975 | 5.060 | 0.021 | 0.021 | 5.055 | 1.638 | 2.411 | 1.006 | 0.010 |
| 660 | 0.917 | 0.979 | 5.081 | 0.021 | 0.021 | 5.076 | 1.638 | 2.421 | 1.017 | 0.010 |
| 670 | 0.931 | 0.983 | 5.102 | 0.021 | 0.021 | 5.097 | 1.638 | 2.432 | 1.027 | 0.010 |
| 680 | 0.944 | 0.987 | 5.123 | 0.021 | 0.021 | 5.117 | 1.638 | 2.442 | 1.038 | 0.011 |
| 690 | 0.958 | 0.991 | 5.143 | 0.021 | 0.021 | 5.138 | 1.638 | 2.452 | 1.048 | 0.011 |
| 700 | 0.972 | 0.994 | 5.159 | 0.016 | 0.021 | 5.159 | 1.638 | 2.462 | 1.059 | 0.011 |
| 710 | 0.986 | 0.997 | 5.174 | 0.016 | 0.016 | 5.174 | 1.638 | 2.470 | 1.067 | 0.008 |
| 720 | 1.000 | 1.000 | 5.190 | 0.016 | 0.016 | 5.190 | 1.638 | 2.478 | 1.075 | 0.008 |

**Table A 32** Design Hyetograph of Incesu Detention Pond Basin (Tr = 100 yr)

| duration (min) | duration / total duration | depth / total depth | cumulative depth (cm) | incremental depth (cm) | ordered depth (cm) | cumulative ordered depth (cm) | cum. initial abstriction, Ia (cm) | cumulative abstriction, Fa (cm) | cumulative excess depth, Pe (cm) | excess depth (cm) |
|---|---|---|---|---|---|---|---|---|---|---|
| 10 | 0.014 | 0.140 | 0.814 | 0.814 | 0.017 | 0.017 | 0.017 | 0.000 | 0.000 | 0.000 |
| 20 | 0.028 | 0.225 | 1.308 | 0.494 | 0.023 | 0.041 | 0.041 | 0.000 | 0.000 | 0.000 |
| 30 | 0.042 | 0.283 | 1.645 | 0.337 | 0.023 | 0.064 | 0.064 | 0.000 | 0.000 | 0.000 |
| 40 | 0.056 | 0.325 | 1.889 | 0.244 | 0.023 | 0.087 | 0.087 | 0.000 | 0.000 | 0.000 |
| 50 | 0.070 | 0.366 | 2.127 | 0.238 | 0.023 | 0.110 | 0.110 | 0.000 | 0.000 | 0.000 |
| 60 | 0.084 | 0.400 | 2.325 | 0.198 | 0.023 | 0.134 | 0.134 | 0.000 | 0.000 | 0.000 |
| 70 | 0.097 | 0.432 | 2.511 | 0.186 | 0.023 | 0.157 | 0.157 | 0.000 | 0.000 | 0.000 |
| 80 | 0.111 | 0.462 | 2.686 | 0.174 | 0.023 | 0.180 | 0.180 | 0.000 | 0.000 | 0.000 |
| 90 | 0.125 | 0.488 | 2.837 | 0.151 | 0.023 | 0.203 | 0.203 | 0.000 | 0.000 | 0.000 |
| 100 | 0.139 | 0.508 | 2.953 | 0.116 | 0.023 | 0.227 | 0.227 | 0.000 | 0.000 | 0.000 |
| 110 | 0.153 | 0.527 | 3.063 | 0.110 | 0.029 | 0.256 | 0.256 | 0.000 | 0.000 | 0.000 |
| 120 | 0.167 | 0.545 | 3.168 | 0.105 | 0.029 | 0.285 | 0.285 | 0.000 | 0.000 | 0.000 |
| 130 | 0.181 | 0.563 | 3.273 | 0.105 | 0.029 | 0.314 | 0.314 | 0.000 | 0.000 | 0.000 |
| 140 | 0.195 | 0.580 | 3.371 | 0.099 | 0.029 | 0.343 | 0.343 | 0.000 | 0.000 | 0.000 |
| 150 | 0.209 | 0.595 | 3.459 | 0.087 | 0.035 | 0.378 | 0.378 | 0.000 | 0.000 | 0.000 |
| 160 | 0.222 | 0.610 | 3.546 | 0.087 | 0.035 | 0.413 | 0.413 | 0.000 | 0.000 | 0.000 |
| 170 | 0.236 | 0.625 | 3.633 | 0.087 | 0.041 | 0.453 | 0.453 | 0.000 | 0.000 | 0.000 |
| 180 | 0.250 | 0.640 | 3.720 | 0.087 | 0.041 | 0.494 | 0.494 | 0.000 | 0.000 | 0.000 |
| 190 | 0.264 | 0.655 | 3.807 | 0.087 | 0.041 | 0.535 | 0.535 | 0.000 | 0.000 | 0.000 |
| 200 | 0.278 | 0.669 | 3.889 | 0.081 | 0.047 | 0.581 | 0.581 | 0.000 | 0.000 | 0.000 |
| 210 | 0.292 | 0.683 | 3.970 | 0.081 | 0.058 | 0.639 | 0.639 | 0.000 | 0.000 | 0.000 |
| 220 | 0.306 | 0.695 | 4.040 | 0.070 | 0.058 | 0.698 | 0.698 | 0.000 | 0.000 | 0.000 |
| 230 | 0.320 | 0.707 | 4.110 | 0.070 | 0.064 | 0.761 | 0.761 | 0.000 | 0.000 | 0.000 |
| 240 | 0.334 | 0.719 | 4.179 | 0.070 | 0.070 | 0.831 | 0.831 | 0.000 | 0.000 | 0.000 |
| 250 | 0.347 | 0.731 | 4.249 | 0.070 | 0.070 | 0.901 | 0.901 | 0.000 | 0.000 | 0.000 |
| 260 | 0.361 | 0.742 | 4.313 | 0.064 | 0.081 | 0.982 | 0.982 | 0.000 | 0.000 | 0.000 |
| 270 | 0.375 | 0.753 | 4.377 | 0.064 | 0.087 | 1.070 | 1.070 | 0.000 | 0.000 | 0.000 |
| 280 | 0.389 | 0.763 | 4.435 | 0.058 | 0.087 | 1.157 | 1.157 | 0.000 | 0.000 | 0.000 |
| 290 | 0.403 | 0.773 | 4.493 | 0.058 | 0.087 | 1.244 | 1.244 | 0.000 | 0.000 | 0.000 |
| 300 | 0.417 | 0.783 | 4.551 | 0.058 | 0.105 | 1.349 | 1.349 | 0.000 | 0.000 | 0.000 |
| 310 | 0.431 | 0.793 | 4.610 | 0.058 | 0.110 | 1.459 | 1.459 | 0.000 | 0.000 | 0.000 |
| 320 | 0.445 | 0.803 | 4.668 | 0.058 | 0.151 | 1.610 | 1.610 | 0.000 | 0.000 | 0.000 |
| 330 | 0.459 | 0.811 | 4.714 | 0.047 | 0.186 | 1.796 | 1.638 | 0.155 | 0.003 | 0.003 |
| 340 | 0.472 | 0.819 | 4.761 | 0.047 | 0.238 | 2.034 | 1.638 | 0.378 | 0.018 | 0.015 |
| 350 | 0.486 | 0.826 | 4.801 | 0.041 | 0.337 | 2.372 | 1.638 | 0.673 | 0.060 | 0.042 |
| 360 | 0.500 | 0.833 | 4.842 | 0.041 | 0.814 | 3.185 | 1.638 | 1.302 | 0.246 | 0.186 |

**Table A 32** (continued)

| duration (min) | duration / total duration | depth / total depth | cumulative depth (cm) | incremental depth (cm) | ordered depth (cm) | cumulative ordered depth (cm) | cum. initial abstriction, Ia (cm) | cumulative abstriction, Fa (cm) | cumulative excess depth, Pe (cm) | excess depth (cm) |
|---|---|---|---|---|---|---|---|---|---|---|
| 370 | 0.514 | 0.840 | 4.883 | 0.041 | 0.494 | 3.680 | 1.638 | 1.634 | 0.407 | 0.161 |
| 380 | 0.528 | 0.847 | 4.923 | 0.041 | 0.244 | 3.924 | 1.638 | 1.787 | 0.499 | 0.091 |
| 390 | 0.542 | 0.854 | 4.964 | 0.041 | 0.198 | 4.121 | 1.638 | 1.906 | 0.578 | 0.079 |
| 400 | 0.556 | 0.860 | 4.999 | 0.035 | 0.174 | 4.296 | 1.638 | 2.007 | 0.651 | 0.073 |
| 410 | 0.569 | 0.866 | 5.034 | 0.035 | 0.116 | 4.412 | 1.638 | 2.072 | 0.702 | 0.051 |
| 420 | 0.583 | 0.872 | 5.069 | 0.035 | 0.105 | 4.517 | 1.638 | 2.130 | 0.749 | 0.047 |
| 430 | 0.597 | 0.878 | 5.104 | 0.035 | 0.099 | 4.615 | 1.638 | 2.184 | 0.794 | 0.045 |
| 440 | 0.611 | 0.883 | 5.133 | 0.029 | 0.087 | 4.703 | 1.638 | 2.230 | 0.835 | 0.041 |
| 450 | 0.625 | 0.888 | 5.162 | 0.029 | 0.087 | 4.790 | 1.638 | 2.276 | 0.876 | 0.041 |
| 460 | 0.639 | 0.893 | 5.191 | 0.029 | 0.081 | 4.871 | 1.638 | 2.318 | 0.915 | 0.039 |
| 470 | 0.653 | 0.898 | 5.220 | 0.029 | 0.070 | 4.941 | 1.638 | 2.354 | 0.949 | 0.034 |
| 480 | 0.667 | 0.903 | 5.249 | 0.029 | 0.070 | 5.011 | 1.638 | 2.389 | 0.984 | 0.035 |
| 490 | 0.681 | 0.908 | 5.278 | 0.029 | 0.064 | 5.075 | 1.638 | 2.421 | 1.016 | 0.032 |
| 500 | 0.694 | 0.913 | 5.307 | 0.029 | 0.058 | 5.133 | 1.638 | 2.449 | 1.045 | 0.029 |
| 510 | 0.708 | 0.918 | 5.336 | 0.029 | 0.058 | 5.191 | 1.638 | 2.478 | 1.075 | 0.030 |
| 520 | 0.722 | 0.923 | 5.365 | 0.029 | 0.058 | 5.249 | 1.638 | 2.506 | 1.105 | 0.030 |
| 530 | 0.736 | 0.927 | 5.388 | 0.023 | 0.047 | 5.295 | 1.638 | 2.528 | 1.129 | 0.024 |
| 540 | 0.750 | 0.931 | 5.412 | 0.023 | 0.041 | 5.336 | 1.638 | 2.548 | 1.151 | 0.021 |
| 550 | 0.764 | 0.935 | 5.435 | 0.023 | 0.041 | 5.377 | 1.638 | 2.567 | 1.172 | 0.021 |
| 560 | 0.778 | 0.939 | 5.458 | 0.023 | 0.035 | 5.412 | 1.638 | 2.583 | 1.191 | 0.018 |
| 570 | 0.792 | 0.943 | 5.481 | 0.023 | 0.035 | 5.447 | 1.638 | 2.600 | 1.209 | 0.019 |
| 580 | 0.806 | 0.947 | 5.505 | 0.023 | 0.029 | 5.476 | 1.638 | 2.613 | 1.225 | 0.016 |
| 590 | 0.819 | 0.951 | 5.528 | 0.023 | 0.029 | 5.505 | 1.638 | 2.627 | 1.240 | 0.016 |
| 600 | 0.833 | 0.955 | 5.551 | 0.023 | 0.029 | 5.534 | 1.638 | 2.640 | 1.256 | 0.016 |
| 610 | 0.847 | 0.959 | 5.574 | 0.023 | 0.029 | 5.563 | 1.638 | 2.653 | 1.272 | 0.016 |
| 620 | 0.861 | 0.963 | 5.598 | 0.023 | 0.029 | 5.592 | 1.638 | 2.667 | 1.288 | 0.016 |
| 630 | 0.875 | 0.967 | 5.621 | 0.023 | 0.023 | 5.615 | 1.638 | 2.677 | 1.300 | 0.013 |
| 640 | 0.889 | 0.971 | 5.644 | 0.023 | 0.023 | 5.638 | 1.638 | 2.688 | 1.313 | 0.013 |
| 650 | 0.903 | 0.975 | 5.667 | 0.023 | 0.023 | 5.662 | 1.638 | 2.698 | 1.326 | 0.013 |
| 660 | 0.917 | 0.979 | 5.691 | 0.023 | 0.023 | 5.685 | 1.638 | 2.709 | 1.339 | 0.013 |
| 670 | 0.931 | 0.983 | 5.714 | 0.023 | 0.023 | 5.708 | 1.638 | 2.719 | 1.351 | 0.013 |
| 680 | 0.944 | 0.987 | 5.737 | 0.023 | 0.023 | 5.731 | 1.638 | 2.729 | 1.364 | 0.013 |
| 690 | 0.958 | 0.991 | 5.760 | 0.023 | 0.023 | 5.755 | 1.638 | 2.740 | 1.377 | 0.013 |
| 700 | 0.972 | 0.994 | 5.778 | 0.017 | 0.023 | 5.778 | 1.638 | 2.750 | 1.390 | 0.013 |
| 710 | 0.986 | 0.997 | 5.795 | 0.017 | 0.017 | 5.795 | 1.638 | 2.758 | 1.400 | 0.010 |
| 720 | 1.000 | 1.000 | 5.813 | 0.017 | 0.017 | 5.813 | 1.638 | 2.765 | 1.410 | 0.010 |

**Table A 33** Design Hyetograph of Incesu Detention Pond Basin (Tr = 500 yr)

| duration (min) | duration / total duration | depth / total depth | cumulative depth (cm) | incremental depth (cm) | ordered depth (cm) | cumulative ordered depth (cm) | cum. initial abstriction, Ia (cm) | cumulative abstriction, Fa (cm) | cumulative excess depth, Pe (cm) | excess depth (cm) |
|---|---|---|---|---|---|---|---|---|---|---|
| 10 | 0.014 | 0.140 | 1.014 | 1.014 | 0.022 | 0.022 | 0.022 | 0.000 | 0.000 | 0.000 |
| 20 | 0.028 | 0.225 | 1.630 | 0.616 | 0.029 | 0.051 | 0.051 | 0.000 | 0.000 | 0.000 |
| 30 | 0.042 | 0.283 | 2.050 | 0.420 | 0.029 | 0.080 | 0.080 | 0.000 | 0.000 | 0.000 |
| 40 | 0.056 | 0.325 | 2.355 | 0.304 | 0.029 | 0.109 | 0.109 | 0.000 | 0.000 | 0.000 |
| 50 | 0.070 | 0.366 | 2.652 | 0.297 | 0.029 | 0.138 | 0.138 | 0.000 | 0.000 | 0.000 |
| 60 | 0.084 | 0.400 | 2.898 | 0.246 | 0.029 | 0.167 | 0.167 | 0.000 | 0.000 | 0.000 |
| 70 | 0.097 | 0.432 | 3.130 | 0.232 | 0.029 | 0.196 | 0.196 | 0.000 | 0.000 | 0.000 |
| 80 | 0.111 | 0.462 | 3.347 | 0.217 | 0.029 | 0.225 | 0.225 | 0.000 | 0.000 | 0.000 |
| 90 | 0.125 | 0.488 | 3.536 | 0.188 | 0.029 | 0.254 | 0.254 | 0.000 | 0.000 | 0.000 |
| 100 | 0.139 | 0.508 | 3.681 | 0.145 | 0.029 | 0.283 | 0.283 | 0.000 | 0.000 | 0.000 |
| 110 | 0.153 | 0.527 | 3.818 | 0.138 | 0.036 | 0.319 | 0.319 | 0.000 | 0.000 | 0.000 |
| 120 | 0.167 | 0.545 | 3.949 | 0.130 | 0.036 | 0.355 | 0.355 | 0.000 | 0.000 | 0.000 |
| 130 | 0.181 | 0.563 | 4.079 | 0.130 | 0.036 | 0.391 | 0.391 | 0.000 | 0.000 | 0.000 |
| 140 | 0.195 | 0.580 | 4.202 | 0.123 | 0.036 | 0.427 | 0.427 | 0.000 | 0.000 | 0.000 |
| 150 | 0.209 | 0.595 | 4.311 | 0.109 | 0.043 | 0.471 | 0.471 | 0.000 | 0.000 | 0.000 |
| 160 | 0.222 | 0.610 | 4.420 | 0.109 | 0.043 | 0.514 | 0.514 | 0.000 | 0.000 | 0.000 |
| 170 | 0.236 | 0.625 | 4.528 | 0.109 | 0.051 | 0.565 | 0.565 | 0.000 | 0.000 | 0.000 |
| 180 | 0.250 | 0.640 | 4.637 | 0.109 | 0.051 | 0.616 | 0.616 | 0.000 | 0.000 | 0.000 |
| 190 | 0.264 | 0.655 | 4.746 | 0.109 | 0.051 | 0.667 | 0.667 | 0.000 | 0.000 | 0.000 |
| 200 | 0.278 | 0.669 | 4.847 | 0.101 | 0.058 | 0.725 | 0.725 | 0.000 | 0.000 | 0.000 |
| 210 | 0.292 | 0.683 | 4.948 | 0.101 | 0.072 | 0.797 | 0.797 | 0.000 | 0.000 | 0.000 |
| 220 | 0.306 | 0.695 | 5.035 | 0.087 | 0.072 | 0.869 | 0.869 | 0.000 | 0.000 | 0.000 |
| 230 | 0.320 | 0.707 | 5.122 | 0.087 | 0.080 | 0.949 | 0.949 | 0.000 | 0.000 | 0.000 |
| 240 | 0.334 | 0.719 | 5.209 | 0.087 | 0.087 | 1.036 | 1.036 | 0.000 | 0.000 | 0.000 |
| 250 | 0.347 | 0.731 | 5.296 | 0.087 | 0.087 | 1.123 | 1.123 | 0.000 | 0.000 | 0.000 |
| 260 | 0.361 | 0.742 | 5.376 | 0.080 | 0.101 | 1.224 | 1.224 | 0.000 | 0.000 | 0.000 |
| 270 | 0.375 | 0.753 | 5.456 | 0.080 | 0.109 | 1.333 | 1.333 | 0.000 | 0.000 | 0.000 |
| 280 | 0.389 | 0.763 | 5.528 | 0.072 | 0.109 | 1.442 | 1.442 | 0.000 | 0.000 | 0.000 |
| 290 | 0.403 | 0.773 | 5.601 | 0.072 | 0.109 | 1.550 | 1.550 | 0.000 | 0.000 | 0.000 |
| 300 | 0.417 | 0.783 | 5.673 | 0.072 | 0.130 | 1.681 | 1.638 | 0.043 | 0.000 | 0.000 |
| 310 | 0.431 | 0.793 | 5.745 | 0.072 | 0.138 | 1.819 | 1.638 | 0.177 | 0.004 | 0.004 |
| 320 | 0.445 | 0.803 | 5.818 | 0.072 | 0.188 | 2.007 | 1.638 | 0.353 | 0.016 | 0.012 |
| 330 | 0.459 | 0.811 | 5.876 | 0.058 | 0.232 | 2.239 | 1.638 | 0.560 | 0.041 | 0.025 |
| 340 | 0.472 | 0.819 | 5.934 | 0.058 | 0.297 | 2.536 | 1.638 | 0.809 | 0.089 | 0.048 |
| 350 | 0.486 | 0.826 | 5.985 | 0.051 | 0.420 | 2.956 | 1.638 | 1.135 | 0.183 | 0.094 |
| 360 | 0.500 | 0.833 | 6.035 | 0.051 | 1.014 | 3.970 | 1.638 | 1.815 | 0.517 | 0.334 |

**Table A 33** (continued)

| duration (min) | duration / total duration | depth / total depth | cumulative depth (cm) | incremental depth (cm) | ordered depth (cm) | cumulative ordered depth (cm) | cum. initial abstriction, Ia (cm) | cumulative abstriction, Fa (cm) | cumulative excess depth, Pe (cm) | excess depth (cm) |
|---|---|---|---|---|---|---|---|---|---|---|
| 370 | 0.514 | 0.840 | 6.086 | 0.051 | 0.616 | 4.586 | 1.638 | 2.168 | 0.781 | 0.263 |
| 380 | 0.528 | 0.847 | 6.137 | 0.051 | 0.304 | 4.891 | 1.638 | 2.328 | 0.925 | 0.144 |
| 390 | 0.542 | 0.854 | 6.187 | 0.051 | 0.246 | 5.137 | 1.638 | 2.452 | 1.048 | 0.123 |
| 400 | 0.556 | 0.860 | 6.231 | 0.043 | 0.217 | 5.354 | 1.638 | 2.556 | 1.160 | 0.113 |
| 410 | 0.569 | 0.866 | 6.274 | 0.043 | 0.145 | 5.499 | 1.638 | 2.624 | 1.237 | 0.077 |
| 420 | 0.583 | 0.872 | 6.318 | 0.043 | 0.130 | 5.630 | 1.638 | 2.684 | 1.308 | 0.071 |
| 430 | 0.597 | 0.878 | 6.361 | 0.043 | 0.123 | 5.753 | 1.638 | 2.739 | 1.376 | 0.068 |
| 440 | 0.611 | 0.883 | 6.398 | 0.036 | 0.109 | 5.861 | 1.638 | 2.786 | 1.437 | 0.061 |
| 450 | 0.625 | 0.888 | 6.434 | 0.036 | 0.109 | 5.970 | 1.638 | 2.833 | 1.499 | 0.062 |
| 460 | 0.639 | 0.893 | 6.470 | 0.036 | 0.101 | 6.072 | 1.638 | 2.876 | 1.557 | 0.058 |
| 470 | 0.653 | 0.898 | 6.506 | 0.036 | 0.087 | 6.158 | 1.638 | 2.913 | 1.608 | 0.051 |
| 480 | 0.667 | 0.903 | 6.542 | 0.036 | 0.087 | 6.245 | 1.638 | 2.949 | 1.659 | 0.051 |
| 490 | 0.681 | 0.908 | 6.579 | 0.036 | 0.080 | 6.325 | 1.638 | 2.981 | 1.706 | 0.047 |
| 500 | 0.694 | 0.913 | 6.615 | 0.036 | 0.072 | 6.398 | 1.638 | 3.010 | 1.750 | 0.043 |
| 510 | 0.708 | 0.918 | 6.651 | 0.036 | 0.072 | 6.470 | 1.638 | 3.039 | 1.793 | 0.044 |
| 520 | 0.722 | 0.923 | 6.687 | 0.036 | 0.072 | 6.542 | 1.638 | 3.067 | 1.837 | 0.044 |
| 530 | 0.736 | 0.927 | 6.716 | 0.029 | 0.058 | 6.600 | 1.638 | 3.090 | 1.873 | 0.035 |
| 540 | 0.750 | 0.931 | 6.745 | 0.029 | 0.051 | 6.651 | 1.638 | 3.110 | 1.904 | 0.031 |
| 550 | 0.764 | 0.935 | 6.774 | 0.029 | 0.051 | 6.702 | 1.638 | 3.129 | 1.935 | 0.031 |
| 560 | 0.778 | 0.939 | 6.803 | 0.029 | 0.043 | 6.745 | 1.638 | 3.146 | 1.962 | 0.027 |
| 570 | 0.792 | 0.943 | 6.832 | 0.029 | 0.043 | 6.789 | 1.638 | 3.162 | 1.989 | 0.027 |
| 580 | 0.806 | 0.947 | 6.861 | 0.029 | 0.036 | 6.825 | 1.638 | 3.176 | 2.012 | 0.023 |
| 590 | 0.819 | 0.951 | 6.890 | 0.029 | 0.036 | 6.861 | 1.638 | 3.189 | 2.034 | 0.023 |
| 600 | 0.833 | 0.955 | 6.919 | 0.029 | 0.036 | 6.897 | 1.638 | 3.203 | 2.057 | 0.023 |
| 610 | 0.847 | 0.959 | 6.948 | 0.029 | 0.036 | 6.934 | 1.638 | 3.216 | 2.080 | 0.023 |
| 620 | 0.861 | 0.963 | 6.977 | 0.029 | 0.036 | 6.970 | 1.638 | 3.229 | 2.103 | 0.023 |
| 630 | 0.875 | 0.967 | 7.006 | 0.029 | 0.029 | 6.999 | 1.638 | 3.240 | 2.121 | 0.018 |
| 640 | 0.889 | 0.971 | 7.035 | 0.029 | 0.029 | 7.028 | 1.638 | 3.251 | 2.140 | 0.018 |
| 650 | 0.903 | 0.975 | 7.064 | 0.029 | 0.029 | 7.057 | 1.638 | 3.261 | 2.158 | 0.018 |
| 660 | 0.917 | 0.979 | 7.093 | 0.029 | 0.029 | 7.086 | 1.638 | 3.272 | 2.177 | 0.019 |
| 670 | 0.931 | 0.983 | 7.122 | 0.029 | 0.029 | 7.115 | 1.638 | 3.282 | 2.195 | 0.019 |
| 680 | 0.944 | 0.987 | 7.151 | 0.029 | 0.029 | 7.144 | 1.638 | 3.292 | 2.214 | 0.019 |
| 690 | 0.958 | 0.991 | 7.180 | 0.029 | 0.029 | 7.173 | 1.638 | 3.303 | 2.232 | 0.019 |
| 700 | 0.972 | 0.994 | 7.202 | 0.022 | 0.029 | 7.202 | 1.638 | 3.313 | 2.251 | 0.019 |
| 710 | 0.986 | 0.997 | 7.224 | 0.022 | 0.022 | 7.224 | 1.638 | 3.321 | 2.265 | 0.014 |
| 720 | 1.000 | 1.000 | 7.245 | 0.022 | 0.022 | 7.245 | 1.638 | 3.328 | 2.279 | 0.014 |

