

# LOW FLOW ANALYSIS FOR KUANTAN RIVER BASIN

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## **SUPERVISOR'S DECLARATION**

I hereby declare that I have checked this thesis and in my opinion, this thesis is adequate in terms of scope and quality for the award of the Bachelor Degree of Civil Engineering

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## **STUDENT'S DECLARATION**

I hereby declare that the work in this thesis is based on my original work except for quotations and citations which have been duly acknowledged. I also declare that it has not been previously or concurrently submitted for any other degree at Universiti Malaysia Pahang or any other institutions.

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Thesis submitted in fulfillment of the requirements  
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## ABSTRAK

Kajian analisis aliran rendah dilakukan untuk menyediakan maklumat permukaan air yang diperlukan untuk kegiatan seperti pengawasan kualiti air, penilaian habitat biologi, reka bentuk infrastruktur serta perancangan dan pengurusan bekalan air. Perangkaan aliran, termasuk tempoh tahunan aliran rekod dan purata aliran minimum 7 hari dikira pada satu stesen aliran sungai (gauging) yang terletak di Bukit Kenau. Bagi stesen aliran sungai (ungauging), 17 tadahan di Lembangan Sungai Kuantan telah dipilih untuk menganalisis aliran rendah, termasuk aliran rendah 1, 4, 7 dan 30 hari berturut-turut dengan selang berulang sebanyak 1.5, 2.33, 5, 10, 20 dan 50 tahun. Data aliran purata harian diambil dari Jabatan Pengairan dan Saliran (JPS) dari tahun 1975 hingga 2014. Objektif utama kajian ini adalah untuk menganggarkan aliran rendah dan menganalisis aliran rendah dari tahun 1975 hingga 2014. Di samping itu, data aliran rendah membantu untuk menunjukkan kemungkinan terdapatnya air di sungai apabila timbul konflik antara bekalan dan permintaan air. Kedudukan data aliran (gauging) dianalisis dengan menggunakan persamaan Weibull. Manakala untuk data aliran (ungauging), persamaan regresi dalam Prosedur Hidrologi No. 12 digunakan untuk menganggarkan aliran rendah. Analisis kekerapan regresi digunakan untuk menganggarkan nilai aliran rendah di aliran aliran stesen yang tidak terjejas. Dari analisis stesen (gauging), aliran minimum tertinggi ialah  $36.5 \text{ m}^3/\text{s}$  pada tahun 2012 manakala aliran minimum terendah adalah  $0.1 \text{ m}^3/\text{s}$  pada tahun 2013. Sementara dari stesen (ungauging), kawasan lembangan memberi kesan kepada pelepasan. Semakin besar kawasan tadahan, semakin tinggi pelepasan air. Sg. Chereh dengan keluasan sebanyak  $227.51 \text{ km}^2$  mempunyai pelepasan tertinggi dalam 50 tahun dengan  $0.87 \text{ m}^3/\text{s}$  manakala Sg. Isap dengan kawasan terkecil iaitu  $4 \text{ km}^2$  mempunyai pelepasan terendah iaitu  $0.00216 \text{ m}^3/\text{s}$ .

## ABSTRACT

Low flow analysis study is done to provide decision makers with surface-water information needed for activities such as water-quality regulation, biological habitat assessment, infrastructure design, and water-supply planning and management. The flow statistics, which included annual period of record flow durations and average minimum flow 7-day were computed at one streamflow-gaging stations which located at Bukit Kenau. For streamflow-ungauging station, 17 catchment in Kuantan River Basin were selected to analyse low flows, including the 1, 4, 7 and 30 consecutive-day low flows with recurrence intervals of 1.5, 2.33, 5, 10, 20 and 50 years. Daily mean streamflow data were taken from Department of Irrigation and Drainage (DID) from year 1975 until 2014. The main objective of this study is to estimate the low flow and analyse the low flow trend from year 1975 until 2014. In addition, low flow data helps to indicate the probable availability of water in streams when conflict arise between water supply and demand. Streamflow gauging station is rank by using Weibull's equation while for ungauging station, the regression equation in Hydrological Procedure No. 12 were used to estimate the low flow. Regional frequency analysis were developed for estimating low flow values at streamflow ungauged station. From gauging station analysis, the highest minimum flow is  $36.5 \text{ m}^3/\text{s}$  in year 2012 while the lowest minimum flow is  $0.1 \text{ m}^3/\text{s}$  in year 2013. Meanwhile from ungauging station, area of the basin give impact to the discharge as the larger the area, the higher the discharge. Chereh with an area of  $227.51 \text{ km}^2$  has the highest discharge in 50 years with  $0.87 \text{ m}^3/\text{s}$  while Sg. Isap with the smallest area with only  $4 \text{ km}^2$  has the lowest discharge which is  $0.00216 \text{ m}^3/\text{s}$ .