## APPENDIX B

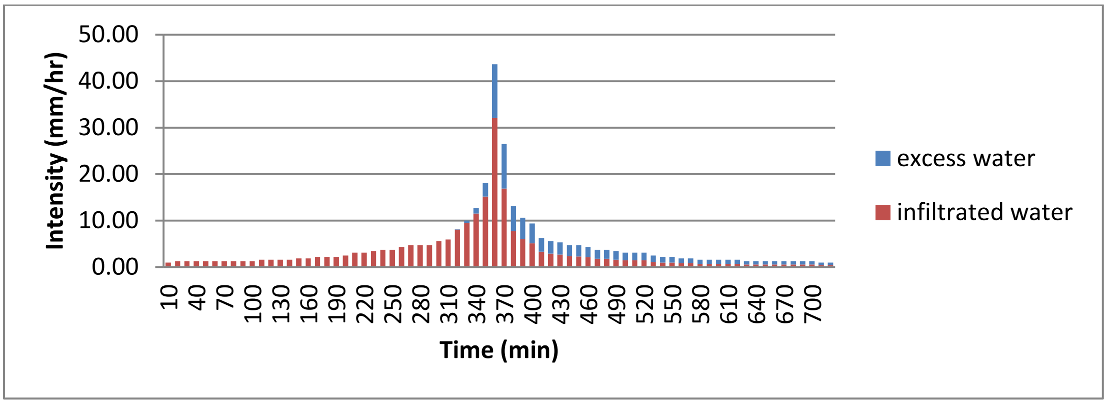



**Figure B 1** Hyetograph of Kepir Creek Subbasin (Tr = 50 yr)

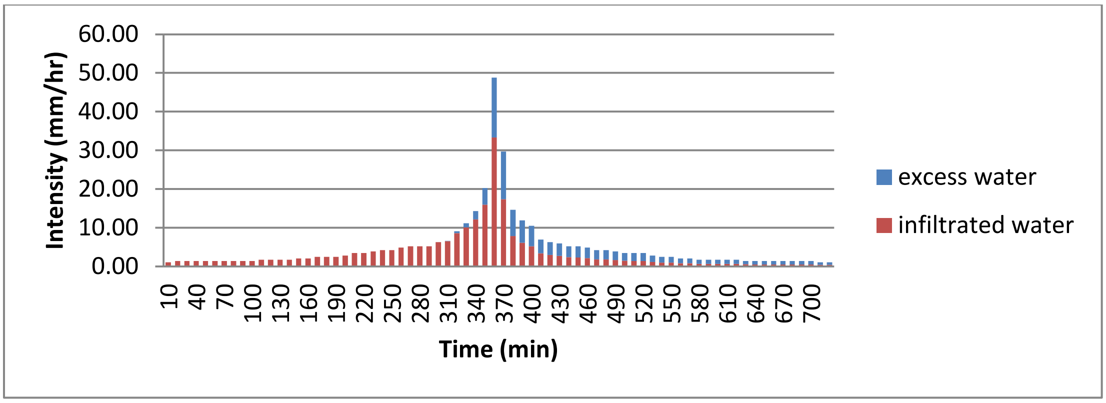



**Figure B 2** Hyetograph of Kepir Creek Subbasin (Tr = 100 yr)

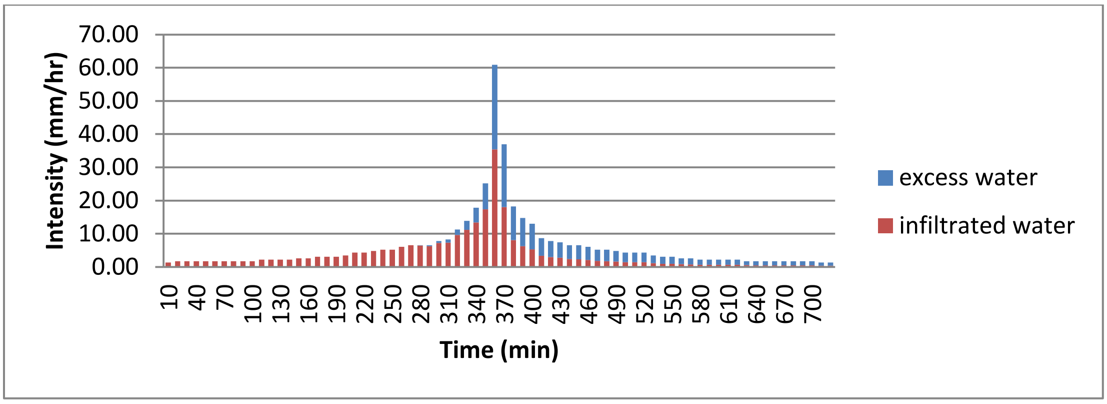



**Figure B 3** Hyetograph of Kepir Creek Subbasin (Tr = 500 yr)

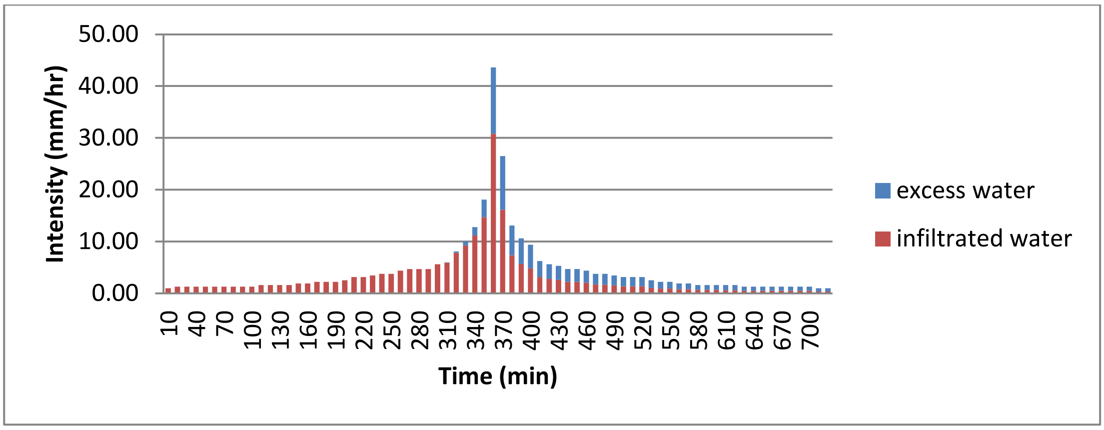



**Figure B 4** Hyetograph of İğdeli Creek Subbasin (Tr = 50 yr)

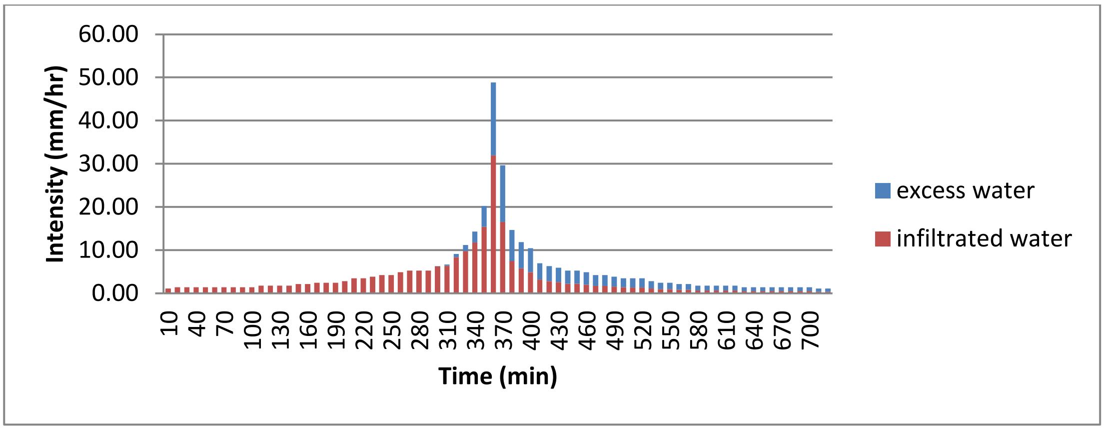



**Figure B 5** Hyetograph of İğdeli Creek Subbasin (Tr = 100 yr)

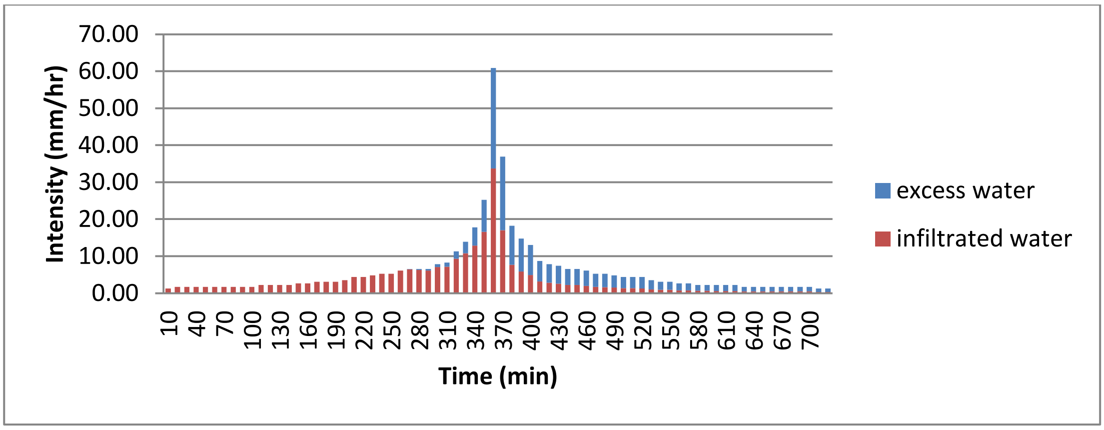



**Figure B 6** Hyetograph of İğdeli Creek Subbasin (Tr = 500 yr)

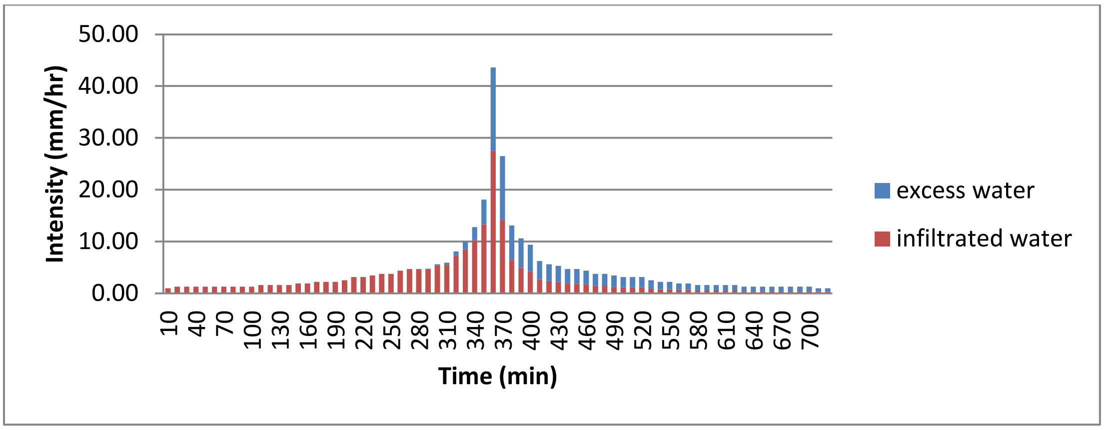



**Figure B 7** Hyetograph of Bağırsak Creek Subbasin (Tr = 50 yr)

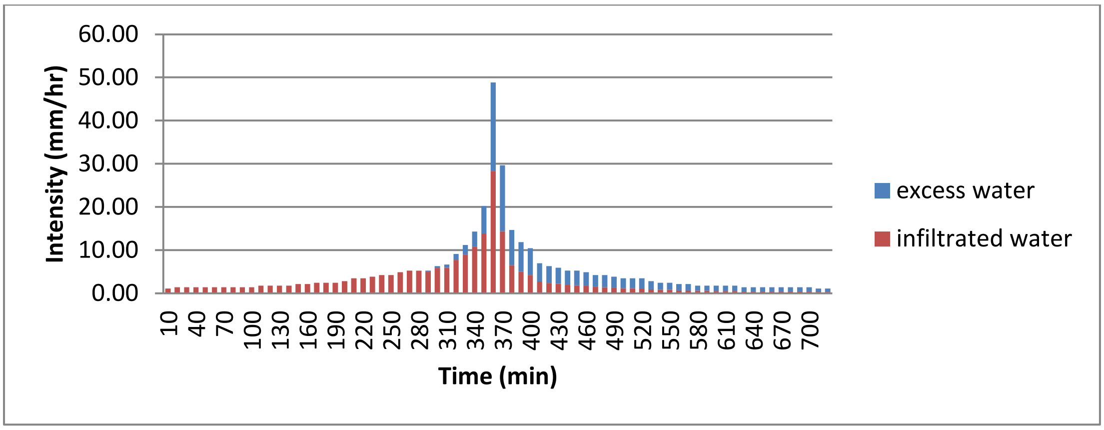



**Figure B 8** Hyetograph of Bağırsak Creek Subbasin (Tr = 100 yr)

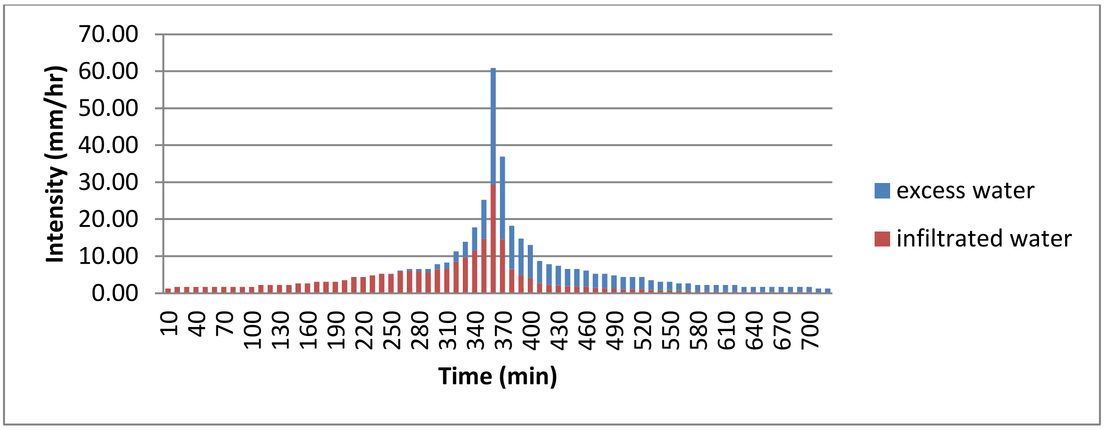



**Figure B 9** Hyetograph of Bağırsak Creek Subbasin (Tr = 500 yr)

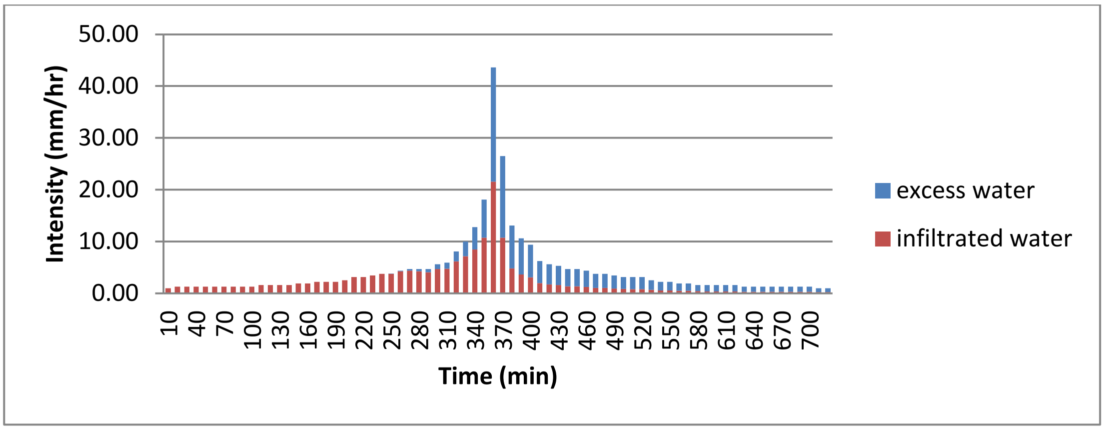



**Figure B 10** Hyetograph of Gölcük Creek Subbasin (Tr = 50 yr)

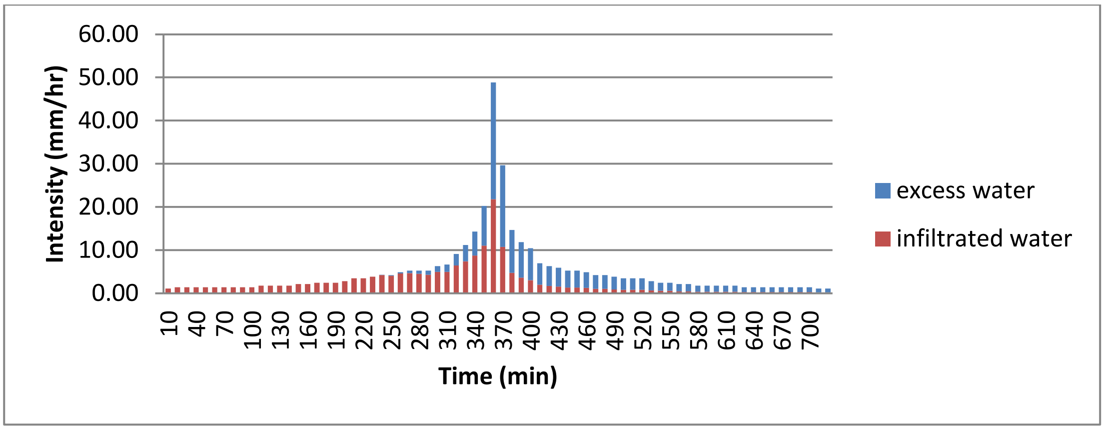



**Figure B 11** Hyetograph of Gölcük Creek Subbasin (Tr = 100 yr)

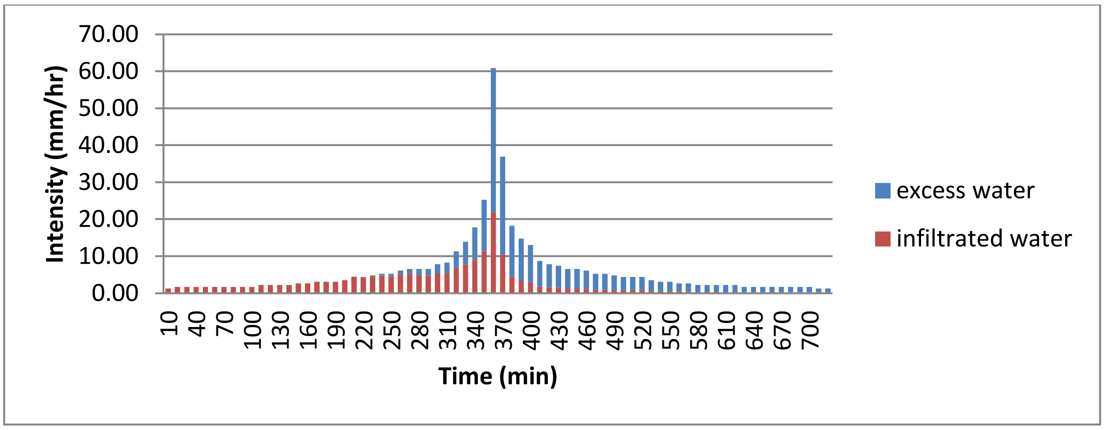



**Figure B 12** Hyetograph of Gölcük Creek Subbasin (Tr = 500 yr)

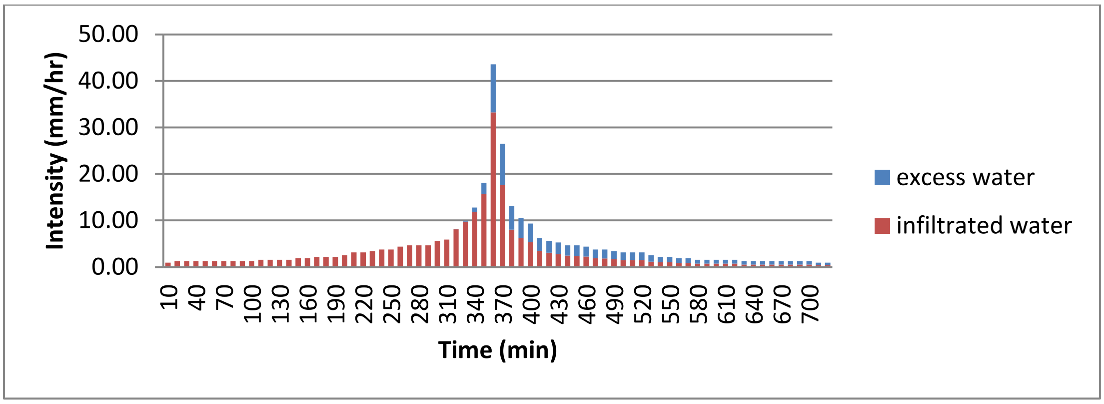



**Figure B 13** Hyetograph of Sukesen Creek Subbasin (Tr = 50 yr)

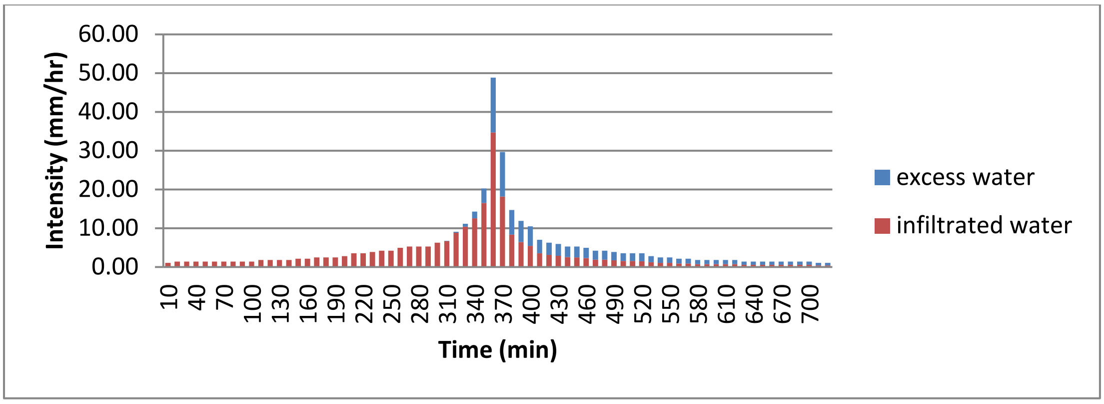



**Figure B 14** Hyetograph of Sukesen Creek Subbasin (Tr = 100 yr)

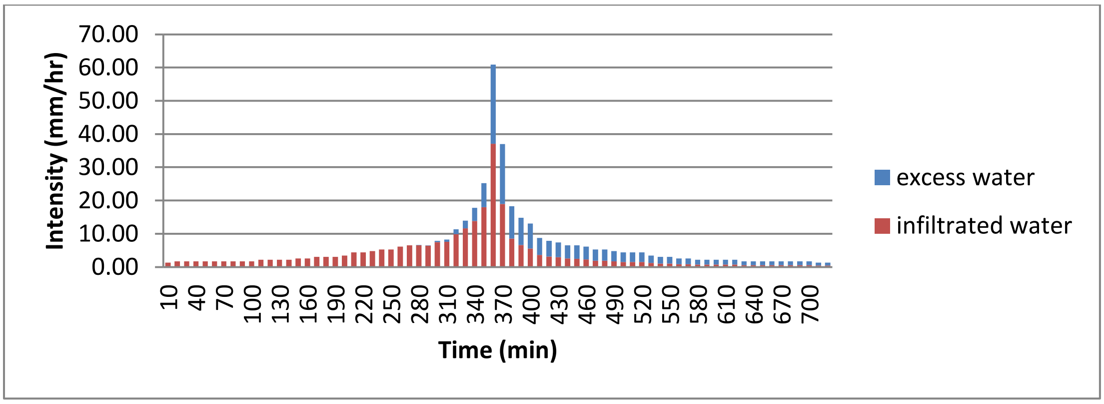



**Figure B 15** Hyetograph of Sukesen Creek Subbasin (Tr = 500 yr)

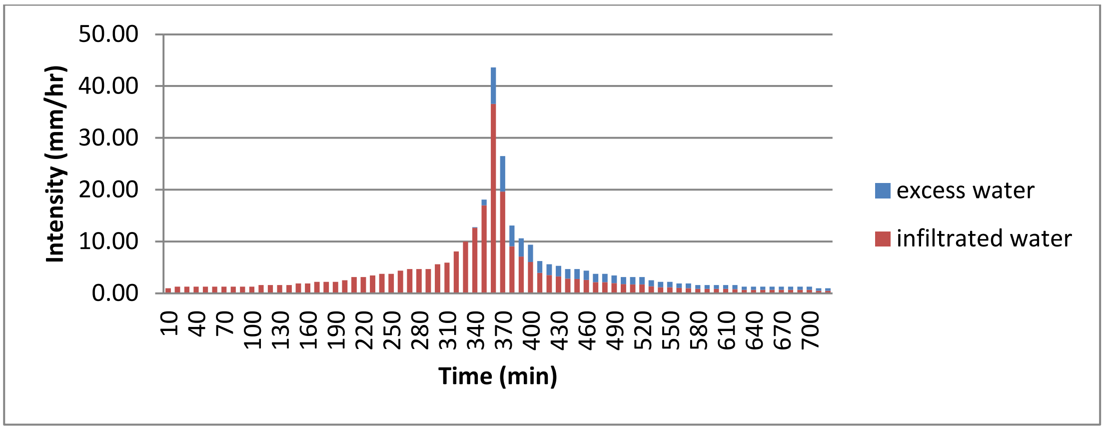



**Figure B 16** Hyetograph of Tatlım Creek Subbasin (Tr = 50 yr)

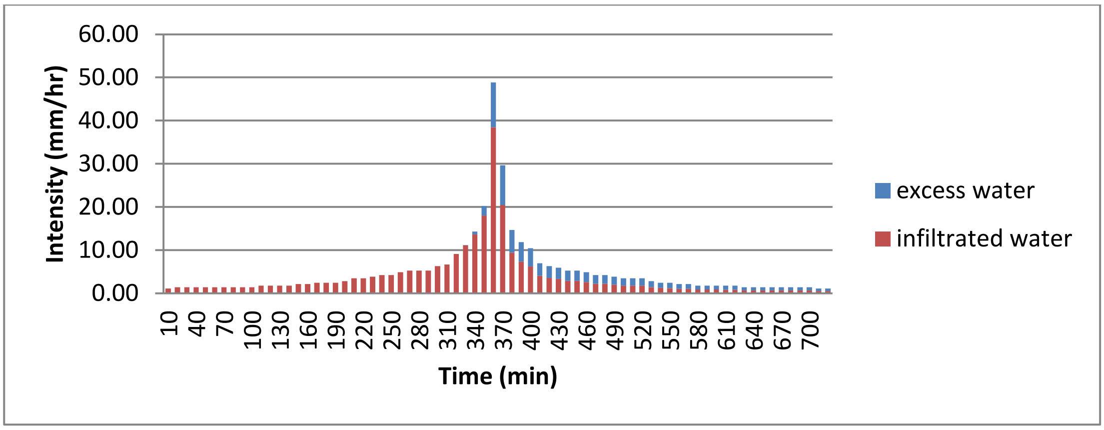



**Figure B 17** Hyetograph of Tatlım Creek Subbasin (Tr = 100 yr)

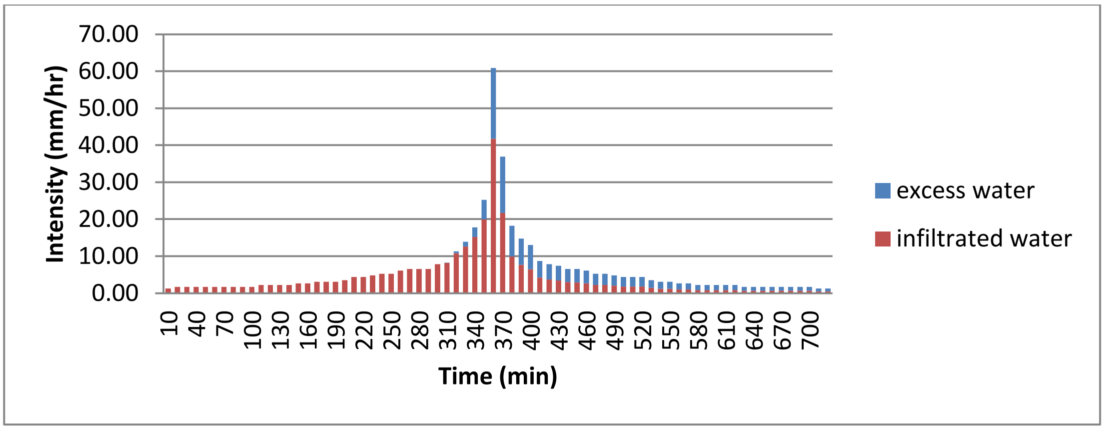



**Figure B 18** Hyetograph of Tatlım Creek Subbasin (Tr = 500 yr)

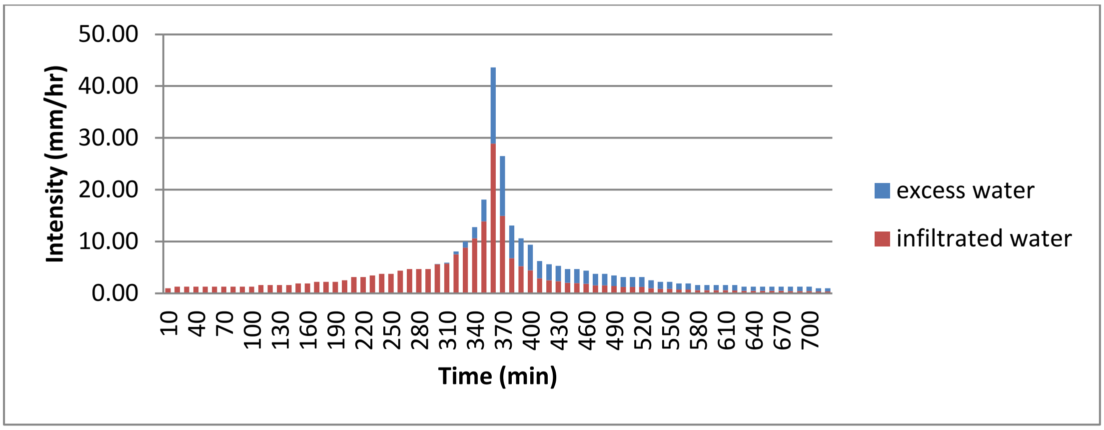



**Figure B 19** Hyetograph of Burcupınar Creek Subbasin (Tr = 50 yr)

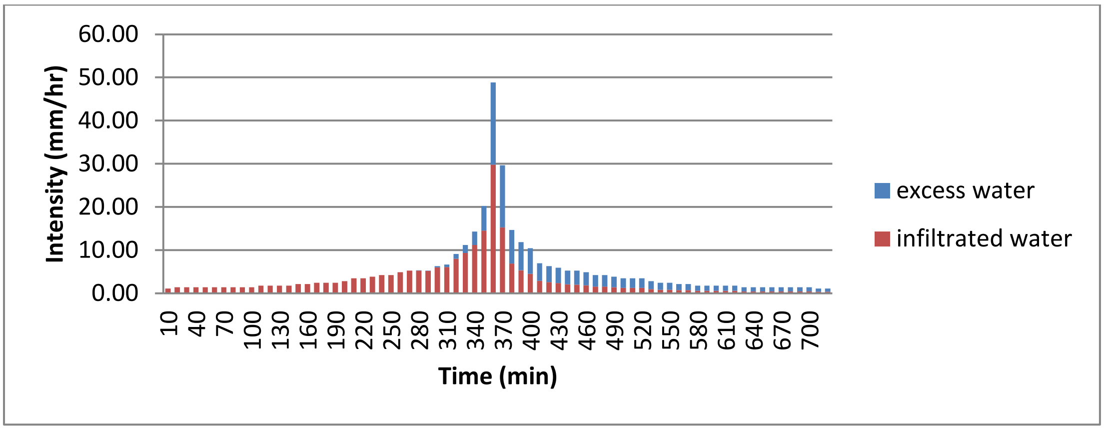



**Figure B 20** Hyetograph of Burcupınar Creek Subbasin (Tr = 100 yr)

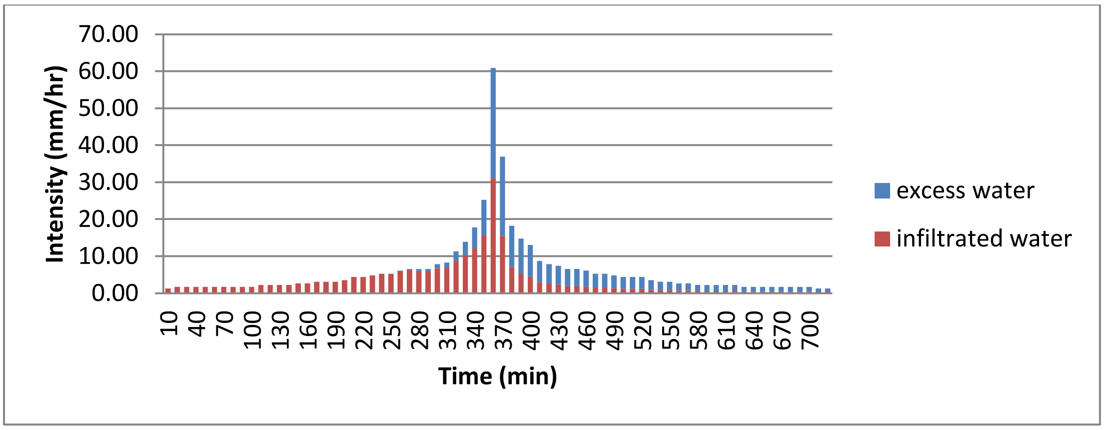



**Figure B 21** Hyetograph of Burcupınar Creek Subbasin (Tr = 500 yr)

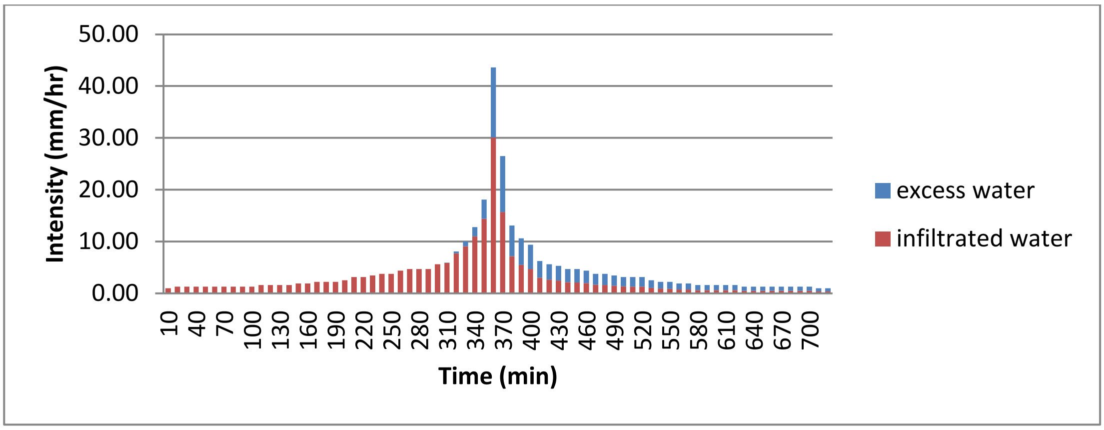



**Figure B 22** Hyetograph of Intermediate Zones (Tr = 50 yr)

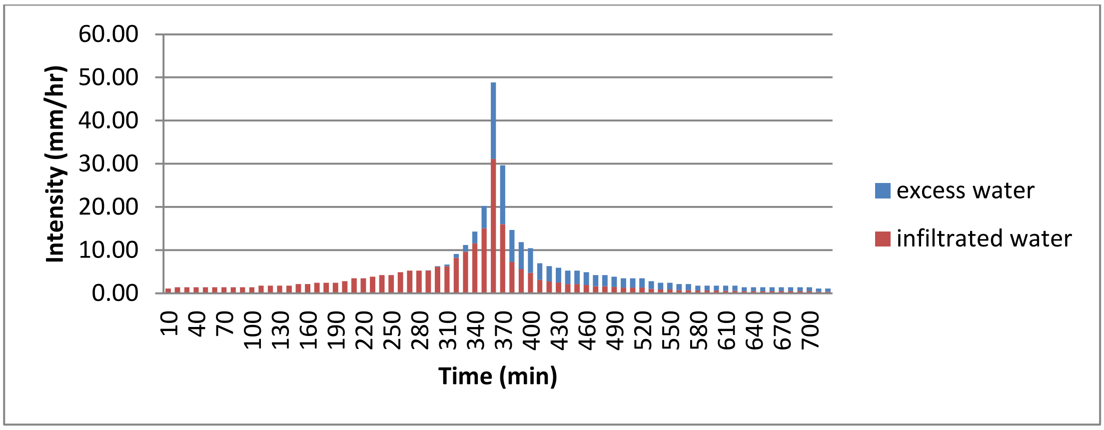



**Figure B 23** Hyetograph of Intermediate Zones (Tr = 100 yr)

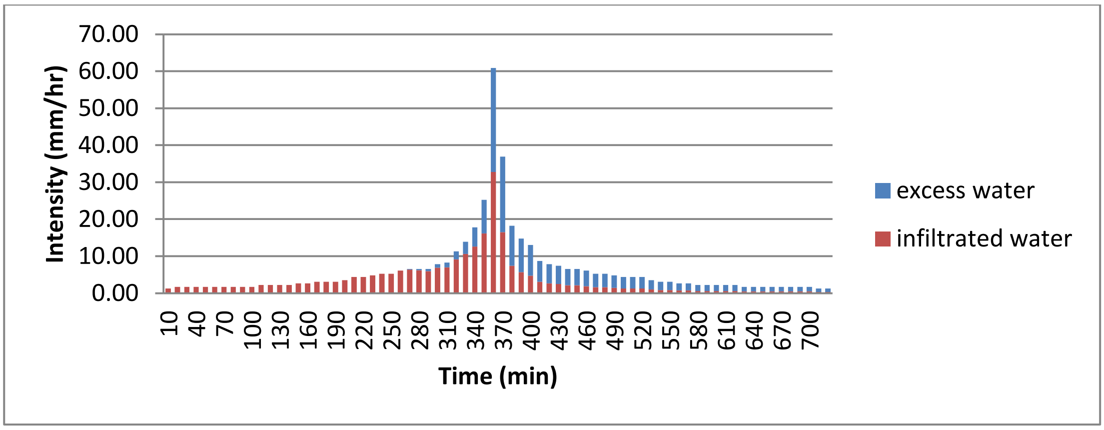



**Figure B 24** Hyetograph of Intermediate Zones (Tr = 500 yr)

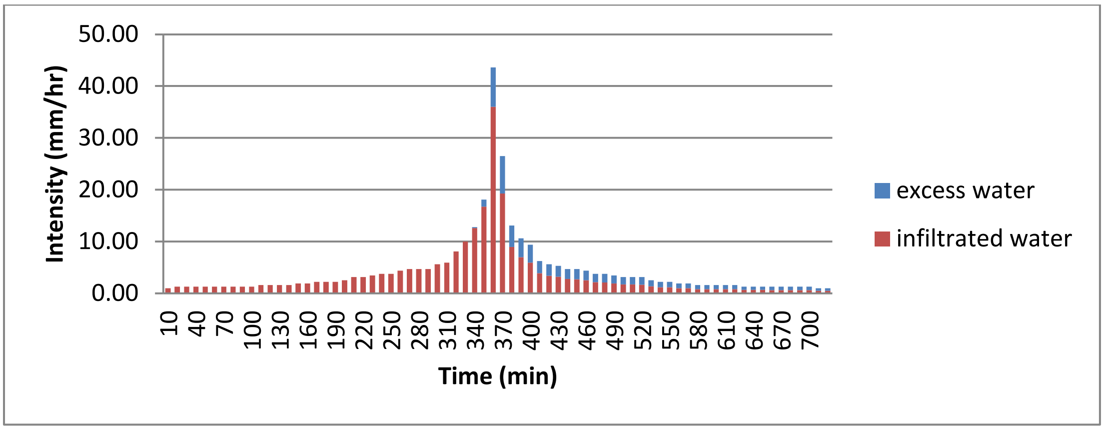



**Figure B 25** Hyetograph of Upstream of Lake Mogan Subbasin (Tr = 50 yr)

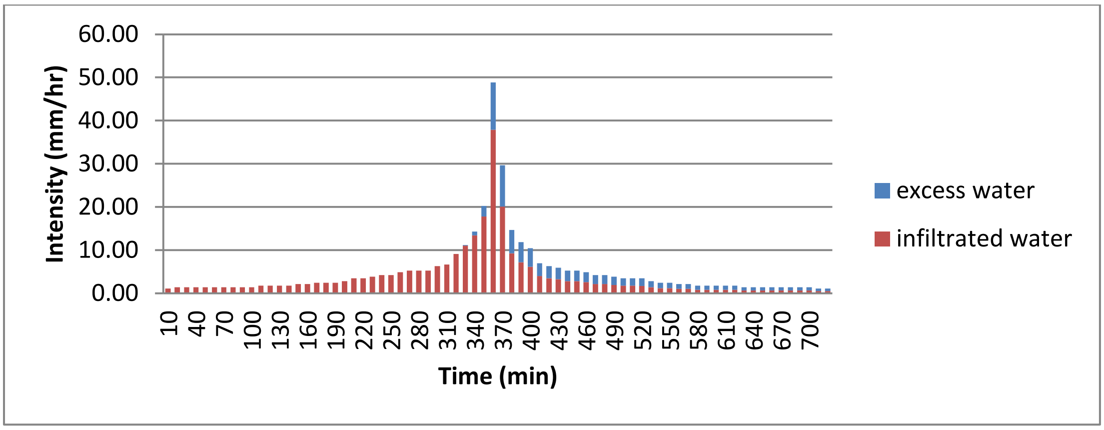



**Figure B 26** Hyetograph of Upstream of Lake Mogan Subbasin (Tr = 100 yr)

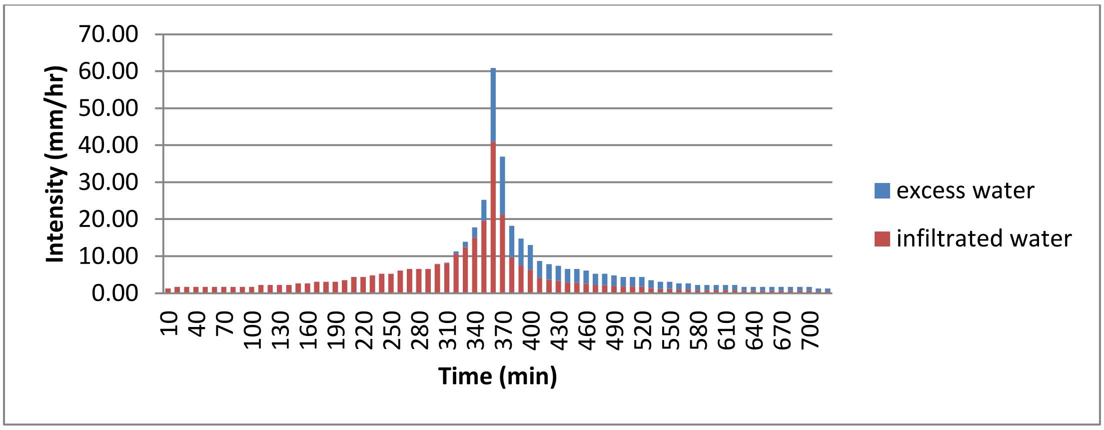



**Figure B 27** Hyetograph of Upstream of Lake Mogan Subbasin (Tr = 500 yr)

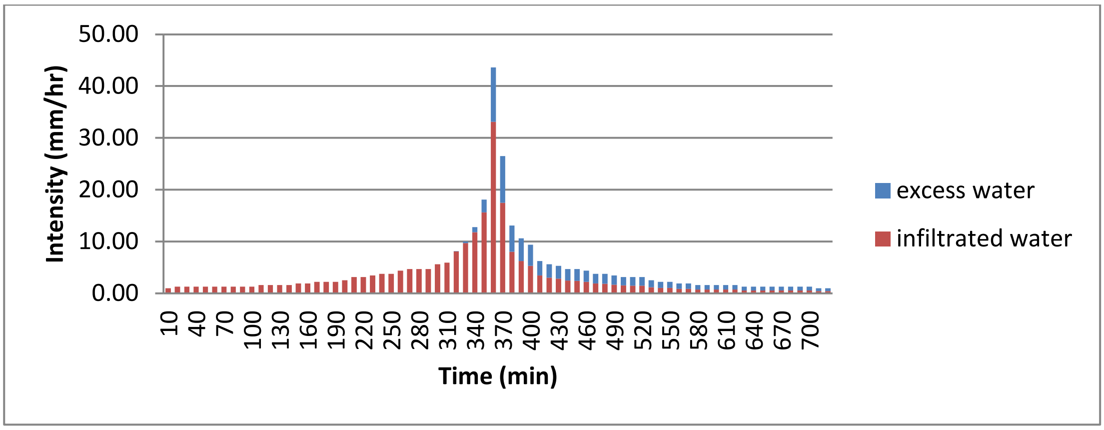



**Figure B 28** Hyetograph of Lake Eymir Basin (Tr = 50 yr)

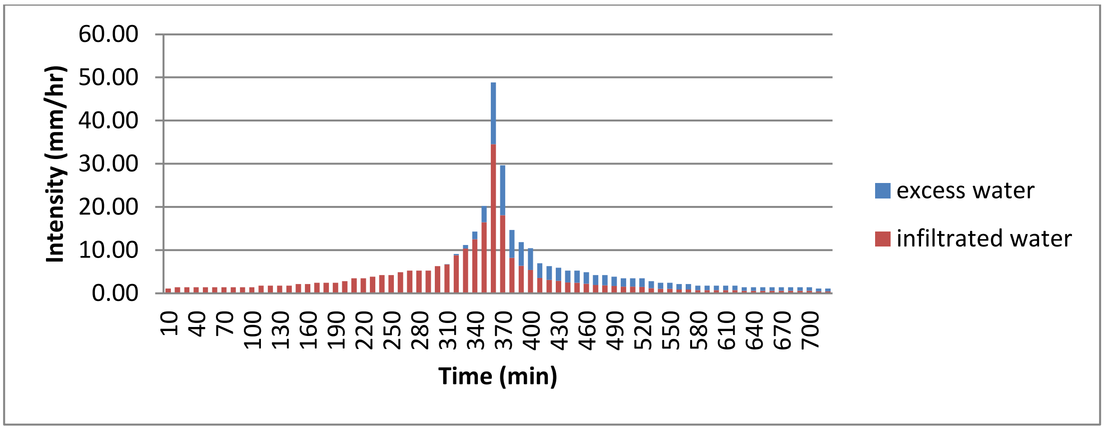



**Figure B 29** Hyetograph of Lake Eymir Basin (Tr = 100 yr)

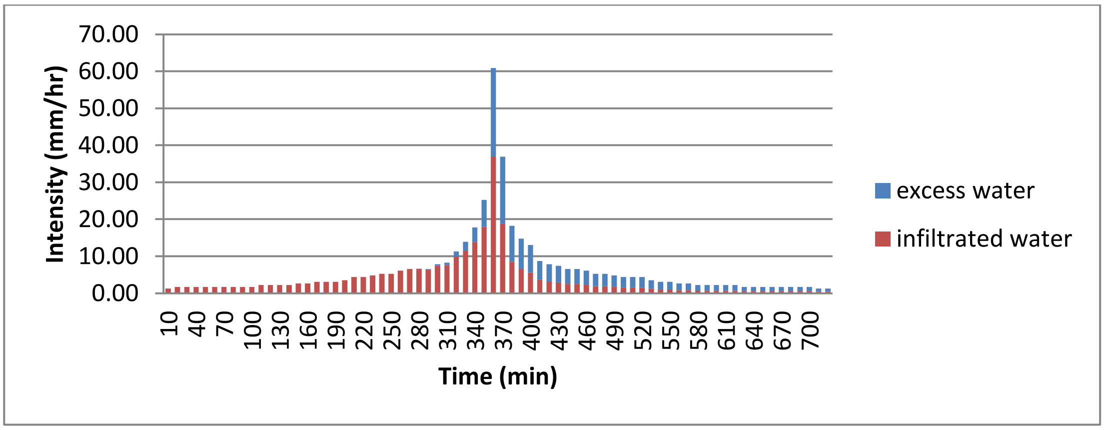



**Figure B 30** Hyetograph of Lake Eymir Basin (Tr = 500 yr)

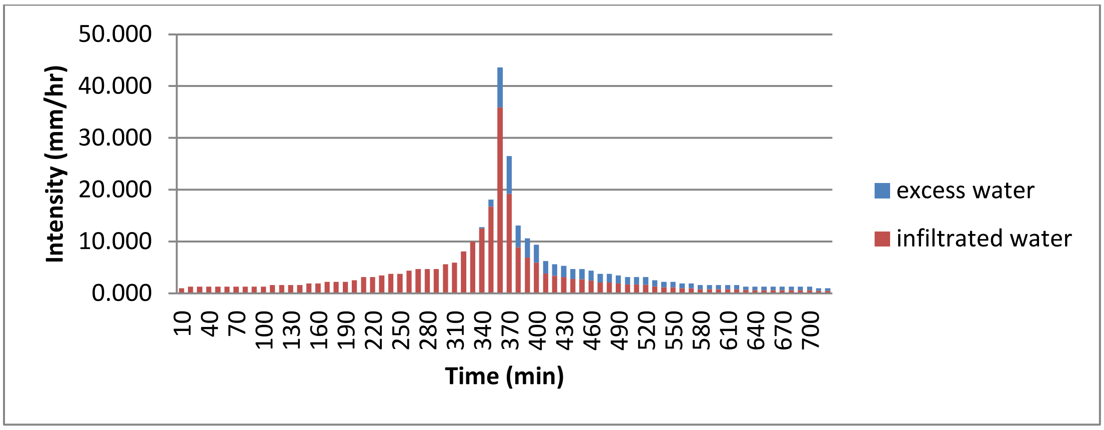



**Figure B 31** Hyetograph of İncesu Detention Pond Basin (Tr = 50 yr)

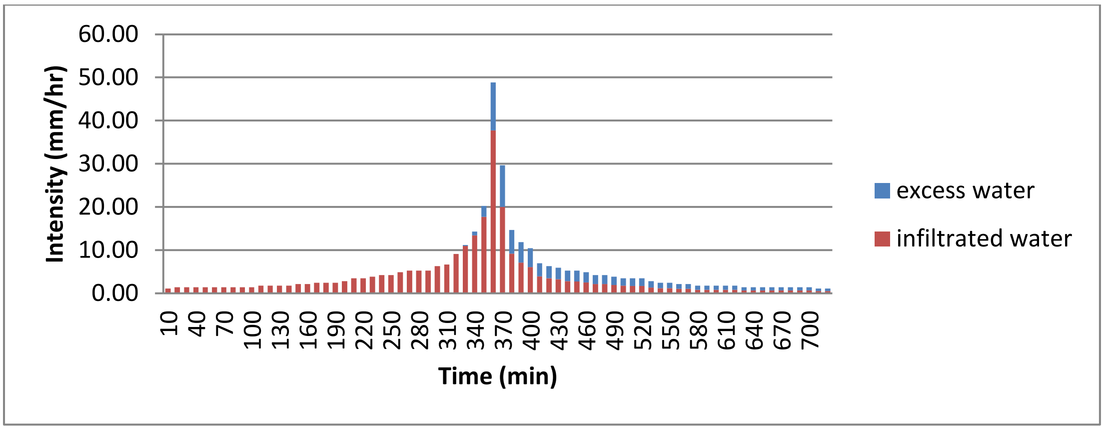



**Figure B 32** Hyetograph of İncesu Detention Pond Basin (Tr = 100 yr)

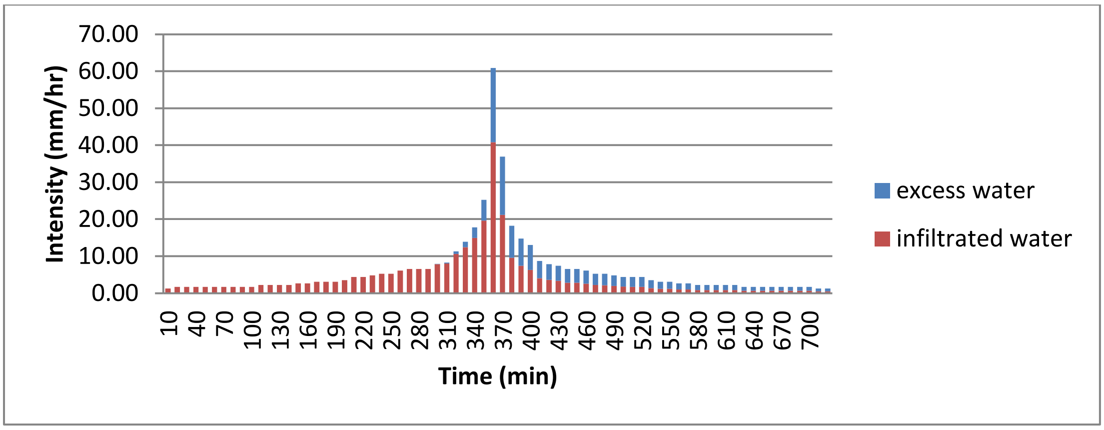



**Figure B 33** Hyetograph of İncesu Detention Pond Basin (Tr = 500 yr)

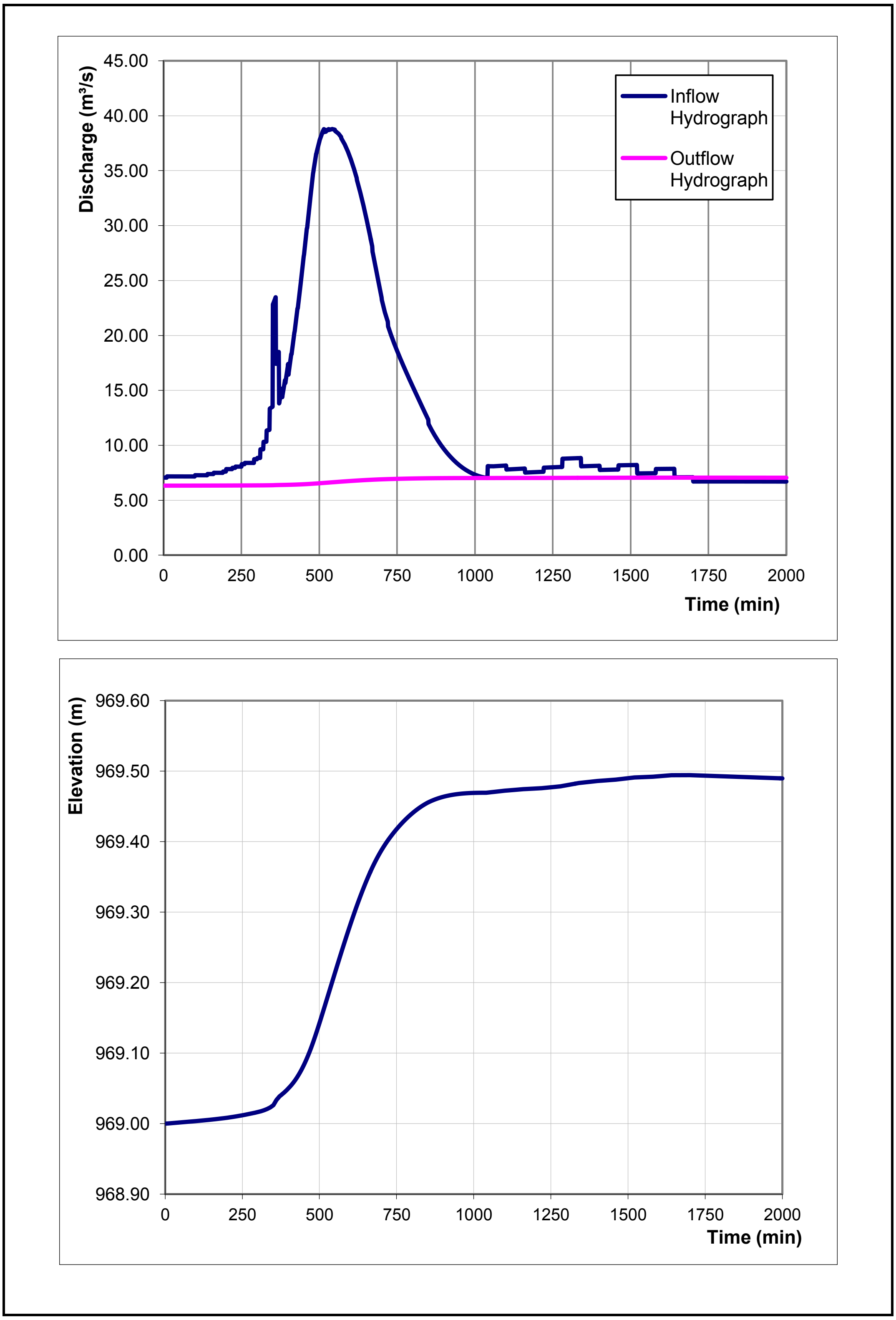



**Figure B 34** Operation Results of Lake Eymir Water Control Structure (Case 1)

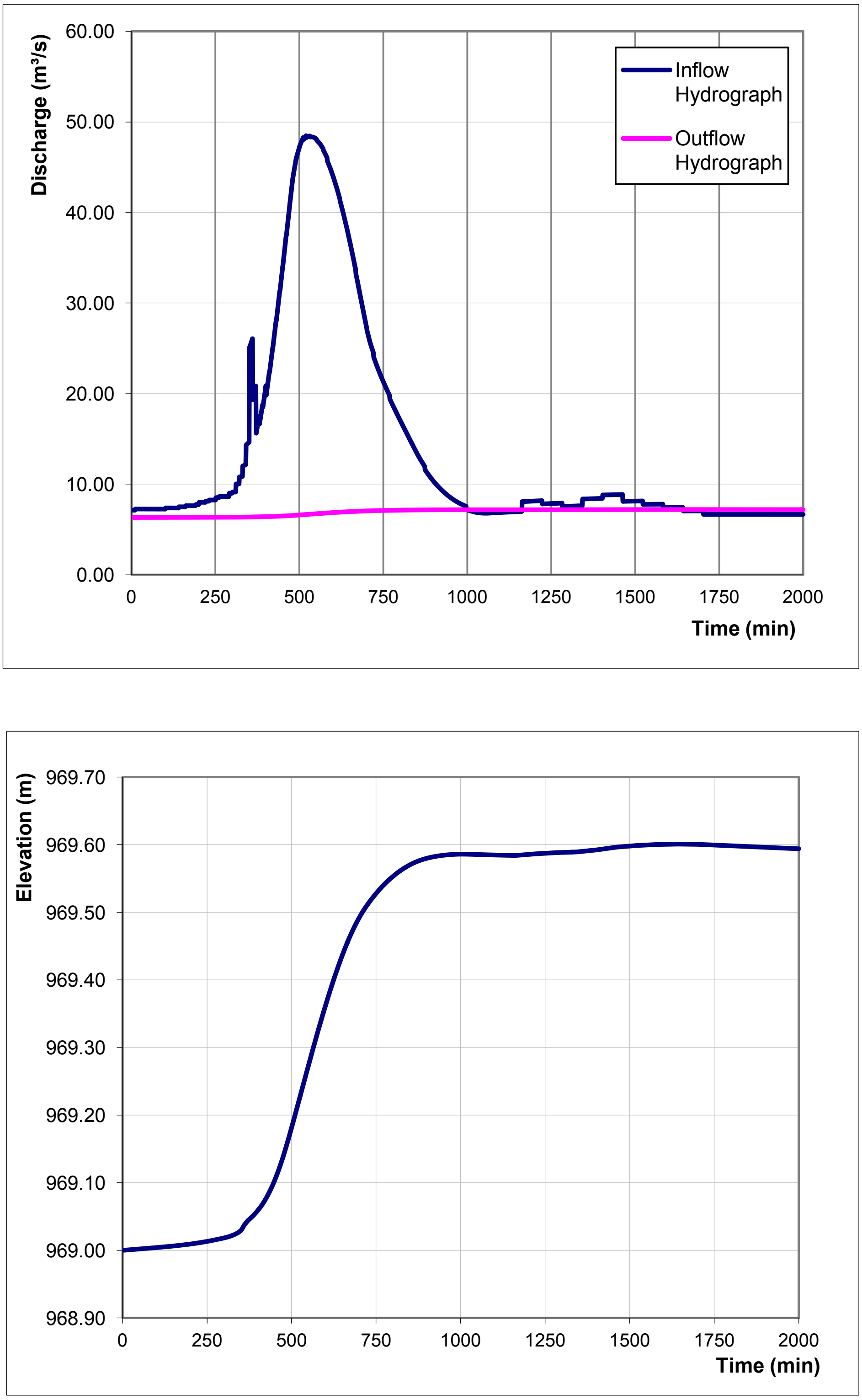



**Figure B 35** Operation Results of Lake Eymir Water Control Structure (Case 2)

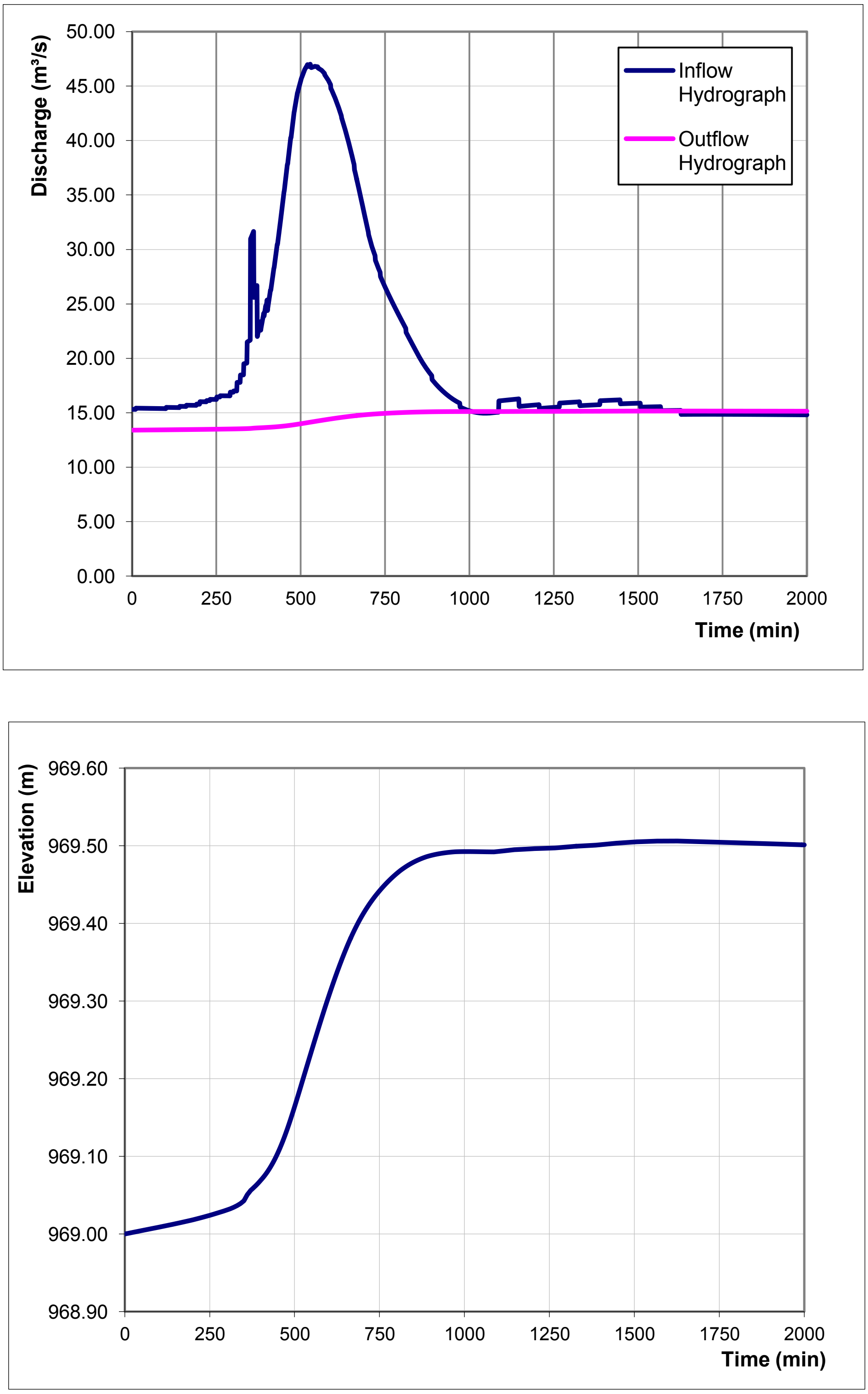
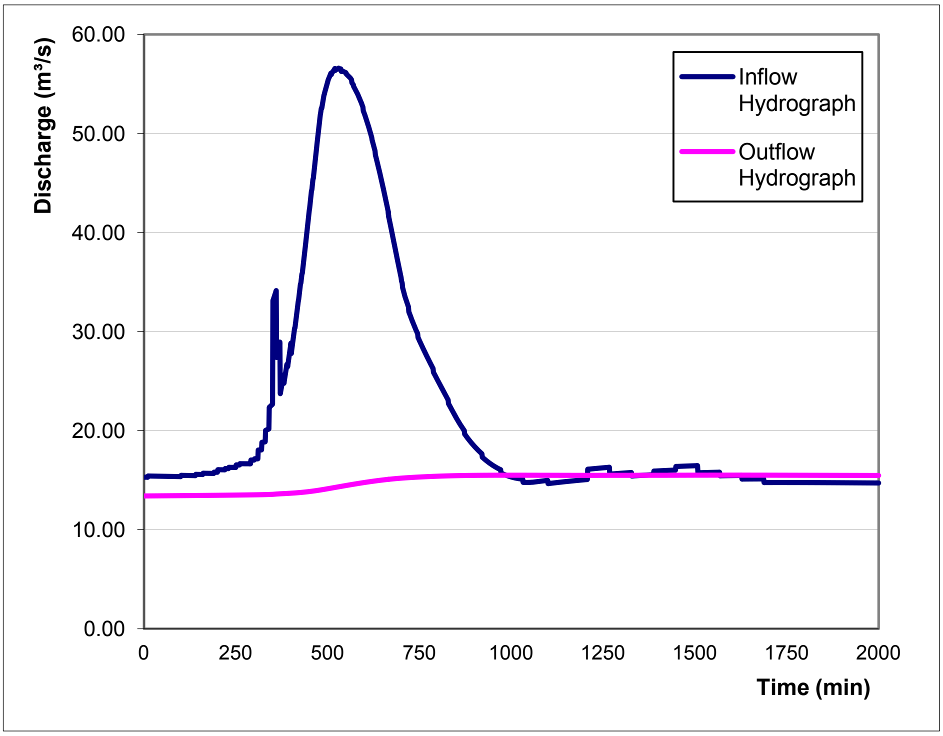