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## LIST OF SYMBOLS

$\mu, \gamma$	Location parameter
$\sigma$	Distribution scale
$\alpha$	Scale parameter
$\beta$	Shape parameter
$D$	Duration of low flow period (days)
$p$	Probability of non-exceedance
$n$	Number of sampled value

## **LIST OF ABBREVIATIONS**

KRB	Kuantan River Basin
DID	Department of Irrigation and Drainage
HTAA	Hospital Tengku Ampuan Afzan
AREA	Catchment area in km <sup>2</sup>
7Q2	Annual minimum 7 day average streamflow with a 2 year recurrence interval
7Q10	Annual minimum 7 day average streamflow with a 10 year recurrence interval
HP12	Hydrological Procedure No. 12
MAR	Mean Annual Rainfall
MAM	Mean Annual Minimum flow
WMO	World Meteorological Organization
EV1	Extreme value distribution type I

## **CHAPTER 1**

### **INTRODUCTION**

#### **1.1 Background**

The term of 'low flow' must be clarified first before started doing analysis of low flow hydrology. This term depends on the understanding of each different group of different interests. In most cases, some people considered low flow as the actual flow in the rivers that occur throughout the dry season or an important part of the flow regime of any stream while others may be concerned with the length of time and situation arise between the flood events (e.g. in erratic). It is commonly obtained from the discharge of groundwater or surface from lakes or stream, melting glacier or swamps.

Kuantan River Basin (KRB) and its tributaries acts as one of the important river basins in Pahang as it supplies the water needs for residents and also, these rivers drain the major rural, agricultural as well as urban and industrial areas for Kuantan District. As the growth of populations were gradually increase in urban and rural area, the competition in the district could become more profound for the water resources. Recently, DID urged to use emergency allocation to resolve Kuantan's water woes problems arising from broken water barrier which caused a drop in water level at the Kobat Barrage Gate. Furthermore, the problem not only affected residential areas but also strategic facilities like Hospital Tengku Ampuan Afzan (HTAA) and health clinics (New Straits Time, 2018). Therefore, low flow analysis are needed to manage water resources for the upcoming challenge.

It can also be used to characterize the trend flow of a certain magnitude at a location of interest on a stream. Unfortunately during dry periods, the large water resources available could not provide enough water needs for daily life including nature

and wildlife. Hence, all water management will aim at low flows. The continuous flow rate during dry period will affect the optimization of surface water resources. Besides, seasonal changes in rainfall will explained the illustration of annual variation in most streams. Commonly in many area, the lowest flows usually occur at the end of rainy days or beginning of sunny days. However, it could not be predict as each stream is different and any particular year can be an anomaly regarding if and when low flows occur. The magnitude and duration of low flows can vary significantly from year to year.

The streamflow gaging station network in the Kuantan River basin, which is Kenau Station is an important asset in managing the basin's water resources as it gives the necessary data for quantifying water availability, establishing decisions on water use, and determining instream flow requirements. It is automated to monitor streamflow, usually at 15-minute intervals.

## **1.2 Problem Statement**

Low flows is a major factor in water demand and supply, water management and operation of reservoirs, and in maintaining the environmental flows to conserve the environment. In Malaysia, floods will occur in some areas during the monsoon season. Instead, it becomes drought during the transition period. This phenomenon could lead to serious harm and safety measure is required to prevent this occurrence. In addition, 28 of the 80 water treatment plants across Pahang recorded low levels due to drought and affected plants acquiring their water resources from the Sungai Pahang river. Low level reading is also due to sand preventing river flow in the water intake point. This causes the water to overflow elsewhere (The Star Online, 2014). Nevertheless, high-flow events are sudden and can put human life at risk, whereas streamflow droughts (i.e. low flows) develop slowly and can affect a large area.

Consequently, the economic loss during low-flow periods can be much bigger than during floods (Pushpalatha et al., 2011; Shukla et al., 2012). Furthermore, low flow during the dry season can cause negative effects on the river ecosystem. According to Hebert et al. (2003), as pressures on rivers become more important during low flows, some conflicts between the different water uses can arise, especially between instream

water use and water abstraction demand. Therefore, this study is important to provide the benefit to water users in the Kuantan River Basin.

The analysis of low flow data can help to indicate the probable availability of water in streams when the conflict between water supply and demand to arise. River low flows can lead to severe consequences in water quality and river ecological status (Whitehead et al., 2009). Thus, the analysis will helps other researcher to choose the right time to do sampling for water quality. Low flows can be calculated from streamflow data collected at gaging station in Kenau River.

### **1.3 Objectives**

Objective of the study are:

- i. To estimate low flow.
- ii. To analyse the trend of low-flow frequencies from year 1975 until 2014.

### **1.4 Scope of Work**

The study was carried out in KRB. There are only one gaging streamflow available which is located at Bukit Kenau. The area of Kenau basin is 135.93 km<sup>2</sup>. In this study, we can compute period of record 7 day low flow frequency statistic (e.g. 7Q10) at Kenau River. Low-flow frequency statistics, such as the 7Q10 (defined as the mean low streamflow that occurs over 7 consecutive days with a 10-year recurrence interval) were calculated for the streamflow-gaging stations in and near the basin. In summary, rainfall, water level and stream flow data is very important in analysis of hydrological process. Furthermore, this study includes data collection work. For data collection, we need to do site visit at Department of Irrigation and Drainage at Indera Mahkota, Kuantan. Stream flow data have been retrieved from DID database from year 1975 until 2014. However, there are missing data found from year 1985 until 1994.

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