**Figure B 36** Operation Results of Lake Eymir Water Control Structure (Case 3)



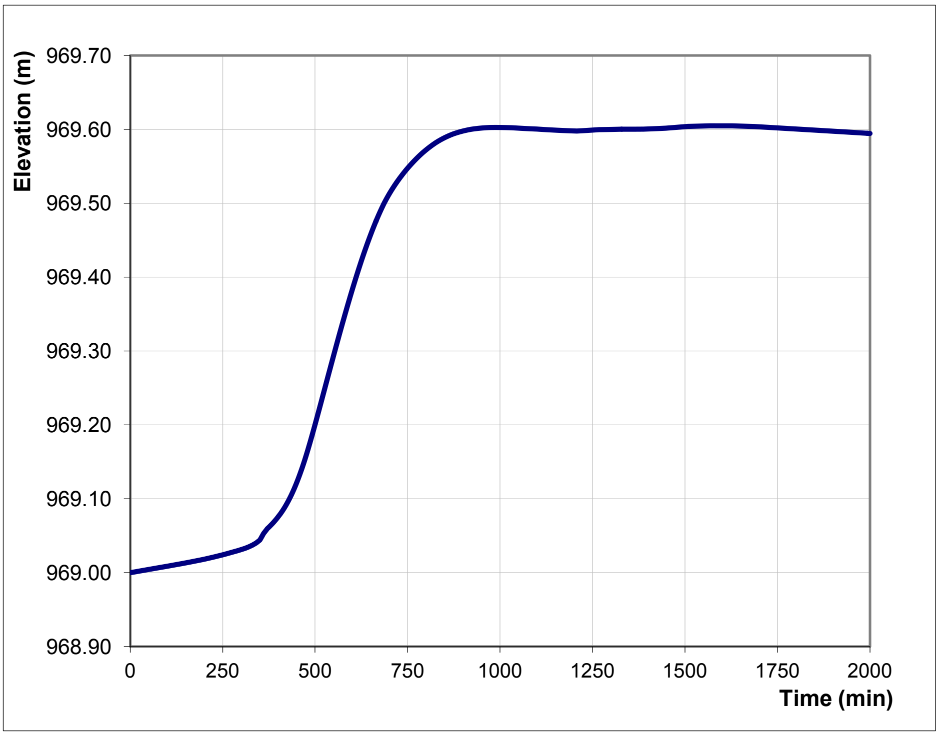
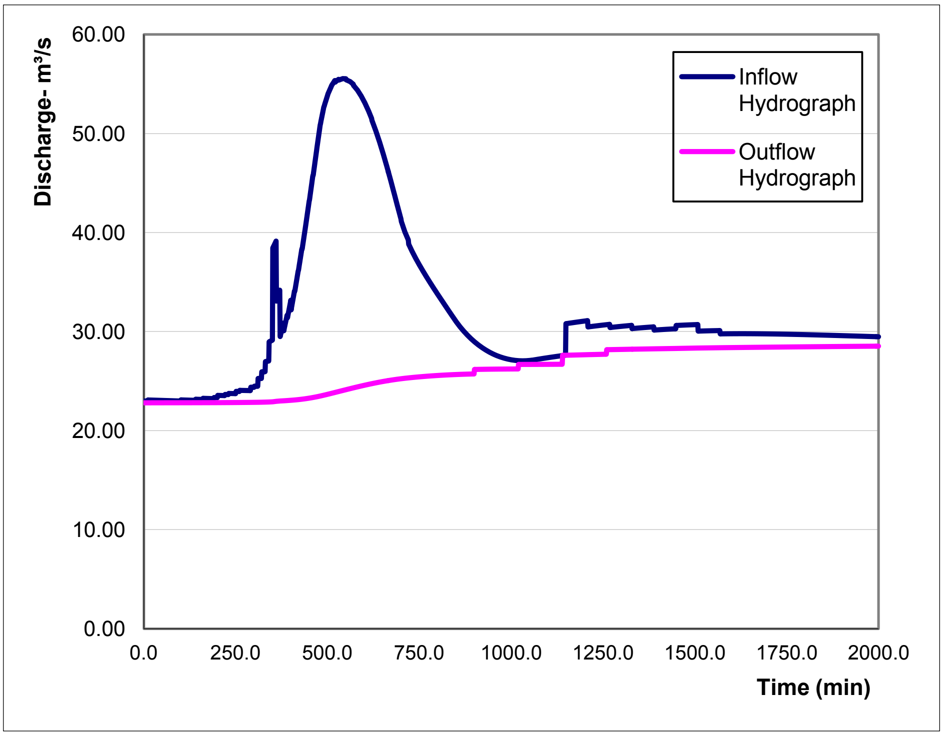




**Figure B 37** Operation Results of Lake Eymir Water Control Structure (Case 4)



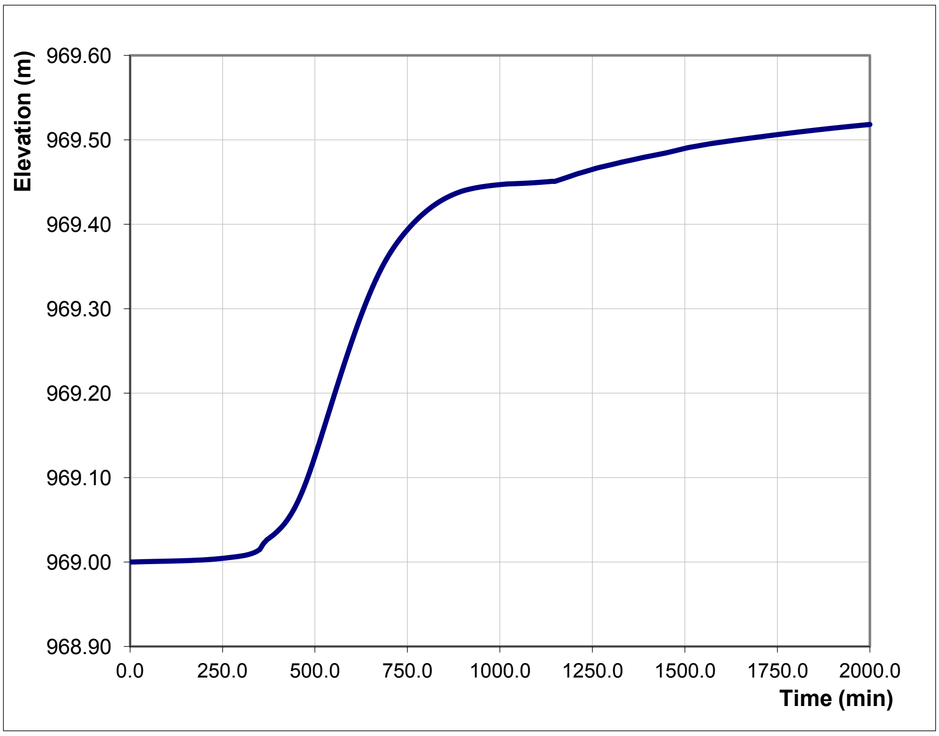
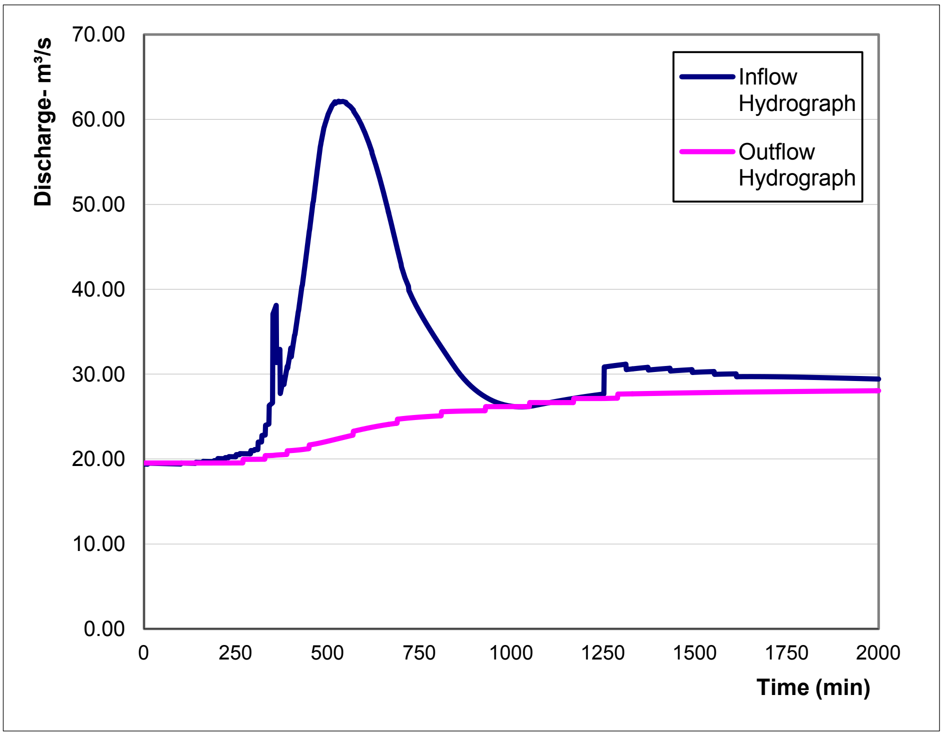




**Figure B 38** Operation Results of Lake Eymir Water Control Structure (Case 5)



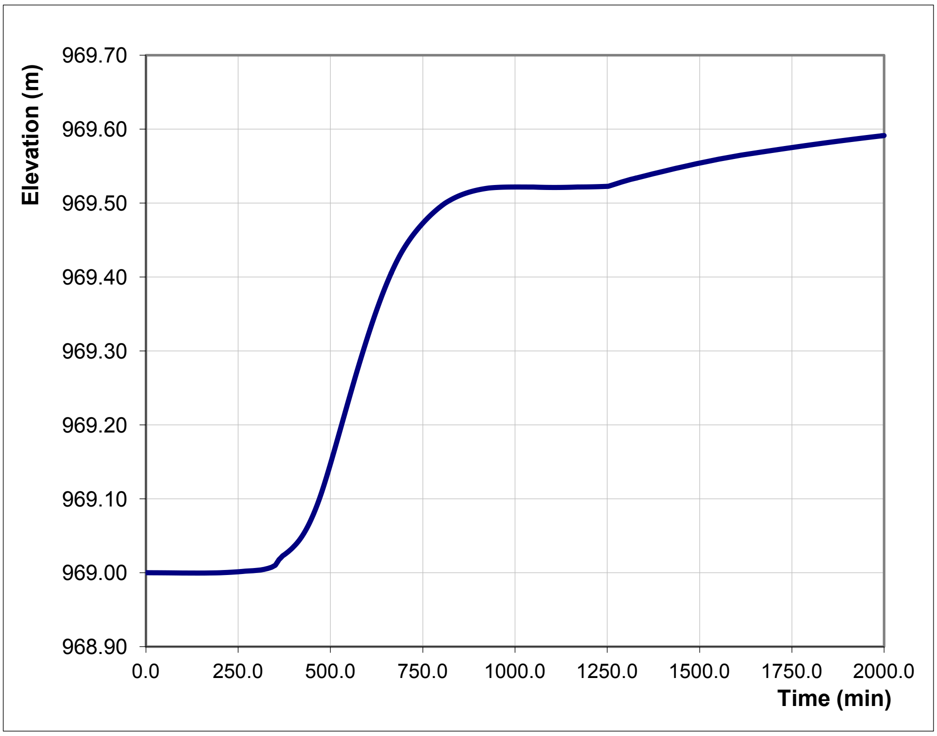




**Figure B 39** Operation Results of Lake Eymir Water Control Structure (Case 6)

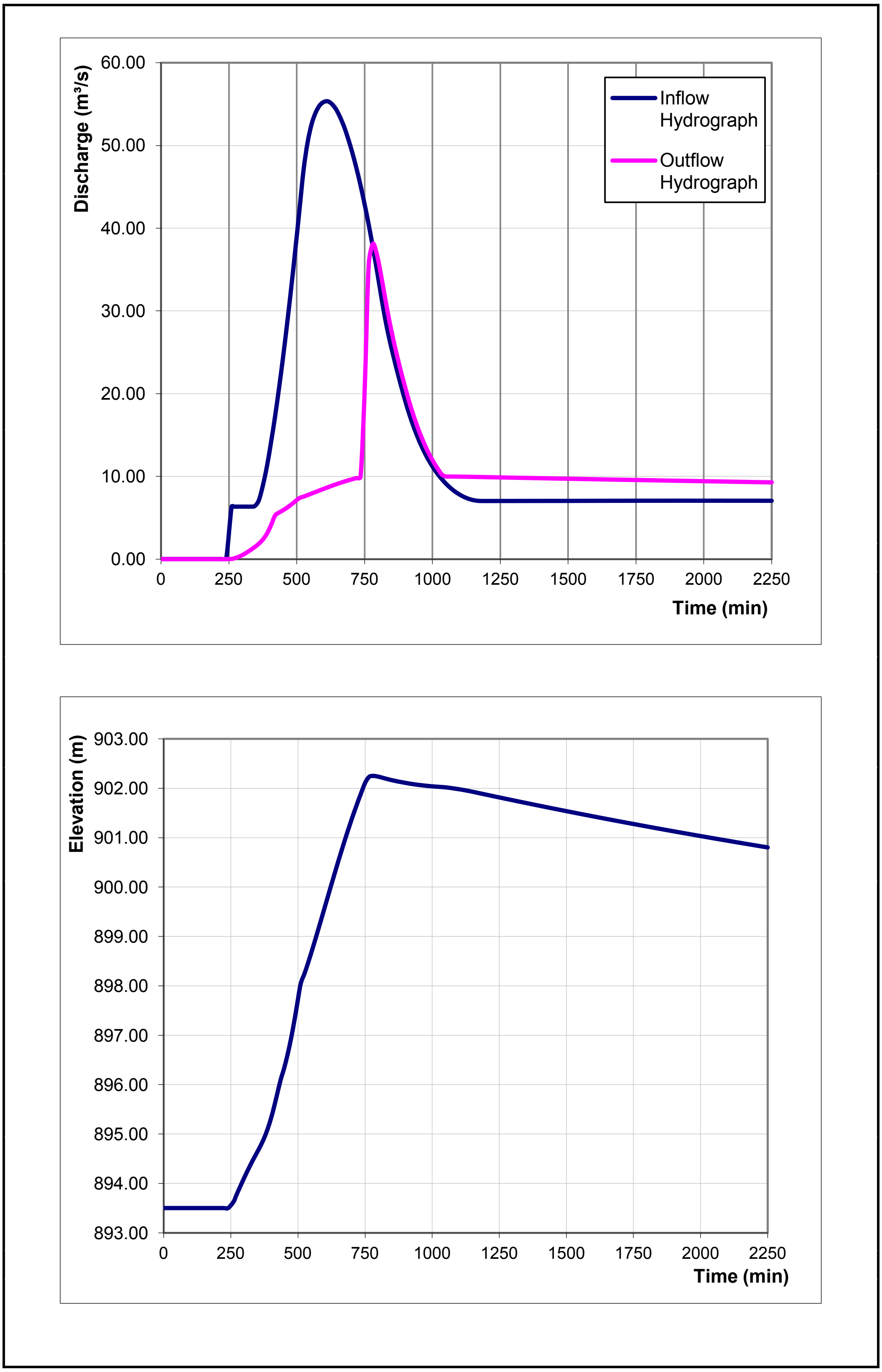
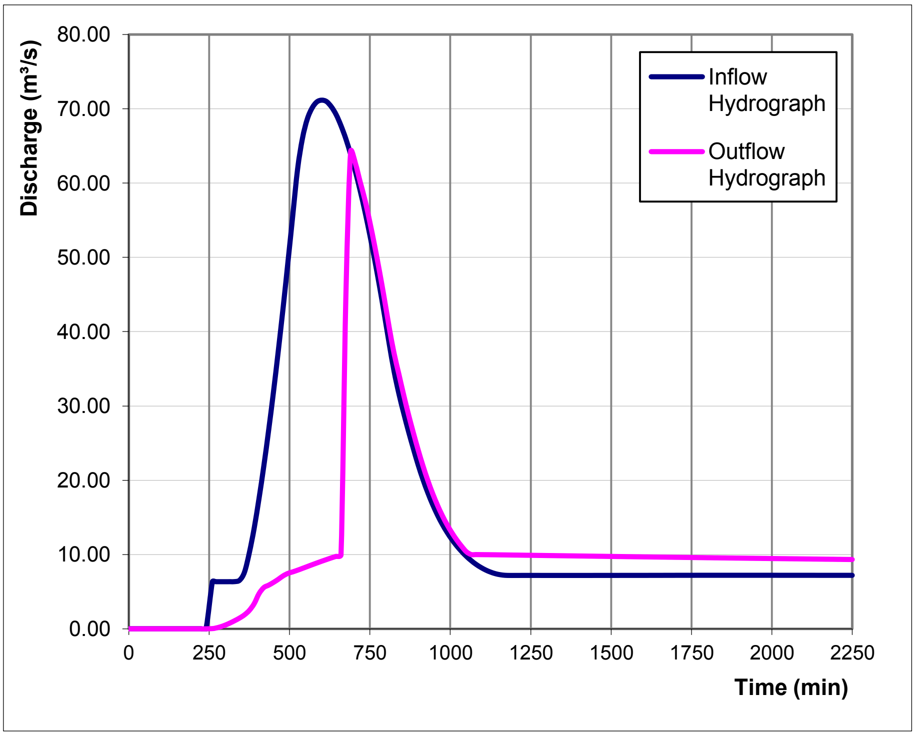



**Figure B 40** Operation Results of İncesu Detention Pond (Case 1)



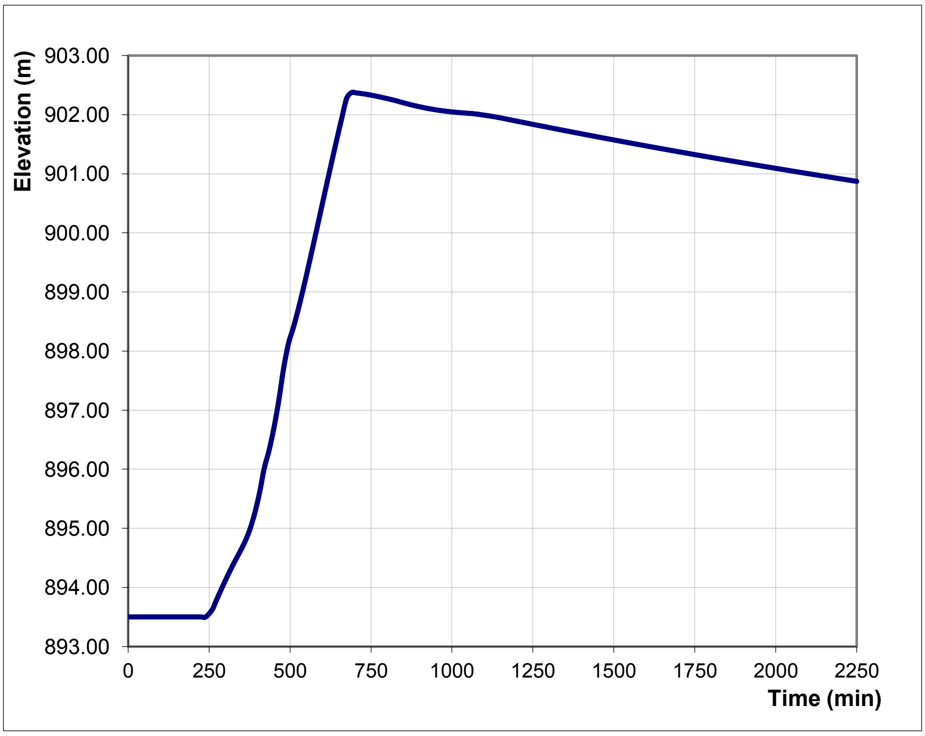




**Figure B 41** Operation Results of İncesu Detention Pond (Case 2)

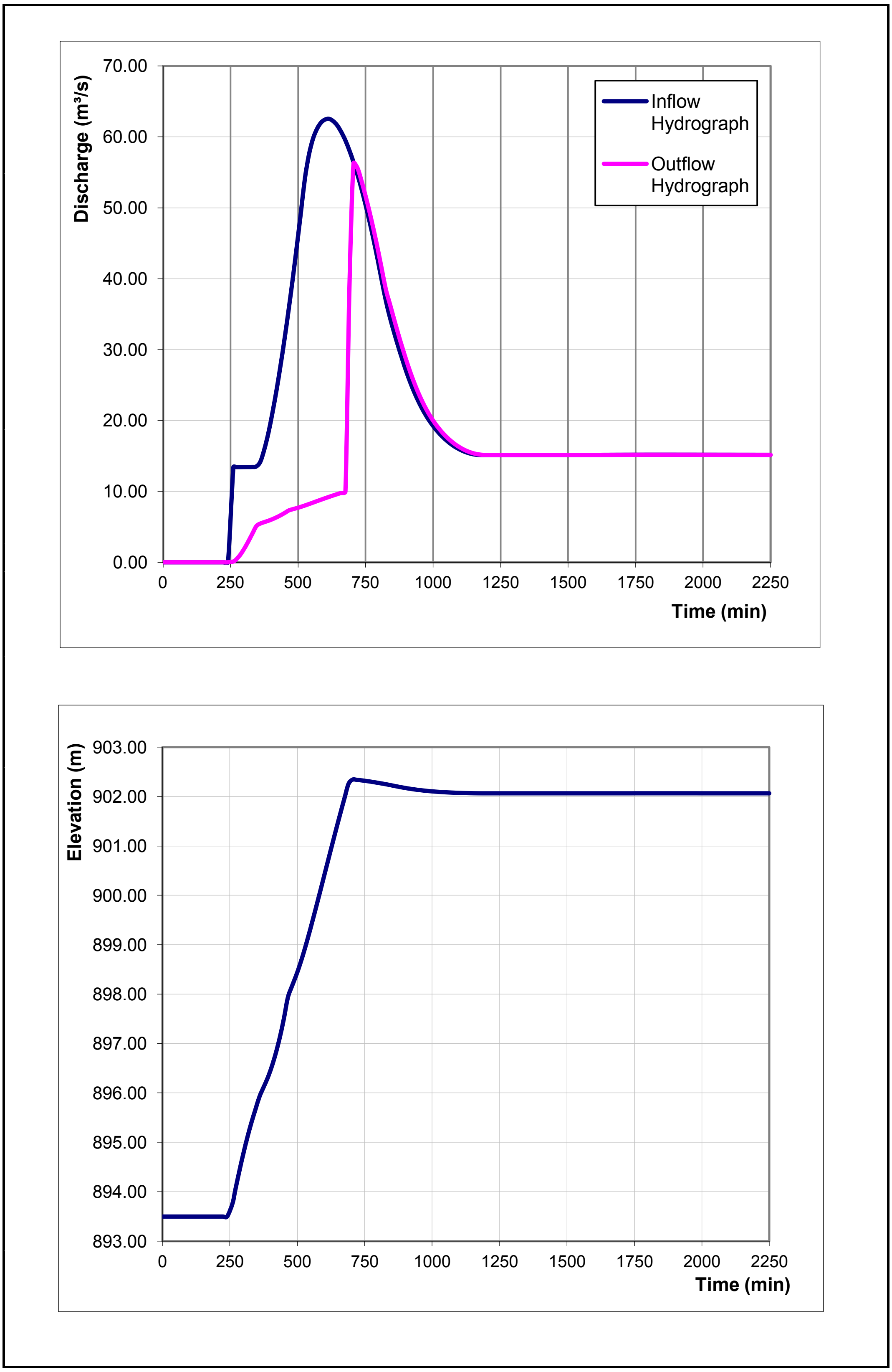



**Figure B 42** Operation Results of İncesu Detention Pond (Case 3)

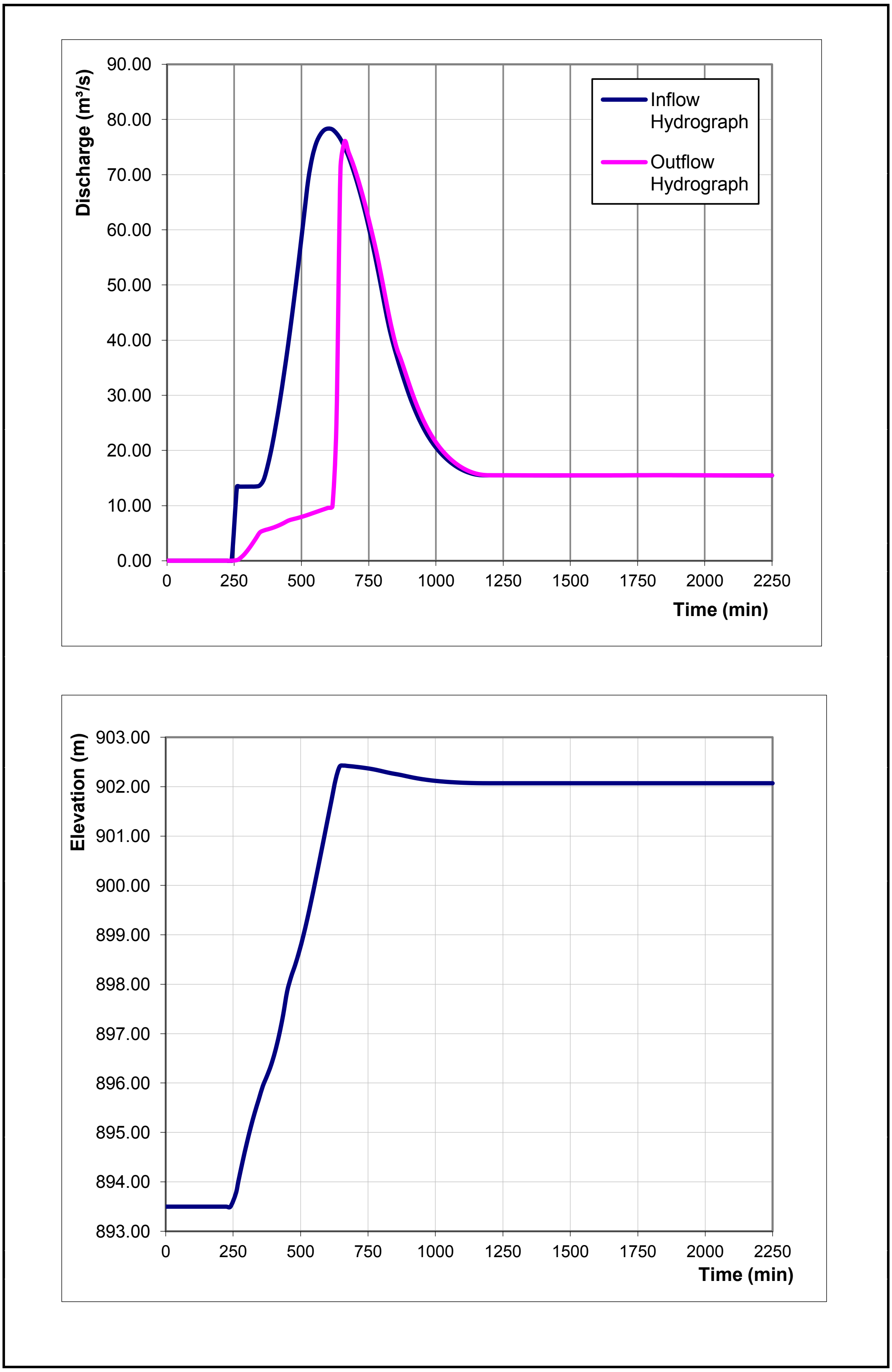



**Figure B 43** Operation Results of İncesu Detention Pond (Case 4)

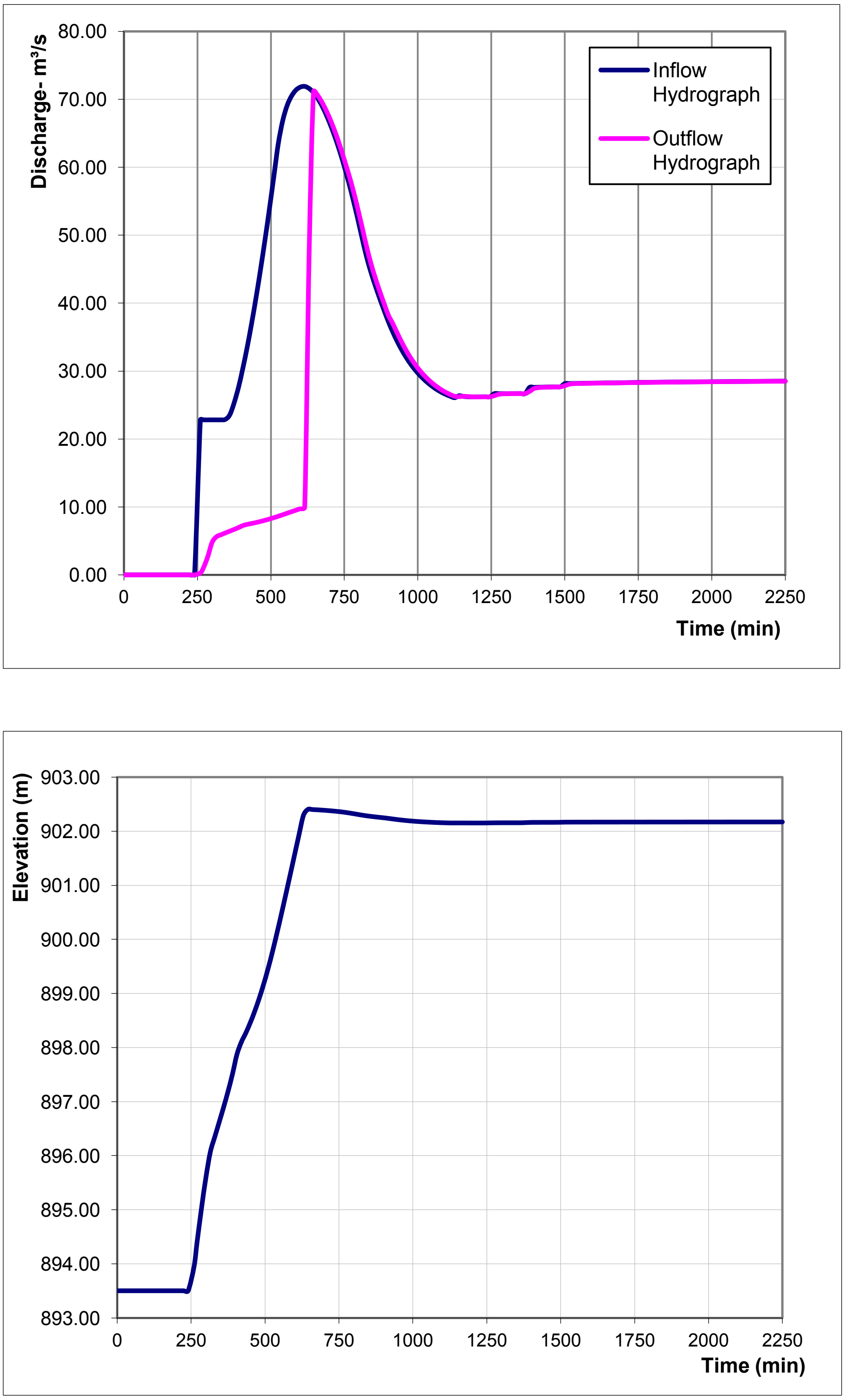



**Figure B 44** Operation Results of İncesu Detention Pond (Case 5)

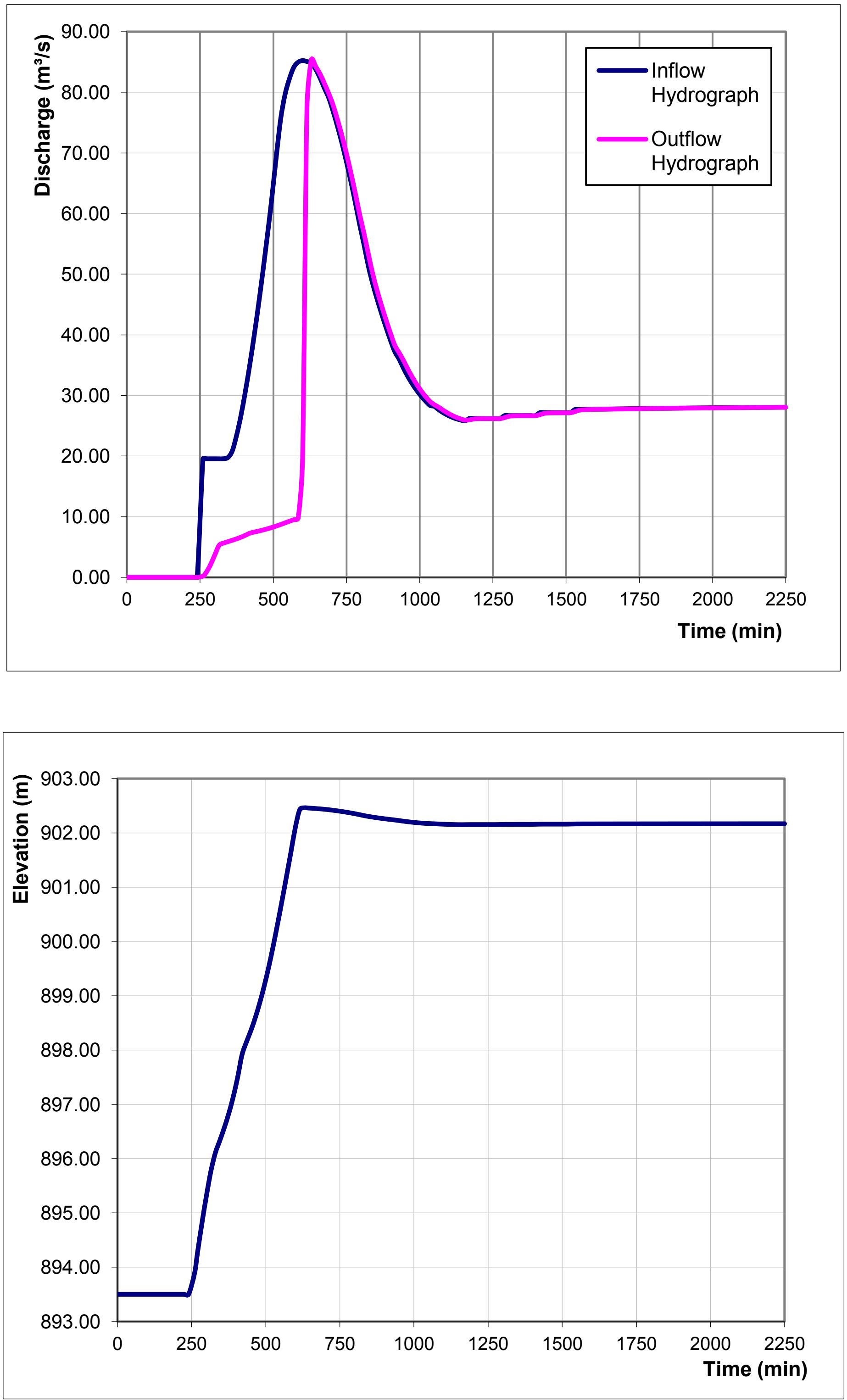



**Figure B 45** Operation Results of İncesu Detention Pond (Case 6)

# APPENDIX C

Table C 1 Water Elevations of Lake Mogan (1997 Water Year)

| DAY/MONTH | OCTOBER | NOVEMBER | DECEMBER | JANUARY | FEBRUARY | MARCH | APRIL | MAY | JUNE | JULY | AUGUST | SEPTEMBER |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **1** | 972.63 | 972.65 | 972.71 | 972.86 | 972.88 | 972.91 | 973.04 | 973.23 | 973.07 | 972.88 | 972.68 | 972.60 |
| **2** | 972.63 | 972.65 | 972.71 | 972.86 | 972.88 | 972.92 | 973.05 | 973.23 | 973.06 | 972.87 | 972.68 | 972.59 |
| **3** | 972.62 | 972.65 | 972.71 | 972.86 | 972.88 | 972.92 | 973.05 | 973.23 | 973.06 | 972.87 | 972.68 | 972.58 |
| **4** | 972.62 | 972.65 | 972.72 | 972.86 | 972.88 | 972.92 | 973.05 | 973.23 | 973.04 | 972.86 | 972.67 | 972.58 |
| **5** | 972.62 | 972.65 | 972.72 | 972.86 | 972.88 | 972.93 | 973.06 | 973.24 | 973.03 | 972.85 | 972.66 | 972.57 |
| **6** | 972.62 | 972.65 | 972.73 | 972.86 | 972.88 | 972.93 | 973.07 | 973.24 | 973.01 | 972.84 | 972.65 | 972.57 |
| **7** | 972.62 | 972.65 | 972.73 | 972.86 | 972.88 | 972.93 | 973.09 | 973.24 | 973.00 | 972.84 | 972.65 | 972.56 |
| **8** | 972.61 | 972.66 | 972.73 | 972.86 | 972.88 | 972.94 | 973.10 | 973.24 | 973.00 | 972.84 | 972.65 | 972.56 |
| **9** | 972.61 | 972.66 | 972.74 | 972.86 | 972.88 | 972.94 | 973.11 | 973.24 | 972.99 | 972.83 | 972.64 | 972.56 |
| **10** | 972.61 | 972.66 | 972.74 | 972.86 | 972.88 | 972.94 | 973.14 | 973.23 | 972.99 | 972.82 | 972.64 | 972.55 |
| **11** | 972.61 | 972.66 | 972.74 | 972.86 | 972.89 | 972.95 | 973.16 | 973.23 | 972.99 | 972.81 | 972.64 | 972.55 |
| **12** | 972.61 | 972.66 | 972.75 | 972.86 | 972.89 | 972.95 | 973.17 | 973.24 | 972.99 | 972.80 | 972.64 | 972.54 |
| **13** | 972.61 | 972.67 | 972.75 | 972.86 | 972.89 | 972.96 | 973.17 | 973.23 | 972.99 | 972.80 | 972.63 | 972.54 |
| **14** | 972.61 | 972.68 | 972.76 | 972.86 | 972.89 | 972.96 | 973.18 | 973.22 | 972.98 | 972.79 | 972.62 | 972.53 |
| **15** | 972.61 | 972.68 | 972.76 | 972.86 | 972.89 | 972.97 | 973.18 | 973.20 | 972.97 | 972.78 | 972.62 | 972.53 |
| **16** | 972.61 | 972.68 | 972.77 | 972.87 | 972.89 | 972.97 | 973.19 | 973.19 | 972.96 | 972.78 | 972.62 | 972.53 |
| **17** | 972.61 | 972.68 | 972.77 | 972.87 | 972.90 | 972.98 | 973.19 | 973.18 | 972.95 | 972.77 | 972.64 | 972.52 |
| **18** | 972.61 | 972.68 | 972.78 | 972.87 | 972.90 | 972.98 | 973.19 | 973.17 | 972.95 | 972.76 | 972.64 | 972.52 |
| **19** | 972.61 | 972.68 | 972.78 | 972.87 | 972.90 | 972.99 | 973.20 | 973.16 | 972.94 | 972.76 | 972.63 | 972.52 |
| **20** | 972.61 | 972.68 | 972.78 | 972.87 | 972.90 | 972.99 | 973.20 | 973.15 | 972.94 | 972.75 | 972.63 | 972.52 |
| **21** | 972.61 | 972.69 | 972.79 | 972.87 | 972.90 | 972.99 | 973.20 | 973.14 | 972.93 | 972.75 | 972.63 | 972.51 |
| **22** | 972.62 | 972.69 | 972.79 | 972.87 | 972.90 | 973.00 | 973.21 | 973.14 | 972.92 | 972.74 | 972.62 | 972.51 |
| **23** | 972.62 | 972.69 | 972.80 | 972.87 | 972.91 | 973.01 | 973.21 | 973.13 | 972.91 | 972.73 | 972.62 | 972.50 |
| **24** | 972.62 | 972.69 | 972.80 | 972.87 | 972.91 | 973.01 | 973.21 | 973.13 | 972.90 | 972.72 | 972.62 | 972.50 |
| **25** | 972.62 | 972.69 | 972.81 | 972.87 | 972.91 | 973.01 | 973.21 | 973.14 | 972.90 | 972.72 | 972.62 | 972.50 |
| **26** | 972.63 | 972.69 | 972.81 | 972.87 | 972.91 | 973.02 | 973.21 | 973.13 | 972.89 | 972.71 | 972.62 | 972.49 |
| **27** | 972.64 | 972.70 | 972.82 | 972.87 | 972.91 | 973.02 | 973.22 | 973.13 | 972.89 | 972.71 | 972.62 | 972.49 |
| **28** | 972.64 | 972.70 | 972.83 | 972.87 | 972.91 | 973.02 | 973.22 | 973.12 | 972.89 | 972.70 | 972.61 | 972.49 |
| **29** | 972.64 | 972.70 | 972.85 | 972.87 | | 973.03 | 973.22 | 973.11 | 972.88 | 972.70 | 972.61 | 972.49 |
| **30** | 972.64 | 972.70 | 972.85 | 972.87 | | 973.03 | 973.22 | 973.10 | 972.88 | 972.69 | 972.61 | 972.48 |
| **31** | 972.64 | | 972.86 | 972.87 | | 973.03 | | 973.09 | | 972.69 | 972.60 | |
| **AVERAGE** | 972.62 | 972.67 | 972.77 | 972.87 | 972.89 | 972.97 | 973.16 | 973.18 | 972.96 | 972.78 | 972.64 | 972.53 |

Table C 2 Water Elevations of Lake Mogan (1998 Water Year)

| DAY/MONTH | OCTOBER | NOVEMBER | DECEMBER | JANUARY | FEBRUARY | MARCH | APRIL | MAY | JUNE | JULY | AUGUST | SEPTEMBER |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **1** | 972.48 | 972.51 | 972.61 | 972.78 | 972.90 | 972.91 | 973.05 | 973.09 | 973.22 | 973.20 | 972.93 | 972.75 |
| **2** | 972.48 | 972.51 | 972.62 | 972.79 | 972.90 | 972.91 | 973.06 | 973.09 | 973.22 | 973.20 | 972.92 | 972.75 |
| **3** | 972.48 | 972.51 | 972.62 | 972.79 | 972.90 | 972.92 | 973.06 | 973.07 | 973.22 | 973.20 | 972.91 | 972.74 |
| **4** | 972.48 | 972.51 | 972.63 | 972.80 | 972.90 | 972.92 | 973.07 | 973.06 | 973.22 | 973.19 | 972.90 | 972.73 |
| **5** | 972.47 | 972.51 | 972.63 | 972.80 | 972.90 | 972.92 | 973.08 | 973.05 | 973.22 | 973.19 | 972.89 | 972.73 |
| **6** | 972.47 | 972.51 | 972.64 | 972.81 | 972.90 | 972.92 | 973.09 | 973.03 | 973.22 | 973.18 | 972.89 | 972.72 |
| **7** | 972.47 | 972.52 | 972.65 | 972.82 | 972.90 | 972.92 | 973.09 | 973.01 | 973.22 | 973.18 | 972.88 | 972.72 |
| **8** | 972.47 | 972.52 | 972.66 | 972.83 | 972.90 | 972.92 | 973.10 | 973.02 | 973.21 | 973.18 | 972.88 | 972.72 |
| **9** | 972.47 | 972.52 | 972.67 | 972.83 | 972.90 | 972.92 | 973.11 | 973.03 | 973.20 | 973.16 | 972.87 | 972.71 |
| **10** | 972.47 | 972.52 | 972.68 | 972.83 | 972.90 | 972.92 | 973.11 | 973.03 | 973.20 | 973.13 | 972.87 | 972.71 |
| **11** | 972.47 | 972.52 | 972.68 | 972.83 | 972.90 | 972.92 | 973.12 | 973.02 | 973.20 | 973.12 | 972.85 | 972.71 |
| **12** | 972.47 | 972.52 | 972.68 | 972.83 | 972.90 | 972.92 | 973.12 | 973.01 | 973.19 | 973.10 | 972.85 | 972.71 |
| **13** | 972.47 | 972.52 | 972.68 | 972.83 | 972.90 | 972.92 | 973.12 | 973.02 | 973.19 | 973.09 | 972.84 | 972.70 |
| **14** | 972.46 | 972.52 | 972.69 | 972.84 | 972.90 | 972.92 | 973.10 | 973.02 | 973.18 | 973.08 | 972.84 | 972.70 |
| **15** | 972.46 | 972.52 | 972.69 | 972.84 | 972.90 | 972.93 | 973.09 | 973.03 | 973.17 | 973.07 | 972.83 | 972.69 |
| **16** | 972.46 | 972.52 | 972.69 | 972.85 | 972.91 | 972.93 | 973.10 | 973.03 | 973.15 | 973.06 | 972.82 | 972.68 |
| **17** | 972.45 | 972.54 | 972.69 | 972.85 | 972.91 | 972.93 | 973.13 | 973.04 | 973.15 | 973.04 | 972.82 | 972.66 |
| **18** | 972.48 | 972.54 | 972.69 | 972.86 | 972.91 | 972.93 | 973.12 | 973.05 | 973.16 | 973.03 | 972.81 | 972.66 |
| **19** | 972.48 | 972.56 | 972.70 | 972.86 | 972.91 | 972.93 | 973.11 | 973.08 | 973.15 | 973.02 | 972.81 | 972.65 |
| **20** | 972.48 | 972.57 | 972.70 | 972.86 | 972.91 | 972.93 | 973.10 | 973.10 | 973.13 | 973.01 | 972.82 | 972.64 |
| **21** | 972.49 | 972.57 | 972.70 | 972.86 | 972.91 | 972.94 | 973.08 | 973.13 | 973.11 | 972.99 | 972.81 | 972.63 |
| **22** | 972.49 | 972.58 | 972.71 | 972.86 | 972.91 | 972.95 | 973.07 | 973.16 | 973.13 | 972.98 | 972.81 | 972.63 |
| **23** | 972.49 | 972.58 | 972.71 | 972.86 | 972.91 | 972.95 | 973.07 | 973.18 | 973.18 | 972.97 | 972.80 | 972.63 |
| **24** | 972.49 | 972.59 | 972.72 | 972.87 | 972.91 | 972.96 | 973.07 | 973.19 | 973.18 | 972.96 | 972.80 | 972.63 |
| **25** | 972.49 | 972.59 | 972.72 | 972.87 | 972.91 | 972.96 | 973.06 | 973.20 | 973.19 | 972.95 | 972.79 | 972.63 |
| **26** | 972.51 | 972.60 | 972.73 | 972.87 | 972.91 | 972.97 | 973.06 | 973.21 | 973.20 | 972.95 | 972.79 | 972.63 |
| **27** | 972.51 | 972.60 | 972.73 | 972.88 | 972.91 | 972.97 | 973.07 | 973.22 | 973.20 | 972.94 | 972.78 | 972.63 |
| **28** | 972.51 | 972.60 | 972.74 | 972.89 | 972.91 | 972.98 | 973.08 | 973.22 | 973.20 | 972.93 | 972.78 | 972.62 |
| **29** | 972.51 | 972.61 | 972.75 | 972.89 | | 973.00 | 973.08 | 973.22 | 973.20 | 972.93 | 972.77 | 972.62 |
| **30** | 972.51 | 972.61 | 972.76 | 972.89 | | 973.01 | 973.09 | 973.22 | 973.20 | 972.93 | 972.77 | 972.62 |
| **31** | 972.51 | | 972.77 | 972.89 | | 973.03 | | 973.22 | | 972.94 | 972.76 | |
| **AVERAGE** | 972.48 | 972.55 | 972.69 | 972.84 | 972.90 | 972.94 | 973.09 | 973.10 | 973.19 | 973.06 | 972.84 | 972.68 |

Table C 3 Water Elevations of Lake Mogan (1999 Water Year)

| DAY/MONTH | OCTOBER | NOVEMBER | DECEMBER | JANUARY | FEBRUARY | MARCH | APRIL | MAY | JUNE | JULY | AUGUST | SEPTEMBER |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **1** | 972.62 | 972.63 | 972.71 | 972.84 | 972.89 | 972.92 | 973.09 | 973.10 | 972.95 | 972.96 | 972.76 | 972.65 |
| **2** | 972.62 | 972.63 | 972.71 | 972.84 | 972.89 | 972.92 | 973.11 | 973.10 | 972.95 | 972.95 | 972.76 | 972.65 |
| **3** | 972.62 | 972.63 | 972.71 | 972.84 | 972.89 | 972.93 | 973.12 | 973.09 | 972.96 | 972.95 | 972.76 | 972.65 |
| **4** | 972.61 | 972.63 | 972.71 | 972.84 | 972.89 | 972.93 | 973.14 | 973.09 | 972.96 | 972.95 | 972.75 | 972.65 |
| **5** | 972.61 | 972.63 | 972.71 | 972.85 | 972.89 | 972.93 | 973.15 | 973.08 | 972.97 | 972.94 | 972.75 | 972.65 |
| **6** | 972.61 | 972.63 | 972.71 | 972.85 | 972.89 | 972.94 | 973.17 | 973.07 | 972.97 | 972.93 | 972.75 | 972.65 |
| **7** | 972.61 | 972.63 | 972.71 | 972.86 | 972.89 | 972.94 | 973.17 | 973.07 | 972.98 | 972.92 | 972.74 | 972.65 |
| **8** | 972.61 | 972.63 | 972.72 | 972.86 | 972.89 | 972.95 | 973.18 | 973.06 | 972.99 | 972.91 | 972.74 | 972.65 |
| **9** | 972.61 | 972.63 | 972.72 | 972.86 | 972.90 | 972.95 | 973.18 | 973.06 | 973.00 | 972.90 | 972.74 | 972.65 |
| **10** | 972.61 | 972.64 | 972.73 | 972.86 | 972.90 | 972.96 | 973.19 | 973.05 | 973.00 | 972.89 | 972.73 | 972.65 |
| **11** | 972.61 | 972.64 | 972.73 | 972.87 | 972.90 | 972.96 | 973.24 | 973.04 | 973.01 | 972.88 | 972.73 | 972.65 |
| **12** | 972.61 | 972.64 | 972.73 | 972.87 | 972.90 | 972.97 | 973.30 | 973.03 | 973.02 | 972.87 | 972.72 | 972.65 |
| **13** | 972.61 | 972.65 | 972.74 | 972.87 | 972.90 | 972.97 | 973.29 | 973.03 | 973.02 | 972.86 | 972.72 | 972.64 |
| **14** | 972.61 | 972.65 | 972.75 | 972.87 | 972.90 | 972.98 | 973.27 | 973.02 | 973.02 | 972.85 | 972.71 | 972.64 |
| **15** | 972.61 | 972.66 | 972.76 | 972.87 | 972.90 | 972.98 | 973.26 | 973.02 | 973.01 | 972.84 | 972.71 | 972.64 |
| **16** | 972.61 | 972.66 | 972.77 | 972.87 | 972.90 | 972.99 | 973.26 | 973.01 | 973.01 | 972.83 | 972.70 | 972.64 |
| **17** | 972.60 | 972.66 | 972.78 | 972.87 | 972.90 | 972.99 | 973.25 | 973.01 | 973.01 | 972.83 | 972.70 | 972.64 |
| **18** | 972.60 | 972.66 | 972.78 | 972.87 | 972.91 | 973.00 | 973.24 | 973.01 | 973.00 | 972.82 | 972.70 | 972.64 |
| **19** | 972.60 | 972.66 | 972.79 | 972.87 | 972.91 | 973.01 | 973.23 | 973.00 | 973.00 | 972.82 | 972.69 | 972.64 |
| **20** | 972.60 | 972.66 | 972.80 | 972.87 | 972.91 | 973.02 | 973.23 | 973.00 | 973.00 | 972.82 | 972.69 | 972.64 |
| **21** | 972.60 | 972.66 | 972.80 | 972.88 | 972.91 | 973.03 | 973.22 | 973.00 | 972.99 | 972.81 | 972.69 | 972.64 |
| **22** | 972.60 | 972.67 | 972.81 | 972.88 | 972.91 | 973.04 | 973.18 | 972.99 | 972.99 | 972.81 | 972.68 | 972.64 |
| **23** | 972.61 | 972.68 | 972.82 | 972.88 | 972.91 | 973.06 | 973.17 | 972.99 | 972.99 | 972.81 | 972.68 | 972.64 |
| **24** | 972.61 | 972.68 | 972.83 | 972.88 | 972.91 | 973.08 | 973.16 | 972.99 | 972.99 | 972.81 | 972.68 | 972.64 |
| **25** | 972.61 | 972.69 | 972.83 | 972.88 | 972.91 | 973.09 | 973.15 | 972.99 | 972.98 | 972.80 | 972.67 | 972.64 |
| **26** | 972.61 | 972.69 | 972.83 | 972.88 | 972.92 | 973.08 | 973.14 | 972.98 | 972.98 | 972.79 | 972.67 | 972.64 |
| **27** | 972.61 | 972.70 | 972.83 | 972.88 | 972.92 | 973.09 | 973.14 | 972.98 | 972.97 | 972.79 | 972.67 | 972.64 |
| **28** | 972.62 | 972.70 | 972.83 | 972.88 | 972.92 | 973.09 | 973.13 | 972.98 | 972.97 | 972.78 | 972.66 | 972.64 |
| **29** | 972.62 | 972.71 | 972.83 | 972.88 | | 973.10 | 973.12 | 972.97 | 972.96 | 972.77 | 972.66 | 972.64 |
| **30** | 972.62 | 972.71 | 972.83 | 972.88 | | 973.09 | 973.11 | 972.97 | 972.96 | 972.77 | 972.66 | 972.64 |
| **31** | 972.62 | | 972.84 | 972.88 | | 973.10 | | 972.96 | | 972.76 | 972.65 | |
| **AVERAGE** | 972.61 | 972.66 | 972.77 | 972.87 | 972.90 | 973.00 | 973.19 | 973.02 | 972.99 | 972.85 | 972.71 | 972.64 |

Table C 4 Water Elevations of Lake Mogan (2000 Water Year)

| DAY/MONTH | OCTOBER | NOVEMBER | DECEMBER | JANUARY | FEBRUARY | MARCH | APRIL | MAY | JUNE | JULY | AUGUST | SEPTEMBER |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 972.64 | 972.65 | 972.71 | 972.82 | 972.86 | 972.90 | 973.42 | 973.43 | 972.96 | 972.79 | 972.56 | 972.35 |
| 2 | 972.64 | 972.65 | 972.71 | 972.83 | 972.86 | 972.90 | 973.41 | 973.43 | 972.95 | 972.79 | 972.55 | 972.35 |
| 3 | 972.64 | 972.65 | 972.72 | 972.83 | 972.86 | 972.90 | 973.42 | 973.42 | 972.95 | 972.78 | 972.54 | 972.34 |
| 4 | 972.64 | 972.65 | 972.72 | 972.84 | 972.86 | 972.90 | 973.44 | 973.41 | 972.94 | 972.78 | 972.54 | 972.34 |
| 5 | 972.64 | 972.65 | 972.72 | 972.84 | 972.86 | 972.90 | 973.41 | 973.39 | 972.92 | 972.77 | 972.53 | 972.33 |
| 6 | 972.64 | 972.65 | 972.72 | 972.84 | 972.86 | 972.90 | 973.41 | 973.36 | 972.92 | 972.76 | 972.52 | 972.33 |
| 7 | 972.64 | 972.65 | 972.72 | 972.84 | 972.87 | 972.91 | 973.41 | 973.35 | 972.91 | 972.74 | 972.51 | 972.32 |
| 8 | 972.64 | 972.65 | 972.72 | 972.84 | 972.87 | 972.91 | 973.42 | 973.34 | 972.90 | 972.73 | 972.50 | 972.32 |
| 9 | 972.64 | 972.65 | 972.73 | 972.84 | 972.87 | 972.91 | 973.43 | 973.32 | 972.89 | 972.73 | 972.49 | 972.31 |
| 10 | 972.64 | 972.65 | 972.73 | 972.84 | 972.87 | 972.92 | 973.41 | 973.30 | 972.88 | 972.72 | 972.48 | 972.31 |
| 11 | 972.65 | 972.65 | 972.73 | 972.84 | 972.87 | 972.93 | 973.39 | 973.29 | 972.88 | 972.72 | 972.47 | 972.30 |
| 12 | 972.65 | 972.65 | 972.73 | 972.84 | 972.87 | 972.93 | 973.38 | 973.27 | 972.87 | 972.71 | 972.46 | 972.30 |
| 13 | 972.65 | 972.65 | 972.73 | 972.84 | 972.87 | 972.98 | 973.39 | 973.26 | 972.86 | 972.71 | 972.45 | 972.29 |
| 14 | 972.65 | 972.65 | 972.74 | 972.84 | 972.88 | 973.00 | 973.43 | 973.25 | 972.85 | 972.70 | 972.44 | 972.29 |
| 15 | 972.65 | 972.65 | 972.74 | 972.84 | 972.88 | 973.03 | 973.44 | 973.23 | 972.83 | 972.69 | 972.44 | 972.29 |
| 16 | 972.64 | 972.66 | 972.74 | 972.84 | 972.88 | 973.05 | 973.44 | 973.22 | 972.81 | 972.68 | 972.43 | 972.29 |
| 17 | 972.64 | 972.66 | 972.74 | 972.84 | 972.88 | 973.07 | 973.43 | 973.21 | 972.81 | 972.67 | 972.43 | 972.28 |
| 18 | 972.64 | 972.67 | 972.75 | 972.84 | 972.88 | 973.13 | 973.44 | 973.20 | 972.81 | 972.66 | 972.42 | 972.28 |
| 19 | 972.64 | 972.67 | 972.75 | 972.84 | 972.88 | 973.19 | 973.45 | 973.18 | 972.81 | 972.65 | 972.42 | 972.28 |
| 20 | 972.64 | 972.68 | 972.75 | 972.84 | 972.89 | 973.26 | 973.45 | 973.16 | 972.81 | 972.64 | 972.41 | 972.28 |
| 21 | 972.63 | 972.68 | 972.76 | 972.84 | 972.89 | 973.32 | 973.44 | 973.14 | 972.81 | 972.64 | 972.41 | 972.27 |
| 22 | 972.63 | 972.68 | 972.76 | 972.84 | 972.89 | 973.36 | 973.44 | 973.11 | 972.81 | 972.63 | 972.40 | 972.27 |
| 23 | 972.64 | 972.69 | 972.76 | 972.85 | 972.89 | 973.37 | 973.44 | 973.09 | 972.81 | 972.63 | 972.40 | 972.27 |
| 24 | 972.64 | 972.69 | 972.78 | 972.85 | 972.89 | 973.37 | 973.44 | 973.07 | 972.81 | 972.62 | 972.39 | 972.26 |
| 25 | 972.64 | 972.70 | 972.79 | 972.85 | 972.90 | 973.37 | 973.44 | 973.04 | 972.80 | 972.62 | 972.39 | 972.25 |
| 26 | 972.64 | 972.70 | 972.80 | 972.85 | 972.90 | 973.37 | 973.44 | 973.02 | 972.80 | 972.61 | 972.38 | 972.25 |
| 27 | 972.64 | 972.71 | 972.81 | 972.85 | 972.90 | 973.40 | 973.44 | 973.01 | 972.80 | 972.60 | 972.38 | 972.25 |
| 28 | 972.64 | 972.71 | 972.81 | 972.85 | 972.90 | 973.43 | 973.44 | 973.00 | 972.80 | 972.59 | 972.37 | 972.23 |
| 29 | 972.64 | 972.71 | 972.81 | 972.85 | 972.90 | 973.43 | 973.44 | 972.99 | 972.80 | 972.58 | 972.37 | 972.23 |
| 30 | 972.64 | 972.71 | 972.82 | 972.85 | | 973.42 | 973.43 | 972.98 | 972.80 | 972.57 | 972.36 | 972.23 |
| 31 | 972.65 | | 972.82 | 972.86 | | 973.41 | | 972.97 | | 972.56 | 972.36 | |
| AVERAGE | 972.64 | 972.67 | 972.75 | 972.84 | 972.88 | 973.12 | 973.43 | 973.21 | 972.85 | 972.68 | 972.45 | 972.29 |

Table C 5 Water Elevations of Lake Mogan (2001 Water Year)

| DAY/MONTH | OCTOBER | NOVEMBER | DECEMBER | JANUARY | FEBRUARY | MARCH | APRIL | MAY | JUNE | JULY | AUGUST | SEPTEMBER |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **1** | 972.23 | 972.21 | 972.27 | 972.44 | 972.56 | 972.66 | 972.72 | 972.72 | 972.76 | 972.57 | 972.35 | 972.16 |
| **2** | 972.23 | 972.21 | 972.28 | 972.45 | 972.56 | 972.67 | 972.72 | 972.72 | 972.75 | 972.56 | 972.35 | 972.16 |
| **3** | 972.23 | 972.21 | 972.28 | 972.45 | 972.57 | 972.68 | 972.72 | 972.72 | 972.75 | 972.55 | 972.34 | 972.15 |
| **4** | 972.22 | 972.21 | 972.28 | 972.46 | 972.58 | 972.68 | 972.72 | 972.72 | 972.74 | 972.55 | 972.33 | 972.14 |
| **5** | 972.22 | 972.21 | 972.28 | 972.47 | 972.58 | 972.68 | 972.72 | 972.72 | 972.73 | 972.54 | 972.32 | 972.14 |
| **6** | 972.22 | 972.21 | 972.29 | 972.47 | 972.58 | 972.69 | 972.72 | 972.72 | 972.72 | 972.54 | 972.32 | 972.14 |
| **7** | 972.22 | 972.22 | 972.29 | 972.48 | 972.58 | 972.69 | 972.72 | 972.72 | 972.72 | 972.53 | 972.32 | 972.13 |
| **8** | 972.22 | 972.22 | 972.30 | 972.48 | 972.59 | 972.70 | 972.71 | 972.72 | 972.71 | 972.52 | 972.31 | 972.12 |
| **9** | 972.22 | 972.22 | 972.30 | 972.48 | 972.59 | 972.71 | 972.71 | 972.72 | 972.71 | 972.52 | 972.30 | 972.12 |
| **10** | 972.21 | 972.22 | 972.30 | 972.49 | 972.60 | 972.71 | 972.71 | 972.72 | 972.70 | 972.51 | 972.30 | 972.12 |
| **11** | 972.21 | 972.22 | 972.31 | 972.49 | 972.60 | 972.71 | 972.71 | 972.74 | 972.70 | 972.50 | 972.29 | 972.12 |
| **12** | 972.21 | 972.22 | 972.31 | 972.49 | 972.61 | 972.71 | 972.71 | 972.74 | 972.69 | 972.50 | 972.28 | 972.11 |
| **13** | 972.21 | 972.23 | 972.31 | 972.49 | 972.61 | 972.72 | 972.71 | 972.76 | 972.69 | 972.49 | 972.27 | 972.10 |
| **14** | 972.21 | 972.23 | 972.32 | 972.49 | 972.62 | 972.72 | 972.71 | 972.78 | 972.69 | 972.48 | 972.26 | 972.10 |
| **15** | 972.21 | 972.23 | 972.32 | 972.50 | 972.62 | 972.72 | 972.71 | 972.78 | 972.68 | 972.48 | 972.26 | 972.10 |
| **16** | 972.21 | 972.23 | 972.33 | 972.50 | 972.62 | 972.72 | 972.71 | 972.79 | 972.67 | 972.47 | 972.25 | 972.09 |
| **17** | 972.21 | 972.23 | 972.34 | 972.50 | 972.62 | 972.72 | 972.71 | 972.79 | 972.66 | 972.47 | 972.24 | 972.09 |
| **18** | 972.21 | 972.23 | 972.34 | 972.51 | 972.62 | 972.72 | 972.71 | 972.80 | 972.66 | 972.46 | 972.24 | 972.09 |
| **19** | 972.21 | 972.23 | 972.34 | 972.51 | 972.63 | 972.72 | 972.71 | 972.80 | 972.65 | 972.45 | 972.23 | 972.09 |
| **20** | 972.20 | 972.23 | 972.35 | 972.51 | 972.63 | 972.72 | 972.71 | 972.80 | 972.65 | 972.44 | 972.23 | 972.08 |
| **21** | 972.20 | 972.23 | 972.35 | 972.51 | 972.63 | 972.72 | 972.71 | 972.80 | 972.64 | 972.43 | 972.22 | 972.08 |
| **22** | 972.20 | 972.24 | 972.35 | 972.52 | 972.63 | 972.72 | 972.71 | 972.79 | 972.63 | 972.43 | 972.22 | 972.07 |
| **23** | 972.20 | 972.24 | 972.36 | 972.52 | 972.63 | 972.73 | 972.71 | 972.79 | 972.62 | 972.42 | 972.21 | 972.07 |
| **24** | 972.20 | 972.24 | 972.39 | 972.53 | 972.64 | 972.73 | 972.71 | 972.78 | 972.61 | 972.42 | 972.21 | 972.07 |
| **25** | 972.20 | 972.24 | 972.39 | 972.53 | 972.64 | 972.73 | 972.71 | 972.78 | 972.61 | 972.41 | 972.20 | 972.06 |
| **26** | 972.20 | 972.24 | 972.39 | 972.53 | 972.65 | 972.73 | 972.71 | 972.78 | 972.60 | 972.40 | 972.19 | 972.06 |
| **27** | 972.20 | 972.25 | 972.39 | 972.54 | 972.65 | 972.73 | 972.72 | 972.78 | 972.59 | 972.40 | 972.19 | 972.05 |
| **28** | 972.21 | 972.26 | 972.39 | 972.54 | 972.66 | 972.73 | 972.72 | 972.77 | 972.59 | 972.39 | 972.19 | 972.05 |
| **29** | 972.21 | 972.27 | 972.40 | 972.54 | | 972.73 | 972.72 | 972.77 | 972.58 | 972.38 | 972.18 | 972.04 |
| **30** | 972.21 | 972.27 | 972.41 | 972.55 | | 972.72 | 972.72 | 972.76 | 972.57 | 972.37 | 972.17 | 972.04 |
| **31** | 972.21 | | 972.42 | 972.56 | | 972.72 | | 972.76 | | 972.36 | 972.17 | |
| **AVERAGE** | 972.21 | 972.23 | 972.33 | 972.50 | 972.61 | 972.71 | 972.71 | 972.76 | 972.67 | 972.47 | 972.26 | 972.10 |

Table C 6 Water Elevations of Lake Mogan (2002 Water Year)

| DAY/MONTH | OCTOBER | NOVEMBER | DECEMBER | JANUARY | FEBRUARY | MARCH | APRIL | MAY | JUNE | JULY | AUGUST | SEPTEMBER |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **1** | 972.03 | 971.94 | 971.97 | 972.26 | 972.38 | 972.85 | 973.00 | 973.39 | 973.36 | 973.25 | 973.10 | 972.93 |
| **2** | 972.03 | 971.94 | 971.97 | 972.28 | 972.38 | 972.85 | 973.01 | 973.40 | 973.36 | 973.25 | 973.09 | 972.92 |
| **3** | 972.03 | 971.94 | 971.98 | 972.29 | 972.38 | 972.86 | 973.03 | 973.39 | 973.36 | 973.24 | 973.08 | 972.92 |
| **4** | 972.02 | 971.95 | 971.98 | 972.30 | 972.38 | 972.86 | 973.04 | 973.36 | 973.36 | 973.24 | 973.07 | 972.94 |
| **5** | 972.02 | 971.95 | 971.98 | 972.30 | 972.38 | 972.87 | 973.06 | 973.36 | 973.36 | 973.23 | 973.07 | 972.93 |
| **6** | 972.01 | 971.96 | 971.98 | 972.30 | 972.38 | 972.87 | 973.08 | 973.36 | 973.36 | 973.23 | 973.06 | 972.93 |
| **7** | 972.01 | 971.96 | 971.98 | 972.30 | 972.39 | 972.88 | 973.11 | 973.35 | 973.35 | 973.22 | 973.06 | 972.93 |
| **8** | 972.01 | 971.95 | 971.99 | 972.30 | 972.39 | 972.88 | 973.12 | 973.34 | 973.35 | 973.22 | 973.05 | 972.93 |
| **9** | 972.01 | 971.95 | 971.99 | 972.30 | 972.39 | 972.88 | 973.14 | 973.33 | 973.35 | 973.22 | 973.04 | 972.92 |
| **10** | 972.00 | 971.96 | 971.99 | 972.30 | 972.39 | 972.88 | 973.14 | 973.32 | 973.35 | 973.21 | 973.04 | 972.92 |
| **11** | 972.00 | 971.96 | 971.99 | 972.30 | 972.39 | 972.89 | 973.15 | 973.33 | 973.35 | 973.21 | 973.03 | 972.92 |
| **12** | 971.99 | 971.95 | 971.99 | 972.30 | 972.40 | 972.89 | 973.16 | 973.33 | 973.35 | 973.21 | 973.03 | 972.92 |
| **13** | 971.99 | 971.95 | 972.01 | 972.30 | 972.44 | 972.89 | 973.17 | 973.33 | 973.35 | 973.20 | 973.02 | 972.92 |
| **14** | 971.99 | 971.95 | 972.02 | 972.30 | 972.46 | 972.89 | 973.19 | 973.34 | 973.34 | 973.20 | 973.01 | 972.91 |
| **15** | 971.99 | 971.95 | 972.02 | 972.30 | 972.53 | 972.90 | 973.20 | 973.37 | 973.34 | 973.20 | 973.00 | 972.91 |
| **16** | 971.98 | 971.95 | 972.02 | 972.30 | 972.58 | 972.90 | 973.21 | 973.38 | 973.33 | 973.19 | 973.00 | 972.91 |
| **17** | 971.98 | 971.95 | 972.03 | 972.30 | 972.59 | 972.90 | 973.23 | 973.37 | 973.32 | 973.19 | 972.99 | 972.91 |
| **18** | 971.97 | 971.94 | 972.07 | 972.30 | 972.61 | 972.90 | 973.24 | 973.37 | 973.32 | 973.19 | 972.99 | 972.91 |
| **19** | 971.97 | 971.94 | 972.09 | 972.30 | 972.63 | 972.91 | 973.26 | 973.37 | 973.31 | 973.18 | 972.98 | 972.90 |
| **20** | 971.97 | 971.95 | 972.09 | 972.30 | 972.64 | 972.91 | 973.27 | 973.37 | 973.30 | 973.17 | 972.99 | 972.90 |
| **21** | 971.97 | 971.96 | 972.09 | 972.30 | 972.65 | 972.91 | 973.29 | 973.37 | 973.29 | 973.17 | 972.98 | 972.90 |
| **22** | 971.97 | 971.96 | 972.09 | 972.30 | 972.67 | 972.91 | 973.30 | 973.36 | 973.29 | 973.16 | 972.98 | 972.89 |
| **23** | 971.96 | 971.96 | 972.09 | 972.34 | 972.68 | 972.92 | 973.32 | 973.37 | 973.29 | 973.16 | 972.98 | 972.89 |
| **24** | 971.96 | 971.96 | 972.10 | 972.38 | 972.72 | 972.93 | 973.33 | 973.38 | 973.28 | 973.15 | 972.97 | 972.89 |
| **25** | 971.96 | 971.96 | 972.11 | 972.38 | 972.75 | 972.95 | 973.34 | 973.38 | 973.28 | 973.14 | 972.96 | 972.89 |
| **26** | 971.95 | 971.97 | 972.13 | 972.38 | 972.76 | 972.96 | 973.35 | 973.39 | 973.28 | 973.13 | 972.96 | 972.88 |
| **27** | 971.95 | 971.97 | 972.14 | 972.38 | 972.80 | 972.97 | 973.36 | 973.39 | 973.27 | 973.12 | 972.95 | 972.88 |
| **28** | 971.95 | 971.97 | 972.18 | 972.38 | 972.84 | 972.97 | 973.36 | 973.38 | 973.26 | 973.12 | 972.94 | 972.88 |
| **29** | 971.95 | 971.97 | 972.20 | 972.38 | | 972.98 | 973.38 | 973.38 | 973.26 | 973.11 | 972.94 | 972.87 |
| **30** | 971.95 | 971.97 | 972.22 | 972.38 | | 972.99 | 973.38 | 973.38 | 973.26 | 973.11 | 972.94 | 972.87 |
| **31** | 971.94 | | 972.24 | 972.38 | | 972.99 | | 973.37 | | 973.10 | 972.93 | |
| **AVERAGE** | 971.98 | 971.95 | 972.06 | 972.32 | 972.54 | 972.91 | 973.21 | 973.36 | 973.26 | 973.18 | 973.01 | 972.86 |

Table C 7 Water Elevations of Lake Mogan (2003 Water Year)

| DAY/MONTH | OCTOBER | NOVEMBER | DECEMBER | JANUARY | FEBRUARY | MARCH | APRIL | MAY | JUNE | JULY | AUGUST | SEPTEMBER |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **1** | 972.87 | 972.84 | 972.89 | 972.94 | 973.14 | 973.32 | 973.44 | 973.44 | 973.38 | 973.21 | 973.00 | 972.80 |
| **2** | 972.87 | 972.84 | 972.89 | 972.95 | 973.15 | 973.33 | 973.44 | 973.44 | 973.38 | 973.20 | 972.99 | 972.79 |
| **3** | 972.86 | 972.84 | 972.89 | 972.95 | 973.16 | 973.33 | 973.43 | 973.44 | 973.38 | 973.20 | 972.99 | 972.79 |
| **4** | 972.86 | 972.84 | 972.89 | 972.96 | 973.16 | 973.34 | 973.43 | 973.43 | 973.37 | 973.19 | 972.98 | 972.78 |
| **5** | 972.85 | 972.84 | 972.89 | 972.98 | 973.17 | 973.35 | 973.43 | 973.43 | 973.37 | 973.19 | 972.98 | 972.78 |
| **6** | 972.85 | 972.84 | 972.90 | 972.99 | 973.17 | 973.35 | 973.42 | 973.42 | 973.37 | 973.18 | 972.97 | 972.77 |
| **7** | 972.85 | 972.84 | 972.90 | 972.99 | 973.19 | 973.36 | 973.42 | 973.41 | 973.37 | 973.18 | 972.96 | 972.77 |
| **8** | 972.85 | 972.85 | 972.90 | 973.00 | 973.20 | 973.37 | 973.42 | 973.39 | 973.36 | 973.17 | 972.95 | 972.77 |
| **9** | 972.84 | 972.85 | 972.90 | 973.01 | 973.21 | 973.38 | 973.41 | 973.38 | 973.36 | 973.17 | 972.95 | 972.76 |
| **10** | 972.84 | 972.85 | 972.90 | 973.02 | 973.22 | 973.39 | 973.41 | 973.38 | 973.35 | 973.17 | 972.94 | 972.76 |
| **11** | 972.84 | 972.85 | 972.90 | 973.03 | 973.22 | 973.40 | 973.41 | 973.37 | 973.35 | 973.15 | 972.94 | 972.76 |
| **12** | 972.84 | 972.85 | 972.90 | 973.03 | 973.23 | 973.40 | 973.40 | 973.37 | 973.34 | 973.13 | 972.93 | 972.75 |
| **13** | 972.84 | 972.85 | 972.91 | 973.04 | 973.23 | 973.41 | 973.40 | 973.37 | 973.33 | 973.13 | 972.93 | 972.75 |
| **14** | 972.84 | 972.86 | 972.91 | 973.04 | 973.24 | 973.41 | 973.40 | 973.36 | 973.33 | 973.12 | 972.92 | 972.74 |
| **15** | 972.85 | 972.86 | 972.91 | 973.04 | 973.25 | 973.42 | 973.39 | 973.36 | 973.32 | 973.12 | 972.91 | 972.74 |
| **16** | 972.85 | 972.86 | 972.91 | 973.04 | 973.25 | 973.42 | 973.39 | 973.36 | 973.32 | 973.11 | 972.91 | 972.74 |
| **17** | 972.85 | 972.86 | 972.91 | 973.05 | 973.26 | 973.42 | 973.39 | 973.36 | 973.31 | 973.10 | 972.91 | 972.73 |
| **18** | 972.85 | 972.86 | 972.91 | 973.05 | 973.27 | 973.43 | 973.39 | 973.36 | 973.30 | 973.09 | 972.90 | 972.73 |
| **19** | 972.85 | 972.86 | 972.91 | 973.05 | 973.27 | 973.43 | 973.40 | 973.36 | 973.29 | 973.08 | 972.89 | 972.73 |
| **20** | 972.85 | 972.86 | 972.91 | 973.06 | 973.28 | 973.43 | 973.41 | 973.36 | 973.29 | 973.08 | 972.88 | 972.72 |
| **21** | 972.85 | 972.86 | 972.92 | 973.06 | 973.29 | 973.44 | 973.41 | 973.36 | 973.29 | 973.07 | 972.88 | 972.72 |
| **22** | 972.85 | 972.86 | 972.92 | 973.07 | 973.29 | 973.44 | 973.41 | 973.36 | 973.28 | 973.06 | 972.87 | 972.72 |
| **23** | 972.85 | 972.86 | 972.92 | 973.08 | 973.30 | 973.44 | 973.41 | 973.36 | 973.27 | 973.05 | 972.86 | 972.72 |
| **24** | 972.85 | 972.88 | 972.92 | 973.09 | 973.30 | 973.45 | 973.43 | 973.35 | 973.26 | 973.05 | 972.86 | 972.71 |
| **25** | 972.85 | 972.88 | 972.92 | 973.10 | 973.31 | 973.45 | 973.44 | 973.36 | 973.25 | 973.04 | 972.85 | 972.71 |
| **26** | 972.84 | 972.88 | 972.92 | 973.10 | 973.31 | 973.45 | 973.45 | 973.36 | 973.25 | 973.03 | 972.85 | 972.71 |
| **27** | 972.84 | 972.88 | 972.92 | 973.10 | 973.32 | 973.46 | 973.45 | 973.36 | 973.24 | 973.03 | 972.84 | 972.71 |
| **28** | 972.84 | 972.88 | 972.92 | 973.11 | 973.32 | 973.46 | 973.45 | 973.36 | 973.23 | 973.02 | 972.84 | 972.70 |
| **29** | 972.84 | 972.88 | 972.92 | 973.12 | | 973.46 | 973.45 | 973.37 | 973.22 | 973.01 | 972.83 | 972.70 |
| **30** | 972.84 | 972.89 | 972.92 | 973.12 | | 973.45 | 973.45 | 973.37 | 973.22 | 973.01 | 972.82 | 972.70 |
| **31** | 972.84 | | 972.93 | 973.13 | | 973.45 | | 973.38 | | 973.00 | 972.81 | |
| **AVERAGE** | 972.85 | 972.86 | 972.91 | 973.04 | 973.24 | 973.41 | 973.42 | 973.38 | 973.31 | 973.11 | 972.91 | 972.74 |

Table C 8 Water Elevations of Lake Mogan (2004 Water Year)

| DAY/MONTH | OCTOBER | NOVEMBER | DECEMBER | JANUARY | FEBRUARY | MARCH | APRIL | MAY | JUNE | JULY | AUGUST | SEPTEMBER |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 972.69 | 972.67 | 972.64 | 972.70 | 972.83 | 973.02 | 973.14 | 973.09 | 973.11 | 973.05 | 972.77 | 972.60 |
| 2 | 972.69 | 972.66 | 972.64 | 972.70 | 972.83 | 973.02 | 973.13 | 973.09 | 973.11 | 973.05 | 972.76 | 972.60 |
| 3 | 972.69 | 972.66 | 972.64 | 972.71 | 972.84 | 973.03 | 973.13 | 973.10 | 973.11 | 973.04 | 972.75 | 972.59 |
| 4 | 972.69 | 972.66 | 972.64 | 972.71 | 972.85 | 973.03 | 973.13 | 973.10 | 973.10 | 973.04 | 972.75 | 972.59 |
| 5 | 972.69 | 972.66 | 972.64 | 972.72 | 972.86 | 973.03 | 973.12 | 973.10 | 973.10 | 973.03 | 972.74 | 972.58 |
| 6 | 972.69 | 972.66 | 972.64 | 972.73 | 972.87 | 973.03 | 973.12 | 973.11 | 973.10 | 973.03 | 972.73 | 972.58 |
| 7 | 972.69 | 972.66 | 972.64 | 972.73 | 972.88 | 973.03 | 973.12 | 973.13 | 973.10 | 973.02 | 972.73 | 972.57 |
| 8 | 972.69 | 972.66 | 972.64 | 972.74 | 972.90 | 973.03 | 973.12 | 973.14 | 973.09 | 973.02 | 972.72 | 972.57 |
| 9 | 972.68 | 972.66 | 972.64 | 972.74 | 972.91 | 973.03 | 973.11 | 973.15 | 973.09 | 973.01 | 972.72 | 972.56 |
| 10 | 972.68 | 972.66 | 972.64 | 972.75 | 972.92 | 973.03 | 973.11 | 973.15 | 973.09 | 973.00 | 972.71 | 972.56 |
| 11 | 972.68 | 972.66 | 972.64 | 972.75 | 972.93 | 973.04 | 973.11 | 973.16 | 973.09 | 972.99 | 972.71 | 972.55 |
| 12 | 972.68 | 972.65 | 972.64 | 972.76 | 972.93 | 973.04 | 973.10 | 973.16 | 973.09 | 972.98 | 972.70 | 972.55 |
| 13 | 972.68 | 972.65 | 972.65 | 972.76 | 972.94 | 973.04 | 973.10 | 973.17 | 973.08 | 972.97 | 972.70 | 972.54 |
| 14 | 972.68 | 972.65 | 972.65 | 972.76 | 972.94 | 973.04 | 973.10 | 973.17 | 973.08 | 972.96 | 972.69 | 972.54 |
| 15 | 972.68 | 972.65 | 972.65 | 972.77 | 972.94 | 973.04 | 973.09 | 973.17 | 973.08 | 972.95 | 972.69 | 972.53 |
| 16 | 972.68 | 972.65 | 972.65 | 972.77 | 972.95 | 973.04 | 973.09 | 973.16 | 973.08 | 972.94 | 972.68 | 972.53 |
| 17 | 972.68 | 972.65 | 972.65 | 972.77 | 972.95 | 973.04 | 973.09 | 973.16 | 973.08 | 972.93 | 972.68 | 972.53 |
| 18 | 972.68 | 972.65 | 972.65 | 972.77 | 972.96 | 973.04 | 973.09 | 973.16 | 973.07 | 972.92 | 972.67 | 972.52 |
| 19 | 972.68 | 972.65 | 972.65 | 972.78 | 972.96 | 973.04 | 973.08 | 973.15 | 973.07 | 972.91 | 972.67 | 972.52 |
| 20 | 972.68 | 972.64 | 972.65 | 972.78 | 972.97 | 973.04 | 973.08 | 973.15 | 973.07 | 972.90 | 972.66 | 972.52 |
| 21 | 972.68 | 972.64 | 972.65 | 972.79 | 972.97 | 973.04 | 973.08 | 973.15 | 973.07 | 972.89 | 972.65 | 972.51 |
| 22 | 972.68 | 972.64 | 972.65 | 972.79 | 972.97 | 973.04 | 973.07 | 973.15 | 973.06 | 972.88 | 972.65 | 972.51 |
| 23 | 972.67 | 972.64 | 972.66 | 972.79 | 972.98 | 973.05 | 973.07 | 973.14 | 973.06 | 972.86 | 972.64 | 972.51 |
| 24 | 972.67 | 972.64 | 972.66 | 972.80 | 972.98 | 973.07 | 973.07 | 973.14 | 973.06 | 972.85 | 972.64 | 972.50 |
| 25 | 972.67 | 972.64 | 972.67 | 972.80 | 972.99 | 973.08 | 973.06 | 973.14 | 973.06 | 972.84 | 972.63 | 972.50 |
| 26 | 972.67 | 972.64 | 972.67 | 972.80 | 973.00 | 973.09 | 973.06 | 973.13 | 973.06 | 972.83 | 972.63 | 972.50 |
| 27 | 972.67 | 972.64 | 972.68 | 972.81 | 973.00 | 973.09 | 973.06 | 973.13 | 973.06 | 972.82 | 972.62 | 972.49 |
| 28 | 972.67 | 972.64 | 972.68 | 972.81 | 973.01 | 973.10 | 973.07 | 973.13 | 973.05 | 972.81 | 972.62 | 972.49 |
| 29 | 972.67 | 972.64 | 972.68 | 972.81 | 973.01 | 973.10 | 973.07 | 973.12 | 973.05 | 972.80 | 972.62 | 972.49 |
| 30 | 972.67 | 972.64 | 972.69 | 972.82 | | 973.11 | 973.08 | 973.12 | 973.05 | 972.79 | 972.61 | 972.49 |
| 31 | 972.67 | | 972.69 | 972.82 | | 973.13 | | 973.12 | | 972.78 | 972.61 | |
| AVERAGE | 972.68 | 972.65 | 972.65 | 972.77 | 972.93 | 973.05 | 973.10 | 973.14 | 973.08 | 972.93 | 972.68 | 972.54 |

Table C 9 Water Elevations of Lake Mogan (2005 Water Year)

| DAY/MONTH | OCTOBER | NOVEMBER | DECEMBER | JANUARY | FEBRUARY | MARCH | APRIL | MAY | JUNE | JULY | AUGUST | SEPTEMBER |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **1** | 972.49 | 972.43 | 972.48 | 972.45 | 972.46 | 972.53 | 972.66 | 972.68 | 972.69 | 972.68 | 972.49 | 972.29 |
| **2** | 972.49 | 972.43 | 972.48 | 972.45 | 972.46 | 972.53 | 972.66 | 972.68 | 972.69 | 972.67 | 972.49 | 972.29 |
| **3** | 972.49 | 972.43 | 972.47 | 972.45 | 972.46 | 972.54 | 972.67 | 972.68 | 972.70 | 972.66 | 972.48 | 972.29 |
| **4** | 972.49 | 972.43 | 972.47 | 972.45 | 972.46 | 972.54 | 972.67 | 972.69 | 972.70 | 972.65 | 972.48 | 972.29 |
| **5** | 972.49 | 972.43 | 972.47 | 972.45 | 972.46 | 972.55 | 972.67 | 972.69 | 972.70 | 972.64 | 972.47 | 972.28 |
| **6** | 972.49 | 972.43 | 972.46 | 972.45 | 972.46 | 972.55 | 972.67 | 972.69 | 972.70 | 972.63 | 972.47 | 972.28 |
| **7** | 972.48 | 972.43 | 972.46 | 972.45 | 972.46 | 972.56 | 972.67 | 972.69 | 972.70 | 972.62 | 972.47 | 972.28 |
| **8** | 972.48 | 972.42 | 972.45 | 972.45 | 972.46 | 972.56 | 972.67 | 972.69 | 972.71 | 972.61 | 972.46 | 972.28 |
| **9** | 972.48 | 972.42 | 972.45 | 972.45 | 972.46 | 972.57 | 972.67 | 972.69 | 972.71 | 972.61 | 972.46 | 972.27 |
| **10** | 972.48 | 972.42 | 972.45 | 972.45 | 972.46 | 972.57 | 972.67 | 972.69 | 972.71 | 972.60 | 972.45 | 972.27 |
| **11** | 972.48 | 972.42 | 972.44 | 972.45 | 972.46 | 972.58 | 972.67 | 972.69 | 972.71 | 972.59 | 972.45 | 972.27 |
| **12** | 972.47 | 972.43 | 972.44 | 972.45 | 972.46 | 972.58 | 972.67 | 972.69 | 972.71 | 972.58 | 972.45 | 972.26 |
| **13** | 972.47 | 972.43 | 972.44 | 972.45 | 972.46 | 972.58 | 972.67 | 972.69 | 972.71 | 972.58 | 972.44 | 972.26 |
| **14** | 972.47 | 972.44 | 972.43 | 972.45 | 972.46 | 972.59 | 972.67 | 972.69 | 972.71 | 972.57 | 972.43 | 972.26 |
| **15** | 972.47 | 972.44 | 972.43 | 972.45 | 972.46 | 972.59 | 972.67 | 972.69 | 972.72 | 972.57 | 972.42 | 972.25 |
| **16** | 972.47 | 972.44 | 972.43 | 972.45 | 972.46 | 972.59 | 972.67 | 972.69 | 972.72 | 972.57 | 972.42 | 972.25 |
| **17** | 972.47 | 972.45 | 972.43 | 972.45 | 972.46 | 972.60 | 972.67 | 972.69 | 972.72 | 972.56 | 972.41 | 972.25 |
| **18** | 972.47 | 972.45 | 972.43 | 972.45 | 972.46 | 972.60 | 972.68 | 972.69 | 972.72 | 972.57 | 972.40 | 972.24 |
| **19** | 972.46 | 972.46 | 972.43 | 972.46 | 972.46 | 972.60 | 972.68 | 972.69 | 972.71 | 972.56 | 972.40 | 972.24 |
| **20** | 972.46 | 972.46 | 972.43 | 972.46 | 972.46 | 972.61 | 972.68 | 972.69 | 972.71 | 972.56 | 972.39 | 972.23 |
| **21** | 972.46 | 972.46 | 972.43 | 972.46 | 972.46 | 972.61 | 972.68 | 972.69 | 972.71 | 972.55 | 972.39 | 972.23 |
| **22** | 972.46 | 972.47 | 972.43 | 972.46 | 972.46 | 972.61 | 972.68 | 972.69 | 972.71 | 972.55 | 972.39 | 972.23 |
| **23** | 972.46 | 972.47 | 972.44 | 972.46 | 972.47 | 972.61 | 972.68 | 972.69 | 972.71 | 972.54 | 972.37 | 972.23 |
| **24** | 972.45 | 972.47 | 972.44 | 972.46 | 972.48 | 972.62 | 972.68 | 972.69 | 972.71 | 972.54 | 972.36 | 972.23 |
| **25** | 972.45 | 972.48 | 972.44 | 972.46 | 972.49 | 972.62 | 972.68 | 972.69 | 972.70 | 972.53 | 972.36 | 972.23 |
| **26** | 972.45 | 972.48 | 972.44 | 972.46 | 972.50 | 972.62 | 972.68 | 972.69 | 972.70 | 972.53 | 972.35 | 972.22 |
| **27** | 972.45 | 972.48 | 972.44 | 972.46 | 972.51 | 972.62 | 972.68 | 972.69 | 972.70 | 972.52 | 972.34 | 972.22 |
| **28** | 972.44 | 972.49 | 972.44 | 972.46 | 972.52 | 972.63 | 972.68 | 972.69 | 972.69 | 972.52 | 972.33 | 972.22 |
| **29** | 972.44 | 972.49 | 972.44 | 972.46 | | 972.64 | 972.68 | 972.69 | 972.69 | 972.51 | 972.32 | 972.22 |
| **30** | 972.44 | 972.49 | 972.45 | 972.46 | | 972.65 | 972.68 | 972.69 | 972.68 | 972.51 | 972.31 | 972.22 |
| **31** | 972.43 | | 972.45 | 972.46 | | 972.65 | | 972.69 | | 972.50 | 972.30 | |
| **AVERAGE** | 972.47 | 972.45 | 972.45 | 972.45 | 972.47 | 972.59 | 972.67 | 972.69 | 972.71 | 972.58 | 972.41 | 972.25 |

Table C 10 Water Elevations of Lake Mogan (2006 Water Year)

| DAY/MONTH | OCTOBER | NOVEMBER | DECEMBER | JANUARY | FEBRUARY | MARCH | APRIL | MAY | JUNE | JULY | AUGUST | SEPTEMBER |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **1** | 972.22 | 972.18 | 972.23 | 972.25 | 972.31 | 972.55 | 972.93 | 973.01 | 973.03 | 972.94 | 972.76 | 972.57 |
| **2** | 972.22 | 972.19 | 972.23 | 972.25 | 972.31 | 972.57 | 972.93 | 973.02 | 973.03 | 972.93 | 972.76 | 972.56 |
| **3** | 972.22 | 972.19 | 972.23 | 972.25 | 972.32 | 972.59 | 972.93 | 973.03 | 973.03 | 972.93 | 972.75 | 972.56 |
| **4** | 972.22 | 972.19 | 972.23 | 972.25 | 972.32 | 972.61 | 972.93 | 973.03 | 973.03 | 972.93 | 972.74 | 972.56 |
| **5** | 972.22 | 972.20 | 972.23 | 972.25 | 972.32 | 972.62 | 972.93 | 973.03 | 973.03 | 972.92 | 972.73 | 972.56 |
| **6** | 972.21 | 972.20 | 972.23 | 972.25 | 972.33 | 972.64 | 972.93 | 973.03 | 973.02 | 972.91 | 972.72 | 972.55 |
| **7** | 972.21 | 972.20 | 972.23 | 972.25 | 972.33 | 972.65 | 972.94 | 973.03 | 973.02 | 972.91 | 972.71 | 972.55 |
| **8** | 972.21 | 972.20 | 972.23 | 972.25 | 972.33 | 972.68 | 972.94 | 973.03 | 973.02 | 972.90 | 972.71 | 972.55 |
| **9** | 972.21 | 972.21 | 972.23 | 972.25 | 972.34 | 972.69 | 972.94 | 973.03 | 973.02 | 972.90 | 972.70 | 972.55 |
| **10** | 972.21 | 972.21 | 972.23 | 972.25 | 972.34 | 972.70 | 972.94 | 973.03 | 973.01 | 972.89 | 972.69 | 972.54 |
| **11** | 972.21 | 972.21 | 972.23 | 972.25 | 972.35 | 972.71 | 972.94 | 973.03 | 973.01 | 972.88 | 972.69 | 972.54 |
| **12** | 972.21 | 972.21 | 972.23 | 972.25 | 972.36 | 972.72 | 972.94 | 973.03 | 973.01 | 972.87 | 972.68 | 972.54 |
| **13** | 972.21 | 972.21 | 972.24 | 972.26 | 972.37 | 972.73 | 972.95 | 973.03 | 973.00 | 972.86 | 972.67 | 972.53 |
| **14** | 972.20 | 972.21 | 972.24 | 972.26 | 972.38 | 972.74 | 972.95 | 973.03 | 973.00 | 972.85 | 972.66 | 972.53 |
| **15** | 972.20 | 972.22 | 972.24 | 972.26 | 972.39 | 972.75 | 972.95 | 973.03 | 973.00 | 972.84 | 972.66 | 972.53 |
| **16** | 972.20 | 972.22 | 972.24 | 972.26 | 972.40 | 972.76 | 972.95 | 973.03 | 973.00 | 972.84 | 972.65 | 972.53 |
| **17** | 972.20 | 972.22 | 972.24 | 972.26 | 972.41 | 972.77 | 972.95 | 973.03 | 972.99 | 972.83 | 972.65 | 972.53 |
| **18** | 972.20 | 972.22 | 972.24 | 972.26 | 972.42 | 972.78 | 972.95 | 973.03 | 972.99 | 972.83 | 972.64 | 972.53 |
| **19** | 972.20 | 972.22 | 972.24 | 972.26 | 972.43 | 972.79 | 972.96 | 973.03 | 972.99 | 972.82 | 972.64 | 972.53 |
| **20** | 972.19 | 972.22 | 972.24 | 972.27 | 972.44 | 972.80 | 972.96 | 973.03 | 972.98 | 972.82 | 972.63 | 972.53 |
| **21** | 972.19 | 972.22 | 972.24 | 972.27 | 972.45 | 972.81 | 972.96 | 973.03 | 972.98 | 972.82 | 972.63 | 972.53 |
| **22** | 972.19 | 972.22 | 972.24 | 972.27 | 972.46 | 972.82 | 972.96 | 973.03 | 972.98 | 972.81 | 972.62 | 972.53 |
| **23** | 972.19 | 972.22 | 972.24 | 972.28 | 972.47 | 972.83 | 972.96 | 973.03 | 972.97 | 972.81 | 972.61 | 972.53 |
| **24** | 972.19 | 972.22 | 972.24 | 972.28 | 972.48 | 972.85 | 972.96 | 973.03 | 972.97 | 972.81 | 972.61 | 972.53 |
| **25** | 972.18 | 972.22 | 972.25 | 972.28 | 972.49 | 972.86 | 972.97 | 973.03 | 972.96 | 972.80 | 972.60 | 972.53 |
| **26** | 972.18 | 972.23 | 972.25 | 972.29 | 972.51 | 972.88 | 972.97 | 973.03 | 972.96 | 972.80 | 972.60 | 972.53 |
| **27** | 972.18 | 972.23 | 972.25 | 972.29 | 972.52 | 972.89 | 972.98 | 973.03 | 972.95 | 972.79 | 972.59 | 972.53 |
| **28** | 972.18 | 972.23 | 972.25 | 972.29 | 972.53 | 972.90 | 972.99 | 973.03 | 972.95 | 972.79 | 972.59 | 972.53 |
| **29** | 972.18 | 972.23 | 972.25 | 972.30 | | 972.91 | 973.00 | 973.03 | 972.95 | 972.78 | 972.58 | 972.53 |
| **30** | 972.18 | 972.23 | 972.25 | 972.30 | | 972.91 | 973.00 | 973.03 | 972.94 | 972.78 | 972.58 | 972.53 |
| **31** | 972.18 | | 972.25 | 972.31 | | 972.92 | | 973.03 | | 972.77 | 972.57 | |
| **AVERAGE** | 972.20 | 972.21 | 972.24 | 972.27 | 972.40 | 972.76 | 972.95 | 973.03 | 972.99 | 972.85 | 972.66 | 972.54 |

Table C 11 Water Elevations of Lake Eymir (1998 Water Year)

| DAY/MONTH | OCTOBER | NOVEMBER | DECEMBER | JANUARY | FEBRUARY | MARCH | APRIL | MAY | JUNE | JULY | AUGUST | SEPTEMBER |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **1** | 968.32 | 968.27 | 968.31 | 968.44 | 968.52 | 968.57 | 968.91 | 969.09 | 968.98 | 968.70 | 968.90 | 968.61 |
| **2** | 968.32 | 968.27 | 968.31 | 968.45 | 968.52 | 968.57 | 968.93 | 969.09 | 969.02 | 968.69 | 968.89 | 968.60 |
| **3** | 968.32 | 968.27 | 968.31 | 968.46 | 968.52 | 968.58 | 968.99 | 969.08 | 969.11 | 968.68 | 968.88 | 968.59 |
| **4** | 968.31 | 968.26 | 968.31 | 968.47 | 968.53 | 968.58 | 969.06 | 969.10 | 969.18 | 968.67 | 968.87 | 968.58 |
| **5** | 968.31 | 968.26 | 968.32 | 968.47 | 968.53 | 968.59 | 969.08 | 969.11 | 969.21 | 968.67 | 968.86 | 968.57 |
| **6** | 968.31 | 968.26 | 968.32 | 968.47 | 968.53 | 968.60 | 969.07 | 969.12 | 969.18 | 968.65 | 968.85 | 968.56 |
| **7** | 968.31 | 968.26 | 968.33 | 968.47 | 968.53 | 968.61 | 969.06 | 969.13 | 969.18 | 968.65 | 968.84 | 968.56 |
| **8** | 968.30 | 968.26 | 968.34 | 968.48 | 968.53 | 968.62 | 969.04 | 969.12 | 969.19 | 968.65 | 968.83 | 968.55 |
| **9** | 968.30 | 968.26 | 968.34 | 968.48 | 968.53 | 968.63 | 969.02 | 969.10 | 969.19 | 968.64 | 968.82 | 968.54 |
| **10** | 968.30 | 968.26 | 968.35 | 968.48 | 968.54 | 968.64 | 969.00 | 969.08 | 969.17 | 968.64 | 968.81 | 968.54 |
| **11** | 968.30 | 968.25 | 968.35 | 968.48 | 968.54 | 968.64 | 968.99 | 969.05 | 969.15 | 968.65 | 968.80 | 968.53 |
| **12** | 968.30 | 968.25 | 968.35 | 968.48 | 968.54 | 968.65 | 968.97 | 969.03 | 969.16 | 968.69 | 968.79 | 968.53 |
| **13** | 968.30 | 968.25 | 968.35 | 968.48 | 968.54 | 968.65 | 968.95 | 969.03 | 969.14 | 968.75 | 968.78 | 968.52 |
| **14** | 968.29 | 968.25 | 968.35 | 968.48 | 968.54 | 968.66 | 968.98 | 969.01 | 969.12 | 968.78 | 968.77 | 968.51 |
| **15** | 968.29 | 968.25 | 968.37 | 968.48 | 968.54 | 968.66 | 969.04 | 968.98 | 969.10 | 968.82 | 968.76 | 968.50 |
| **16** | 968.29 | 968.25 | 968.39 | 968.48 | 968.55 | 968.67 | 969.12 | 968.93 | 969.09 | 968.85 | 968.75 | 968.50 |
| **17** | 968.29 | 968.26 | 968.41 | 968.48 | 968.55 | 968.68 | 969.19 | 968.90 | 969.03 | 968.88 | 968.74 | 968.49 |
| **18** | 968.29 | 968.27 | 968.41 | 968.48 | 968.55 | 968.70 | 969.21 | 968.86 | 968.95 | 968.90 | 968.73 | 968.49 |
| **19** | 968.29 | 968.29 | 968.41 | 968.49 | 968.55 | 968.72 | 969.18 | 968.86 | 968.91 | 968.92 | 968.72 | 968.48 |
| **20** | 968.29 | 968.30 | 968.41 | 968.49 | 968.55 | 968.73 | 969.15 | 968.87 | 968.94 | 968.94 | 968.71 | 968.48 |
| **21** | 968.28 | 968.30 | 968.41 | 968.49 | 968.55 | 968.74 | 969.14 | 968.92 | 968.97 | 968.96 | 968.71 | 968.47 |
| **22** | 968.28 | 968.30 | 968.41 | 968.49 | 968.56 | 968.75 | 969.12 | 968.96 | 968.99 | 968.98 | 968.70 | 968.47 |
| **23** | 968.28 | 968.30 | 968.41 | 968.49 | 968.56 | 968.76 | 969.12 | 968.95 | 968.96 | 968.99 | 968.69 | 968.47 |
| **24** | 968.28 | 968.30 | 968.42 | 968.50 | 968.56 | 968.77 | 969.09 | 968.93 | 968.88 | 969.01 | 968.68 | 968.47 |
| **25** | 968.28 | 968.31 | 968.42 | 968.50 | 968.56 | 968.79 | 969.06 | 968.90 | 968.81 | 969.02 | 968.67 | 968.47 |
| **26** | 968.28 | 968.31 | 968.42 | 968.50 | 968.56 | 968.80 | 969.05 | 968.86 | 968.75 | 969.02 | 968.66 | 968.47 |
| **27** | 968.27 | 968.31 | 968.42 | 968.50 | 968.57 | 968.82 | 969.06 | 968.85 | 968.72 | 969.01 | 968.66 | 968.46 |
| **28** | 968.27 | 968.31 | 968.42 | 968.50 | 968.57 | 968.84 | 969.06 | 968.87 | 968.72 | 968.98 | 968.65 | 968.46 |
| **29** | 968.27 | 968.31 | 968.43 | 968.51 | | 968.87 | 969.05 | 968.91 | 968.71 | 968.95 | 968.64 | 968.45 |
| **30** | 968.27 | 968.31 | 968.44 | 968.51 | | 968.89 | 969.06 | 968.96 | 968.71 | 968.91 | 968.63 | 968.45 |
| **31** | 968.27 | | 968.44 | 968.51 | | 968.90 | | 968.98 | | 968.91 | 968.62 | |
| **ORT** | 968.29 | 968.28 | 968.38 | 968.48 | 968.54 | 968.70 | 969.06 | 968.99 | 969.01 | 968.82 | 968.76 | 968.51 |

Table C 12 Water Elevations of Lake Eymir (1999 Water Year)

| DAY/MONTH | OCTOBER | NOVEMBER | DECEMBER | JANUARY | FEBRUARY | MARCH | APRIL | MAY | JUNE | JULY | AUGUST | SEPTEMBER |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **1** | 968.45 | 968.32 | 968.31 | 968.36 | 968.40 | 968.47 | 968.98 | 969.03 | 968.78 | 968.60 | 968.46 | 968.35 |
| **2** | 968.44 | 968.32 | 968.31 | 968.36 | 968.40 | 968.47 | 968.99 | 969.02 | 968.77 | 968.59 | 968.46 | 968.35 |
| **3** | 968.44 | 968.32 | 968.31 | 968.36 | 968.40 | 968.48 | 968.99 | 968.97 | 968.77 | 968.59 | 968.45 | 968.35 |
| **4** | 968.44 | 968.32 | 968.31 | 968.36 | 968.40 | 968.48 | 969.01 | 968.93 | 968.77 | 968.58 | 968.45 | 968.35 |
| **5** | 968.43 | 968.31 | 968.31 | 968.36 | 968.41 | 968.49 | 969.01 | 968.90 | 968.76 | 968.57 | 968.45 | 968.37 |
| **6** | 968.43 | 968.31 | 968.31 | 968.36 | 968.41 | 968.50 | 969.02 | 968.90 | 968.75 | 968.57 | 968.44 | 968.37 |
| **7** | 968.42 | 968.31 | 968.32 | 968.36 | 968.41 | 968.51 | 969.05 | 968.93 | 968.75 | 968.56 | 968.44 | 968.37 |
| **8** | 968.41 | 968.30 | 968.32 | 968.36 | 968.42 | 968.52 | 969.04 | 968.97 | 968.74 | 968.56 | 968.43 | 968.37 |
| **9** | 968.41 | 968.30 | 968.33 | 968.36 | 968.42 | 968.53 | 969.03 | 969.00 | 968.73 | 968.55 | 968.43 | 968.37 |
| **10** | 968.40 | 968.30 | 968.35 | 968.36 | 968.42 | 968.53 | 969.02 | 969.03 | 968.73 | 968.55 | 968.42 | 968.37 |
| **11** | 968.40 | 968.30 | 968.35 | 968.36 | 968.42 | 968.55 | 969.01 | 969.06 | 968.73 | 968.54 | 968.42 | 968.37 |
| **12** | 968.39 | 968.30 | 968.35 | 968.36 | 968.42 | 968.56 | 969.00 | 969.12 | 968.73 | 968.54 | 968.42 | 968.36 |
| **13** | 968.39 | 968.30 | 968.35 | 968.36 | 968.42 | 968.57 | 969.00 | 969.16 | 968.74 | 968.53 | 968.41 | 968.36 |
| **14** | 968.38 | 968.31 | 968.35 | 968.36 | 968.43 | 968.59 | 969.02 | 969.11 | 968.73 | 968.53 | 968.41 | 968.36 |
| **15** | 968.38 | 968.31 | 968.35 | 968.36 | 968.43 | 968.61 | 969.07 | 969.10 | 968.72 | 968.52 | 968.40 | 968.36 |
| **16** | 968.38 | 968.31 | 968.35 | 968.37 | 968.43 | 968.63 | 969.09 | 969.10 | 968.72 | 968.52 | 968.40 | 968.35 |
| **17** | 968.37 | 968.31 | 968.35 | 968.37 | 968.43 | 968.65 | 969.10 | 969.09 | 968.71 | 968.51 | 968.39 | 968.35 |
| **18** | 968.37 | 968.31 | 968.35 | 968.37 | 968.43 | 968.66 | 969.11 | 969.03 | 968.71 | 968.51 | 968.39 | 968.35 |
| **19** | 968.37 | 968.31 | 968.35 | 968.37 | 968.44 | 968.68 | 969.11 | 968.94 | 968.70 | 968.51 | 968.38 | 968.34 |
| **20** | 968.36 | 968.31 | 968.35 | 968.38 | 968.44 | 968.70 | 969.11 | 968.87 | 968.69 | 968.51 | 968.38 | 968.34 |
| **21** | 968.36 | 968.31 | 968.35 | 968.38 | 968.44 | 968.71 | 969.09 | 968.86 | 968.68 | 968.51 | 968.37 | 968.35 |
| **22** | 968.36 | 968.31 | 968.35 | 968.38 | 968.44 | 968.73 | 969.08 | 968.85 | 968.67 | 968.50 | 968.37 | 968.35 |
| **23** | 968.35 | 968.31 | 968.35 | 968.38 | 968.44 | 968.74 | 969.07 | 968.85 | 968.66 | 968.50 | 968.36 | 968.34 |
| **24** | 968.35 | 968.31 | 968.35 | 968.38 | 968.45 | 968.75 | 969.06 | 968.84 | 968.64 | 968.49 | 968.37 | 968.34 |
| **25** | 968.35 | 968.31 | 968.36 | 968.38 | 968.45 | 968.76 | 969.05 | 968.84 | 968.63 | 968.49 | 968.37 | 968.34 |
| **26** | 968.34 | 968.31 | 968.36 | 968.38 | 968.45 | 968.77 | 969.02 | 968.83 | 968.63 | 968.48 | 968.37 | 968.35 |
| **27** | 968.34 | 968.31 | 968.36 | 968.39 | 968.46 | 968.78 | 968.99 | 968.82 | 968.62 | 968.48 | 968.37 | 968.36 |
| **28** | 968.34 | 968.31 | 968.36 | 968.39 | 968.46 | 968.79 | 968.96 | 968.81 | 968.62 | 968.47 | 968.36 | 968.37 |
| **29** | 968.33 | 968.31 | 968.36 | 968.39 | | 968.83 | 968.95 | 968.81 | 968.61 | 968.47 | 968.36 | 968.38 |
| **30** | 968.33 | 968.31 | 968.36 | 968.39 | | 968.89 | 968.98 | 968.80 | 968.60 | 968.47 | 968.35 | 968.39 |
| **31** | 968.33 | | 968.36 | 968.40 | | 968.96 | | 968.79 | | 968.46 | 968.35 | |
| **ORT** | 968.38 | 968.31 | 968.34 | 968.37 | 968.43 | 968.64 | 969.03 | 968.95 | 968.70 | 968.52 | 968.40 | 968.36 |

Table C 13 Water Elevations of Lake Eymir (2000 Water Year)

| DAY/MONTH | OCTOBER | NOVEMBER | DECEMBER | JANUARY | FEBRUARY | MARCH | APRIL | MAY | JUNE | JULY | AUGUST | SEPTEMBER |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **1** | 968.39 | 968.46 | 968.53 | 968.60 | 968.65 | 968.71 | 969.04 | 969.16 | 969.10 | 969.01 | 968.70 | 968.64 |
| **2** | 968.39 | 968.46 | 968.54 | 968.60 | 968.65 | 968.71 | 969.04 | 969.17 | 969.10 | 969.00 | 968.69 | 968.63 |
| **3** | 968.39 | 968.46 | 968.54 | 968.60 | 968.65 | 968.72 | 969.04 | 969.17 | 969.09 | 968.99 | 968.68 | 968.62 |
| **4** | 968.39 | 968.47 | 968.54 | 968.60 | 968.65 | 968.72 | 969.05 | 969.18 | 969.09 | 968.98 | 968.68 | 968.62 |
| **5** | 968.39 | 968.47 | 968.54 | 968.60 | 968.65 | 968.72 | 969.05 | 969.18 | 969.09 | 968.97 | 968.69 | 968.61 |
| **6** | 968.39 | 968.47 | 968.55 | 968.60 | 968.66 | 968.72 | 969.05 | 969.19 | 969.08 | 968.96 | 968.69 | 968.60 |
| **7** | 968.39 | 968.47 | 968.55 | 968.61 | 968.66 | 968.73 | 969.05 | 969.19 | 969.08 | 968.95 | 968.69 | 968.60 |
| **8** | 968.39 | 968.48 | 968.55 | 968.61 | 968.66 | 968.74 | 969.06 | 969.18 | 969.08 | 968.94 | 968.70 | 968.59 |
| **9** | 968.39 | 968.48 | 968.55 | 968.61 | 968.66 | 968.75 | 969.06 | 969.18 | 969.09 | 968.93 | 968.70 | 968.58 |
| **10** | 968.40 | 968.48 | 968.56 | 968.61 | 968.66 | 968.77 | 969.06 | 969.17 | 968.92 | 968.92 | 968.71 | 968.58 |
| **11** | 968.40 | 968.48 | 968.56 | 968.61 | 968.66 | 968.79 | 969.06 | 969.17 | 968.83 | 968.91 | 968.71 | 968.57 |
| **12** | 968.40 | 968.49 | 968.56 | 968.61 | 968.67 | 968.81 | 969.07 | 969.17 | 968.86 | 968.90 | 968.71 | 968.56 |
| **13** | 968.40 | 968.49 | 968.56 | 968.62 | 968.67 | 968.82 | 969.07 | 969.16 | 968.91 | 968.89 | 968.70 | 968.55 |
| **14** | 968.41 | 968.49 | 968.57 | 968.62 | 968.67 | 968.84 | 969.08 | 969.16 | 968.98 | 968.88 | 968.70 | 968.55 |
| **15** | 968.41 | 968.49 | 968.57 | 968.62 | 968.67 | 968.85 | 969.08 | 969.16 | 968.91 | 968.87 | 968.70 | 968.54 |
| **16** | 968.41 | 968.50 | 968.57 | 968.62 | 968.68 | 968.87 | 969.09 | 969.15 | 968.97 | 968.86 | 968.70 | 968.54 |
| **17** | 968.41 | 968.50 | 968.57 | 968.62 | 968.68 | 968.89 | 969.09 | 969.15 | 969.02 | 968.85 | 968.70 | 968.54 |
| **18** | 968.42 | 968.50 | 968.57 | 968.62 | 968.68 | 968.90 | 969.10 | 969.15 | 969.03 | 968.84 | 968.69 | 968.53 |
| **19** | 968.42 | 968.50 | 968.57 | 968.63 | 968.68 | 968.92 | 969.10 | 969.14 | 969.04 | 968.83 | 968.69 | 968.53 |
| **20** | 968.42 | 968.51 | 968.58 | 968.63 | 968.68 | 968.93 | 969.11 | 969.14 | 969.07 | 968.81 | 968.69 | 968.52 |
| **21** | 968.43 | 968.51 | 968.58 | 968.63 | 968.69 | 968.95 | 969.11 | 969.14 | 969.09 | 968.80 | 968.68 | 968.52 |
| **22** | 968.43 | 968.51 | 968.58 | 968.63 | 968.69 | 968.96 | 969.12 | 969.13 | 969.08 | 968.79 | 968.68 | 968.51 |
| **23** | 968.43 | 968.51 | 968.58 | 968.63 | 968.69 | 968.97 | 969.12 | 969.13 | 969.07 | 968.78 | 968.67 | 968.50 |
| **24** | 968.44 | 968.52 | 968.58 | 968.63 | 968.69 | 968.98 | 969.13 | 969.13 | 969.07 | 968.77 | 968.67 | 968.50 |
| **25** | 968.44 | 968.52 | 968.58 | 968.64 | 968.70 | 969.00 | 969.13 | 969.12 | 969.06 | 968.76 | 968.66 | 968.49 |
| **26** | 968.44 | 968.52 | 968.58 | 968.64 | 968.70 | 969.01 | 969.14 | 969.12 | 969.05 | 968.75 | 968.66 | 968.48 |
| **27** | 968.45 | 968.52 | 968.59 | 968.64 | 968.70 | 969.02 | 969.14 | 969.12 | 969.04 | 968.74 | 968.66 | 968.47 |
| **28** | 968.45 | 968.53 | 968.59 | 968.64 | 968.70 | 969.02 | 969.15 | 969.11 | 969.03 | 968.74 | 968.66 | 968.46 |
| **29** | 968.45 | 968.53 | 968.59 | 968.64 | 968.71 | 969.03 | 969.15 | 969.11 | 969.02 | 968.73 | 968.65 | 968.46 |
| **30** | 968.45 | 968.53 | 968.59 | 968.64 |  | 969.03 | 969.16 | 969.11 | 969.02 | 968.72 | 968.65 | 968.45 |
| **31** | 968.46 |  | 968.59 | 968.65 |  | 969.04 |  | 969.10 |  | 968.71 | 968.64 |  |
| **ORTA** | 968.42 | 968.50 | 968.57 | 968.62 | 968.67 | 968.87 | 969.09 | 969.15 | 969.03 | 968.86 | 968.68 | 968.54 |

Table C 14 Water Elevations of Lake Eymir (2001 Water Year)

| DAY/MONTH | OCTOBER | NOVEMBER | DECEMBER | JANUARY | FEBRUARY | MARCH | APRIL | MAY | JUNE | JULY | AUGUST | SEPTEMBER |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **1** | 968.44 | 968.06 | 967.92 | 967.90 | 967.92 | 967.89 | 967.85 | 967.84 | 967.94 | 967.74 | 967.56 | 967.37 |
| **2** | 968.44 | 968.05 | 967.92 | 967.90 | 967.92 | 967.89 | 967.85 | 967.84 | 967.94 | 967.73 | 967.56 | 967.36 |
| **3** | 968.43 | 968.04 | 967.92 | 967.90 | 967.92 | 967.89 | 967.85 | 967.84 | 967.93 | 967.73 | 967.55 | 967.36 |
| **4** | 968.42 | 968.03 | 967.92 | 967.90 | 967.92 | 967.89 | 967.84 | 967.85 | 967.93 | 967.72 | 967.54 | 967.35 |
| **5** | 968.42 | 968.02 | 967.91 | 967.90 | 967.92 | 967.89 | 967.84 | 967.85 | 967.92 | 967.71 | 967.53 | 967.35 |
| **6** | 968.41 | 968.01 | 967.91 | 967.90 | 967.92 | 967.88 | 967.84 | 967.85 | 967.91 | 967.71 | 967.52 | 967.34 |
| **7** | 968.41 | 968.00 | 967.91 | 967.90 | 967.92 | 967.88 | 967.84 | 967.86 | 967.90 | 967.70 | 967.51 | 967.34 |
| **8** | 968.40 | 968.00 | 967.91 | 967.90 | 967.92 | 967.89 | 967.83 | 967.87 | 967.89 | 967.70 | 967.50 | 967.33 |
| **9** | 968.40 | 967.99 | 967.91 | 967.90 | 967.91 | 967.89 | 967.83 | 967.88 | 967.89 | 967.69 | 967.49 | 967.33 |
| **10** | 968.39 | 967.98 | 967.90 | 967.90 | 967.91 | 967.89 | 967.83 | 967.89 | 967.88 | 967.69 | 967.49 | 967.33 |
| **11** | 968.39 | 967.98 | 967.90 | 967.90 | 967.91 | 967.89 | 967.83 | 967.90 | 967.88 | 967.68 | 967.48 | 967.32 |
| **12** | 968.38 | 967.97 | 967.90 | 967.90 | 967.90 | 967.89 | 967.83 | 967.91 | 967.87 | 967.68 | 967.48 | 967.32 |
| **13** | 968.38 | 967.97 | 967.90 | 967.90 | 967.90 | 967.89 | 967.83 | 967.92 | 967.86 | 967.67 | 967.47 | 967.32 |
| **14** | 968.37 | 967.97 | 967.90 | 967.90 | 967.90 | 967.88 | 967.83 | 967.96 | 967.86 | 967.67 | 967.46 | 967.31 |
| **15** | 968.37 | 967.96 | 967.90 | 967.91 | 967.89 | 967.88 | 967.83 | 967.98 | 967.85 | 967.66 | 967.46 | 967.31 |
| **16** | 968.36 | 967.96 | 967.90 | 967.91 | 967.89 | 967.88 | 967.83 | 967.98 | 967.84 | 967.65 | 967.45 | 967.30 |
| **17** | 968.36 | 967.95 | 967.90 | 967.91 | 967.89 | 967.88 | 967.83 | 967.98 | 967.83 | 967.65 | 967.45 | 967.30 |
| **18** | 968.35 | 967.95 | 967.90 | 967.91 | 967.89 | 967.88 | 967.83 | 967.99 | 967.83 | 967.64 | 967.44 | 967.30 |
| **19** | 968.34 | 967.94 | 967.90 | 967.91 | 967.88 | 967.87 | 967.83 | 967.98 | 967.82 | 967.63 | 967.43 | 967.29 |
| **20** | 968.34 | 967.94 | 967.90 | 967.91 | 967.88 | 967.87 | 967.84 | 967.98 | 967.82 | 967.62 | 967.43 | 967.29 |
| **21** | 968.33 | 967.94 | 967.90 | 967.91 | 967.88 | 967.87 | 967.84 | 967.98 | 967.80 | 967.62 | 967.42 | 967.29 |
| **22** | 968.32 | 967.93 | 967.90 | 967.91 | 967.88 | 967.87 | 967.84 | 967.98 | 967.80 | 967.61 | 967.41 | 967.29 |
| **23** | 968.32 | 967.93 | 967.90 | 967.91 | 967.88 | 967.87 | 967.84 | 967.98 | 967.79 | 967.61 | 967.41 | 967.28 |
| **24** | 968.30 | 967.93 | 967.89 | 967.91 | 967.88 | 967.87 | 967.84 | 967.97 | 967.78 | 967.60 | 967.40 | 967.28 |
| **25** | 968.26 | 967.93 | 967.89 | 967.92 | 967.88 | 967.87 | 967.84 | 967.97 | 967.78 | 967.60 | 967.40 | 967.28 |
| **26** | 968.22 | 967.92 | 967.89 | 967.92 | 967.88 | 967.87 | 967.84 | 967.96 | 967.77 | 967.59 | 967.39 | 967.28 |
| **27** | 968.18 | 967.92 | 967.89 | 967.92 | 967.88 | 967.86 | 967.84 | 967.96 | 967.76 | 967.59 | 967.39 | 967.27 |
| **28** | 968.15 | 967.92 | 967.89 | 967.92 | 967.89 | 967.86 | 967.84 | 967.96 | 967.76 | 967.58 | 967.38 | 967.27 |
| **29** | 968.12 | 967.93 | 967.89 | 967.92 | | 967.86 | 967.84 | 967.95 | 967.75 | 967.58 | 967.38 | 967.27 |
| **30** | 968.10 | 967.92 | 967.89 | 967.92 | | 967.86 | 967.84 | 967.95 | 967.74 | 967.57 | 967.37 | 967.26 |
| **31** | 968.08 | | 967.89 | 967.92 | | 967.85 | | 967.94 | | 967.57 | 967.37 | |
| **ORT** | 968.33 | 967.97 | 967.90 | 967.91 | 967.90 | 967.88 | 967.84 | 967.93 | 967.84 | 967.65 | 967.46 | 967.31 |

Table C 15 Water Elevations of Lake Eymir (2002 Water Year)

| DAY/MONTH | OCTOBER | NOVEMBER | DECEMBER | JANUARY | FEBRUARY | MARCH | APRIL | MAY | JUNE | JULY | AUGUST | SEPTEMBER |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **1** | 967.26 | 967.17 | 967.19 | 967.78 | 967.82 | 967.93 | 968.08 | 968.86 | 968.74 | 968.53 | 968.25 | 967.97 |
| **2** | 967.26 | 967.17 | 967.19 | 967.80 | 967.82 | 967.93 | 968.12 | 968.89 | 968.73 | 968.51 | 968.23 | 967.97 |
| **3** | 967.25 | 967.17 | 967.19 | 967.83 | 967.82 | 967.93 | 968.17 | 968.92 | 968.70 | 968.51 | 968.22 | 967.96 |
| **4** | 967.25 | 967.17 | 967.20 | 967.84 | 967.82 | 967.93 | 968.19 | 968.96 | 968.69 | 968.49 | 968.22 | 967.96 |
| **5** | 967.24 | 967.18 | 967.20 | 967.84 | 967.82 | 967.94 | 968.23 | 969.01 | 968.69 | 968.49 | 968.21 | 967.95 |
| **6** | 967.24 | 967.18 | 967.20 | 967.84 | 967.82 | 967.94 | 968.30 | 969.06 | 968.69 | 968.47 | 968.20 | 967.94 |
| **7** | 967.23 | 967.19 | 967.20 | 967.85 | 967.82 | 967.94 | 968.36 | 969.09 | 968.68 | 968.46 | 968.19 | 967.94 |
| **8** | 967.23 | 967.19 | 967.21 | 967.85 | 967.82 | 967.94 | 968.40 | 969.12 | 968.68 | 968.46 | 968.18 | 967.93 |
| **9** | 967.22 | 967.19 | 967.21 | 967.85 | 967.82 | 967.94 | 968.42 | 969.03 | 968.68 | 968.45 | 968.17 | 967.92 |
| **10** | 967.22 | 967.18 | 967.22 | 967.84 | 967.83 | 967.95 | 968.44 | 969.05 | 968.68 | 968.45 | 968.16 | 967.92 |
| **11** | 967.21 | 967.18 | 967.22 | 967.84 | 967.83 | 967.95 | 968.45 | 969.02 | 968.67 | 968.44 | 968.15 | 967.92 |
| **12** | 967.21 | 967.18 | 967.23 | 967.84 | 967.84 | 967.96 | 968.46 | 968.85 | 968.68 | 968.43 | 968.15 | 967.93 |
| **13** | 967.21 | 967.18 | 967.23 | 967.84 | 967.84 | 967.96 | 968.48 | 968.83 | 968.68 | 968.43 | 968.14 | 967.92 |
| **14** | 967.20 | 967.17 | 967.23 | 967.84 | 967.86 | 967.96 | 968.50 | 968.83 | 968.67 | 968.42 | 968.12 | 967.92 |
| **15** | 967.20 | 967.17 | 967.24 | 967.84 | 967.86 | 967.97 | 968.51 | 968.82 | 968.67 | 968.42 | 968.11 | 967.92 |
| **16** | 967.20 | 967.17 | 967.26 | 967.83 | 967.87 | 967.97 | 968.52 | 968.80 | 968.67 | 968.41 | 968.11 | 967.92 |
| **17** | 967.20 | 967.17 | 967.28 | 967.83 | 967.87 | 967.97 | 968.55 | 968.82 | 968.66 | 968.40 | 968.10 | 967.91 |
| **18** | 967.19 | 967.17 | 967.31 | 967.83 | 967.87 | 967.97 | 968.56 | 968.87 | 968.66 | 968.39 | 968.09 | 967.91 |
| **19** | 967.19 | 967.16 | 967.33 | 967.83 | 967.88 | 967.97 | 968.58 | 968.84 | 968.65 | 968.38 | 968.08 | 967.90 |
| **20** | 967.19 | 967.16 | 967.35 | 967.83 | 967.88 | 967.97 | 968.60 | 968.83 | 968.63 | 968.37 | 968.09 | 967.89 |
| **21** | 967.19 | 967.16 | 967.38 | 967.83 | 967.88 | 967.97 | 968.63 | 968.82 | 968.61 | 968.36 | 968.08 | 967.89 |
| **22** | 967.19 | 967.17 | 967.40 | 967.83 | 967.89 | 967.97 | 968.65 | 968.83 | 968.60 | 968.35 | 968.07 | 967.88 |
| **23** | 967.19 | 967.17 | 967.43 | 967.83 | 967.91 | 967.97 | 968.67 | 968.84 | 968.60 | 968.34 | 968.06 | 967.88 |
| **24** | 967.18 | 967.17 | 967.47 | 967.83 | 967.91 | 967.99 | 968.70 | 968.86 | 968.58 | 968.33 | 968.06 | 967.87 |
| **25** | 967.18 | 967.18 | 967.51 | 967.83 | 967.91 | 968.02 | 968.72 | 968.83 | 968.58 | 968.31 | 968.05 | 967.86 |
| **26** | 967.18 | 967.18 | 967.56 | 967.83 | 967.92 | 968.04 | 968.74 | 968.81 | 968.57 | 968.30 | 968.04 | 967.86 |
| **27** | 967.18 | 967.18 | 967.62 | 967.82 | 967.92 | 968.05 | 968.77 | 968.80 | 968.56 | 968.30 | 968.03 | 967.86 |
| **28** | 967.18 | 967.18 | 967.67 | 967.82 | 967.92 | 968.06 | 968.80 | 968.79 | 968.55 | 968.29 | 968.02 | 967.85 |
| **29** | 967.18 | 967.19 | 967.71 | 967.82 | | 968.06 | 968.82 | 968.77 | 968.55 | 968.28 | 968.01 | 967.84 |
| **30** | 967.18 | 967.19 | 967.74 | 967.82 | | 968.07 | 968.84 | 968.76 | 968.54 | 968.27 | 967.99 | 967.84 |
| **31** | 967.18 | | 967.77 | 967.82 | | 968.07 | | 968.75 | | 968.26 | 967.98 | |
| **ORT.** | 967.21 | 967.18 | 967.35 | 967.83 | 967.86 | 967.98 | 968.51 | 968.88 | 968.64 | 968.40 | 968.11 | 967.91 |

Table C 16 Water Elevations of Lake Eymir (2003 Water Year)

| DAY/MONTH | OCTOBER | NOVEMBER | DECEMBER | JANUARY | FEBRUARY | MARCH | APRIL | MAY | JUNE | JULY | AUGUST | SEPTEMBER |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **1** | 967.83 | 967.75 | 967.77 | 967.77 | 967.84 | 967.93 | 968.61 | 968.92 | 968.99 | 968.74 | 968.45 | 968.21 |
| **2** | 967.83 | 967.75 | 967.77 | 967.77 | 967.85 | 967.93 | 968.65 | 968.91 | 968.99 | 968.73 | 968.44 | 968.20 |
| **3** | 967.82 | 967.75 | 967.77 | 967.77 | 967.85 | 967.93 | 968.69 | 968.90 | 968.98 | 968.72 | 968.43 | 968.20 |
| **4** | 967.82 | 967.75 | 967.77 | 967.78 | 967.85 | 967.93 | 968.73 | 968.90 | 968.97 | 968.72 | 968.43 | 968.19 |
| **5** | 967.81 | 967.75 | 967.77 | 967.80 | 967.85 | 967.94 | 968.78 | 968.89 | 968.96 | 968.71 | 968.42 | 968.19 |
| **6** | 967.81 | 967.75 | 967.77 | 967.80 | 967.86 | 967.94 | 968.84 | 968.89 | 968.96 | 968.70 | 968.42 | 968.18 |
| **7** | 967.80 | 967.75 | 967.77 | 967.80 | 967.88 | 967.95 | 968.89 | 968.88 | 968.95 | 968.69 | 968.41 | 968.18 |
| **8** | 967.80 | 967.75 | 967.77 | 967.81 | 967.89 | 967.96 | 968.93 | 968.88 | 968.94 | 968.68 | 968.40 | 968.18 |
| **9** | 967.79 | 967.75 | 967.77 | 967.81 | 967.90 | 967.97 | 968.97 | 968.87 | 968.93 | 968.67 | 968.40 | 968.17 |
| **10** | 967.79 | 967.75 | 967.77 | 967.81 | 967.90 | 967.97 | 968.99 | 968.87 | 968.93 | 968.66 | 968.39 | 968.17 |
| **11** | 967.79 | 967.75 | 967.77 | 967.81 | 967.90 | 967.98 | 969.01 | 968.86 | 968.92 | 968.65 | 968.39 | 968.17 |
| **12** | 967.78 | 967.75 | 967.77 | 967.81 | 967.90 | 967.98 | 969.04 | 968.86 | 968.91 | 968.64 | 968.38 | 968.16 |
| **13** | 967.78 | 967.75 | 967.77 | 967.81 | 967.90 | 967.98 | 969.07 | 968.87 | 968.90 | 968.63 | 968.38 | 968.16 |
| **14** | 967.78 | 967.75 | 967.77 | 967.81 | 967.90 | 967.99 | 969.09 | 968.87 | 968.89 | 968.62 | 968.37 | 968.16 |
| **15** | 967.79 | 967.75 | 967.77 | 967.81 | 967.91 | 968.00 | 969.11 | 968.88 | 968.88 | 968.61 | 968.36 | 968.15 |
| **16** | 967.79 | 967.75 | 967.77 | 967.81 | 967.91 | 968.01 | 969.14 | 968.89 | 968.87 | 968.60 | 968.36 | 968.15 |
| **17** | 967.79 | 967.75 | 967.77 | 967.81 | 967.91 | 968.03 | 969.17 | 968.90 | 968.87 | 968.59 | 968.35 | 968.15 |
| **18** | 967.78 | 967.75 | 967.77 | 967.81 | 967.91 | 968.05 | 969.18 | 968.92 | 968.86 | 968.58 | 968.34 | 968.15 |
| **19** | 967.78 | 967.75 | 967.77 | 967.81 | 967.91 | 968.07 | 969.18 | 968.93 | 968.85 | 968.57 | 968.34 | 968.14 |
| **20** | 967.78 | 967.75 | 967.77 | 967.81 | 967.92 | 968.10 | 969.17 | 968.94 | 968.84 | 968.56 | 968.33 | 968.14 |
| **21** | 967.78 | 967.75 | 967.77 | 967.81 | 967.92 | 968.12 | 969.15 | 968.97 | 968.84 | 968.55 | 968.32 | 968.14 |
| **22** | 967.77 | 967.75 | 967.77 | 967.81 | 967.92 | 968.16 | 969.12 | 968.99 | 968.83 | 968.54 | 968.31 | 968.14 |
| **23** | 967.77 | 967.75 | 967.77 | 967.82 | 967.92 | 968.20 | 969.10 | 969.00 | 968.81 | 968.53 | 968.30 | 968.14 |
| **24** | 967.77 | 967.77 | 967.77 | 967.83 | 967.92 | 968.26 | 969.08 | 969.00 | 968.80 | 968.52 | 968.29 | 968.13 |
| **25** | 967.77 | 967.77 | 967.77 | 967.83 | 967.92 | 968.31 | 969.05 | 969.00 | 968.80 | 968.51 | 968.28 | 968.13 |
| **26** | 967.76 | 967.77 | 967.77 | 967.83 | 967.93 | 968.36 | 969.02 | 969.00 | 968.79 | 968.51 | 968.27 | 968.13 |
| **27** | 967.76 | 967.77 | 967.77 | 967.83 | 967.93 | 968.41 | 968.99 | 969.00 | 968.78 | 968.50 | 968.26 | 968.13 |
| **28** | 967.76 | 967.77 | 967.77 | 967.83 | 967.93 | 968.45 | 968.97 | 969.00 | 968.77 | 968.49 | 968.25 | 968.13 |
| **29** | 967.76 | 967.77 | 967.77 | 967.83 |  | 968.49 | 968.95 | 968.99 | 968.76 | 968.48 | 968.24 | 968.13 |
| **30** | 967.75 | 967.77 | 967.77 | 967.83 |  | 968.53 | 968.93 | 968.99 | 968.75 | 968.47 | 968.23 | 968.12 |
| **31** | 967.75 |  | 967.77 | 967.83 |  | 968.57 |  | 968.99 |  | 968.46 | 968.22 |  |
| **Ortalama** | 967.79 | 967.75 | 967.77 | 967.81 | 967.90 | 968.11 | 968.99 | 968.93 | 968.88 | 968.60 | 968.35 | 968.16 |

Table C 17 Water Elevations of Lake Eymir (2004 Water Year)

| DAY/MONTH | OCTOBER | NOVEMBER | DECEMBER | JANUARY | FEBRUARY | MARCH | APRIL | MAY | JUNE | JULY | AUGUST | SEPTEMBER |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **1** | 968.12 | 968.09 | 968.11 | 968.21 | 968.23 | 968.37 | 968.29 | 968.15 | 968.09 | 967.97 | 967.76 | 967.60 |
| **2** | 968.12 | 968.09 | 968.11 | 968.21 | 968.23 | 968.38 | 968.28 | 968.15 | 968.08 | 967.96 | 967.75 | 967.60 |
| **3** | 968.12 | 968.09 | 968.11 | 968.21 | 968.23 | 968.40 | 968.28 | 968.15 | 968.08 | 967.96 | 967.75 | 967.59 |
| **4** | 968.11 | 968.09 | 968.11 | 968.21 | 968.24 | 968.42 | 968.27 | 968.15 | 968.08 | 967.95 | 967.74 | 967.59 |
| **5** | 968.11 | 968.09 | 968.11 | 968.21 | 968.24 | 968.43 | 968.27 | 968.15 | 968.08 | 967.95 | 967.74 | 967.58 |
| **6** | 968.11 | 968.09 | 968.11 | 968.21 | 968.24 | 968.44 | 968.26 | 968.15 | 968.07 | 967.94 | 967.73 | 967.58 |
| **7** | 968.11 | 968.10 | 968.12 | 968.21 | 968.24 | 968.46 | 968.25 | 968.15 | 968.07 | 967.94 | 967.73 | 967.58 |
| **8** | 968.11 | 968.10 | 968.12 | 968.21 | 968.26 | 968.49 | 968.25 | 968.14 | 968.07 | 967.93 | 967.72 | 967.57 |
| **9** | 968.11 | 968.10 | 968.12 | 968.21 | 968.27 | 968.52 | 968.24 | 968.14 | 968.07 | 967.92 | 967.72 | 967.57 |
| **10** | 968.11 | 968.10 | 968.12 | 968.21 | 968.28 | 968.53 | 968.23 | 968.14 | 968.06 | 967.91 | 967.71 | 967.56 |
| **11** | 968.11 | 968.10 | 968.12 | 968.21 | 968.29 | 968.53 | 968.22 | 968.14 | 968.06 | 967.90 | 967.71 | 967.56 |
| **12** | 968.11 | 968.10 | 968.12 | 968.22 | 968.29 | 968.49 | 968.21 | 968.14 | 968.06 | 967.89 | 967.70 | 967.55 |
| **13** | 968.11 | 968.10 | 968.12 | 968.22 | 968.30 | 968.47 | 968.20 | 968.13 | 968.05 | 967.88 | 967.70 | 967.55 |
| **14** | 968.10 | 968.10 | 968.12 | 968.22 | 968.30 | 968.44 | 968.19 | 968.13 | 968.05 | 967.87 | 967.69 | 967.54 |
| **15** | 968.10 | 968.10 | 968.12 | 968.22 | 968.30 | 968.42 | 968.18 | 968.13 | 968.05 | 967.86 | 967.69 | 967.54 |
| **16** | 968.10 | 968.10 | 968.12 | 968.22 | 968.31 | 968.40 | 968.18 | 968.12 | 968.04 | 967.85 | 967.68 | 967.53 |
| **17** | 968.10 | 968.10 | 968.12 | 968.22 | 968.31 | 968.39 | 968.17 | 968.12 | 968.04 | 967.84 | 967.68 | 967.53 |
| **18** | 968.10 | 968.10 | 968.12 | 968.22 | 968.31 | 968.38 | 968.17 | 968.12 | 968.03 | 967.83 | 967.67 | 967.52 |
| **19** | 968.10 | 968.10 | 968.12 | 968.22 | 968.31 | 968.38 | 968.16 | 968.12 | 968.03 | 967.83 | 967.67 | 967.52 |
| **20** | 968.10 | 968.11 | 968.12 | 968.22 | 968.32 | 968.37 | 968.16 | 968.12 | 968.02 | 967.82 | 967.66 | 967.51 |
| **21** | 968.10 | 968.11 | 968.12 | 968.22 | 968.32 | 968.37 | 968.16 | 968.11 | 968.02 | 967.82 | 967.66 | 967.51 |
| **22** | 968.10 | 968.11 | 968.13 | 968.23 | 968.32 | 968.36 | 968.16 | 968.11 | 968.01 | 967.81 | 967.65 | 967.50 |
| **23** | 968.10 | 968.11 | 968.13 | 968.23 | 968.32 | 968.35 | 968.16 | 968.11 | 968.01 | 967.81 | 967.65 | 967.50 |
| **24** | 968.10 | 968.11 | 968.13 | 968.23 | 968.33 | 968.35 | 968.16 | 968.11 | 968.00 | 967.80 | 967.64 | 967.49 |
| **25** | 968.09 | 968.11 | 968.14 | 968.23 | 968.33 | 968.34 | 968.16 | 968.10 | 968.00 | 967.80 | 967.64 | 967.49 |
| **26** | 968.09 | 968.11 | 968.14 | 968.23 | 968.33 | 968.33 | 968.16 | 968.10 | 967.99 | 967.79 | 967.63 | 967.49 |
| **27** | 968.09 | 968.11 | 968.15 | 968.23 | 968.34 | 968.33 | 968.16 | 968.10 | 967.99 | 967.79 | 967.63 | 967.48 |
| **28** | 968.09 | 968.11 | 968.17 | 968.23 | 968.35 | 968.32 | 968.16 | 968.10 | 967.98 | 967.78 | 967.62 | 967.48 |
| **29** | 968.09 | 968.11 | 968.18 | 968.23 | 968.36 | 968.31 | 968.16 | 968.09 | 967.98 | 967.78 | 967.62 | 967.48 |
| **30** | 968.09 | 968.11 | 968.20 | 968.23 | | 968.30 | 968.15 | 968.09 | 967.97 | 967.77 | 967.61 | 967.47 |
| **31** | 968.09 | | 968.21 | 968.23 | | 968.30 | | 968.09 | | 967.77 | 967.61 | |
| **Ortalama** | 968.10 | 968.10 | 968.13 | 968.22 | 968.29 | 968.40 | 968.20 | 968.12 | 968.04 | 967.86 | 967.68 | 967.54 |

Table C 18 Water Elevations of Lake Eymir (2005 Water Year)

| DAY/MONTH | OCTOBER | NOVEMBER | DECEMBER | JANUARY | FEBRUARY | MARCH | APRIL | MAY | JUNE | JULY | AUGUST | SEPTEMBER |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **1** | 967.47 | 967.42 | 967.40 | 967.44 | 967.49 | 967.60 | 967.75 | 967.80 | 967.83 | 967.75 | 967.59 | 967.42 |
| **2** | 967.47 | 967.42 | 967.40 | 967.45 | 967.49 | 967.61 | 967.76 | 967.80 | 967.83 | 967.75 | 967.58 | 967.41 |
| **3** | 967.47 | 967.42 | 967.40 | 967.45 | 967.50 | 967.62 | 967.76 | 967.80 | 967.83 | 967.74 | 967.58 | 967.40 |
| **4** | 967.46 | 967.42 | 967.40 | 967.45 | 967.50 | 967.63 | 967.76 | 967.80 | 967.83 | 967.74 | 967.58 | 967.40 |
| **5** | 967.46 | 967.42 | 967.40 | 967.45 | 967.50 | 967.63 | 967.76 | 967.80 | 967.83 | 967.73 | 967.58 | 967.39 |
| **6** | 967.46 | 967.42 | 967.40 | 967.45 | 967.50 | 967.64 | 967.77 | 967.80 | 967.83 | 967.73 | 967.57 | 967.39 |
| **7** | 967.46 | 967.42 | 967.40 | 967.45 | 967.50 | 967.64 | 967.77 | 967.81 | 967.83 | 967.72 | 967.57 | 967.38 |
| **8** | 967.46 | 967.42 | 967.40 | 967.45 | 967.50 | 967.64 | 967.77 | 967.81 | 967.83 | 967.72 | 967.57 | 967.38 |
| **9** | 967.46 | 967.42 | 967.40 | 967.45 | 967.50 | 967.64 | 967.77 | 967.81 | 967.82 | 967.71 | 967.56 | 967.37 |
| **10** | 967.46 | 967.42 | 967.39 | 967.45 | 967.50 | 967.65 | 967.77 | 967.81 | 967.82 | 967.71 | 967.56 | 967.37 |
| **11** | 967.46 | 967.42 | 967.39 | 967.46 | 967.51 | 967.65 | 967.77 | 967.81 | 967.82 | 967.70 | 967.55 | 967.36 |
| **12** | 967.46 | 967.41 | 967.39 | 967.46 | 967.51 | 967.65 | 967.77 | 967.81 | 967.82 | 967.70 | 967.55 | 967.35 |
| **13** | 967.46 | 967.41 | 967.39 | 967.46 | 967.51 | 967.65 | 967.78 | 967.81 | 967.82 | 967.69 | 967.54 | 967.34 |
| **14** | 967.45 | 967.41 | 967.39 | 967.46 | 967.51 | 967.66 | 967.78 | 967.81 | 967.82 | 967.69 | 967.53 | 967.33 |
| **15** | 967.45 | 967.41 | 967.39 | 967.46 | 967.51 | 967.66 | 967.78 | 967.81 | 967.82 | 967.68 | 967.52 | 967.32 |
| **16** | 967.45 | 967.41 | 967.39 | 967.46 | 967.51 | 967.66 | 967.78 | 967.82 | 967.82 | 967.68 | 967.52 | 967.31 |
| **17** | 967.45 | 967.41 | 967.39 | 967.46 | 967.51 | 967.66 | 967.78 | 967.82 | 967.82 | 967.67 | 967.51 | 967.30 |
| **18** | 967.44 | 967.41 | 967.40 | 967.46 | 967.52 | 967.67 | 967.78 | 967.82 | 967.82 | 967.67 | 967.50 | 967.30 |
| **19** | 967.44 | 967.41 | 967.40 | 967.46 | 967.52 | 967.67 | 967.78 | 967.82 | 967.81 | 967.66 | 967.49 | 967.29 |
| **20** | 967.44 | 967.41 | 967.40 | 967.47 | 967.52 | 967.68 | 967.78 | 967.82 | 967.81 | 967.66 | 967.49 | 967.29 |
| **21** | 967.44 | 967.41 | 967.41 | 967.47 | 967.52 | 967.68 | 967.79 | 967.82 | 967.80 | 967.65 | 967.48 | 967.28 |
| **22** | 967.44 | 967.41 | 967.41 | 967.47 | 967.53 | 967.69 | 967.79 | 967.82 | 967.79 | 967.64 | 967.47 | 967.28 |
| **23** | 967.44 | 967.41 | 967.41 | 967.47 | 967.54 | 967.69 | 967.79 | 967.82 | 967.79 | 967.63 | 967.47 | 967.28 |
| **24** | 967.43 | 967.41 | 967.41 | 967.47 | 967.55 | 967.70 | 967.79 | 967.82 | 967.78 | 967.63 | 967.46 | 967.28 |
| **25** | 967.43 | 967.41 | 967.42 | 967.47 | 967.56 | 967.71 | 967.79 | 967.82 | 967.78 | 967.62 | 967.45 | 967.28 |
| **26** | 967.43 | 967.40 | 967.42 | 967.47 | 967.57 | 967.72 | 967.79 | 967.82 | 967.78 | 967.62 | 967.45 | 967.28 |
| **27** | 967.43 | 967.40 | 967.42 | 967.47 | 967.58 | 967.73 | 967.79 | 967.82 | 967.77 | 967.61 | 967.44 | 967.28 |
| **28** | 967.43 | 967.40 | 967.43 | 967.47 | 967.59 | 967.74 | 967.80 | 967.82 | 967.77 | 967.61 | 967.44 | 967.28 |
| **29** | 967.43 | 967.40 | 967.43 | 967.48 | | 967.74 | 967.80 | 967.83 | 967.76 | 967.60 | 967.43 | 967.27 |
| **30** | 967.42 | 967.40 | 967.44 | 967.48 | | 967.74 | 967.80 | 967.83 | 967.76 | 967.60 | 967.43 | 967.27 |
| **31** | 967.42 | | 967.44 | 967.48 | | 967.74 | | 967.83 | | 967.59 | 967.42 | |
| **Ortalama** | 967.45 | 967.41 | 967.41 | 967.46 | 967.52 | 967.67 | 967.78 | 967.81 | 967.81 | 967.67 | 967.51 | 967.33 |

Table C 19 Water Elevations of Lake Eymir (2006 Water Year)

| DAY/MONTH | OCTOBER | NOVEMBER | DECEMBER | JANUARY | FEBRUARY | MARCH | APRIL | MAY | JUNE | JULY | AUGUST | SEPTEMBER |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **1** | 967.27 | 967.23 | 967.30 | 967.32 | 967.42 | 967.65 | 967.88 | 967.97 | 967.97 | 967.86 | 967.66 | 967.45 |
| **2** | 967.27 | 967.23 | 967.30 | 967.33 | 967.43 | 967.66 | 967.89 | 967.97 | 967.97 | 967.85 | 967.65 | 967.45 |
| **3** | 967.27 | 967.23 | 967.30 | 967.33 | 967.44 | 967.67 | 967.90 | 967.97 | 967.97 | 967.84 | 967.65 | 967.45 |
| **4** | 967.27 | 967.24 | 967.30 | 967.33 | 967.45 | 967.68 | 967.92 | 967.98 | 967.97 | 967.83 | 967.64 | 967.44 |
| **5** | 967.27 | 967.24 | 967.30 | 967.33 | 967.46 | 967.69 | 967.93 | 967.98 | 967.96 | 967.83 | 967.64 | 967.44 |
| **6** | 967.26 | 967.25 | 967.30 | 967.33 | 967.47 | 967.70 | 967.95 | 967.98 | 967.96 | 967.82 | 967.63 | 967.44 |
| **7** | 967.26 | 967.25 | 967.30 | 967.33 | 967.47 | 967.71 | 967.95 | 967.98 | 967.96 | 967.82 | 967.63 | 967.42 |
| **8** | 967.26 | 967.25 | 967.30 | 967.33 | 967.48 | 967.72 | 967.95 | 967.98 | 967.96 | 967.81 | 967.62 | 967.42 |
| **9** | 967.26 | 967.26 | 967.30 | 967.33 | 967.49 | 967.72 | 967.95 | 967.98 | 967.95 | 967.81 | 967.62 | 967.42 |
| **10** | 967.25 | 967.26 | 967.30 | 967.33 | 967.49 | 967.73 | 967.95 | 967.98 | 967.95 | 967.80 | 967.61 | 967.41 |
| **11** | 967.25 | 967.26 | 967.30 | 967.33 | 967.50 | 967.74 | 967.95 | 967.98 | 967.95 | 967.79 | 967.61 | 967.41 |
| **12** | 967.25 | 967.26 | 967.30 | 967.34 | 967.50 | 967.74 | 967.95 | 967.98 | 967.94 | 967.79 | 967.60 | 967.41 |
| **13** | 967.25 | 967.26 | 967.31 | 967.34 | 967.51 | 967.75 | 967.95 | 967.98 | 967.94 | 967.78 | 967.59 | 967.40 |
| **14** | 967.25 | 967.27 | 967.31 | 967.34 | 967.51 | 967.75 | 967.95 | 967.98 | 967.94 | 967.78 | 967.59 | 967.40 |
| **15** | 967.24 | 967.27 | 967.31 | 967.34 | 967.52 | 967.76 | 967.95 | 967.97 | 967.93 | 967.77 | 967.58 | 967.40 |
| **16** | 967.24 | 967.27 | 967.31 | 967.34 | 967.53 | 967.76 | 967.95 | 967.97 | 967.93 | 967.77 | 967.58 | 967.40 |
| **17** | 967.24 | 967.27 | 967.31 | 967.34 | 967.54 | 967.77 | 967.95 | 967.97 | 967.93 | 967.76 | 967.57 | 967.40 |
| **18** | 967.24 | 967.27 | 967.31 | 967.34 | 967.55 | 967.77 | 967.95 | 967.97 | 967.92 | 967.75 | 967.56 | 967.40 |
| **19** | 967.24 | 967.28 | 967.31 | 967.35 | 967.56 | 967.78 | 967.95 | 967.97 | 967.92 | 967.74 | 967.55 | 967.40 |
| **20** | 967.24 | 967.28 | 967.31 | 967.35 | 967.57 | 967.78 | 967.95 | 967.97 | 967.92 | 967.74 | 967.54 | 967.40 |
| **21** | 967.23 | 967.28 | 967.31 | 967.36 | 967.58 | 967.78 | 967.95 | 967.97 | 967.91 | 967.71 | 967.53 | 967.40 |
| **22** | 967.23 | 967.28 | 967.31 | 967.37 | 967.59 | 967.79 | 967.95 | 967.97 | 967.91 | 967.71 | 967.52 | 967.40 |
| **23** | 967.23 | 967.28 | 967.31 | 967.37 | 967.60 | 967.79 | 967.95 | 967.97 | 967.90 | 967.70 | 967.51 | 967.40 |
| **24** | 967.23 | 967.29 | 967.31 | 967.38 | 967.61 | 967.79 | 967.95 | 967.97 | 967.90 | 967.70 | 967.50 | 967.40 |
| **25** | 967.23 | 967.29 | 967.32 | 967.39 | 967.62 | 967.79 | 967.95 | 967.97 | 967.89 | 967.69 | 967.49 | 967.40 |
| **26** | 967.23 | 967.29 | 967.32 | 967.39 | 967.63 | 967.80 | 967.96 | 967.97 | 967.89 | 967.69 | 967.48 | 967.40 |
| **27** | 967.22 | 967.29 | 967.32 | 967.40 | 967.63 | 967.81 | 967.96 | 967.97 | 967.88 | 967.68 | 967.48 | 967.40 |
| **28** | 967.22 | 967.30 | 967.32 | 967.40 | 967.64 | 967.82 | 967.96 | 967.97 | 967.88 | 967.68 | 967.47 | 967.40 |
| **29** | 967.22 | 967.30 | 967.32 | 967.41 | | 967.84 | 967.96 | 967.97 | 967.87 | 967.67 | 967.47 | 967.40 |
| **30** | 967.22 | 967.30 | 967.32 | 967.41 | | 967.86 | 967.97 | 967.97 | 967.86 | 967.67 | 967.46 | 967.40 |
| **31** | 967.22 | | 967.32 | 967.42 | | 967.87 | | 967.97 | | 967.66 | 967.46 | |
| **Ortlama** | 967.24 | 967.27 | 967.31 | 967.35 | 967.53 | 967.76 | 967.94 | 967.97 | 967.93 | 967.76 | 967.56 | 967.41 |