STUDY OF SELECT THE IDEAL HYDROLOGY STATION

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ABSTRACT

Hydrology is often defined as a science dealing with the properties, distribution, and circulation of water. The purpose of hydrologic study is to determine the type and amount of hydrologic data needed. To collect the data, the hydrology stations need to be select before doing the fieldwork. The physical criteria of the hydrology station will affect the result of the research. The objective of this study is to identify the factor and criteria to select the ideal hydrology station for water discharge station and water quality station. The impact of the unfulfilled criteria of the hydrology station to the water flow and selected water quality's parameters will be determined. The parameter that will be test on this study is water flow rate, Q (m^3/s), total suspended solid, TSS (mg/L), chemical oxygen demand, COD (mg/L), and biochemical oxygen demand, BOD (mg/L). Three factors involve in this study are; i) river features, ii) existing of obstruction on the water flow and iii) the distance between two hydrology station. Velocity area method is used to determine the total flow rate. For this study, Sungai Galing Besar has been chosen as a study area. This study shows that unfulfilled criteria of the hydrology station give effect to the selected parameter's reading. The result at the station of curved stream shows the velocity become lower and the TSS, COD and BOD reading will increase. At the station that having the obstruction on water flow, the velocity are increase because of the cross section area are decrease. The longest distance between two hydrology stations give the readings of the parameter are more different. For the medium distance, the difference reading is about average. While for the short distance, the difference reading is too small. From the result, the medium distance is acceptable as the distance between two hydrology stations. So that, the criteria of hydrology station need to be consider before conduct the hydrology study to obtain the accurate result.

ABSTRAK

Hidrologi sering ditakrifkan sebagai sains yang berkaitan dengan sifat-sifat, pengedaran, dan peredaran air. Tujuan kajian hidrologi adalah untuk menentukan jenis dan jumlah data hidrologi yang diperlukan. Untuk mengumpul data, stesen-stesen hidrologi perlu pilih sebelum melakukan kerja lapangan ini. Kriteria fizikal stesen hidrologi akan memberi kesan kepada hasil kajian. Objektif kajian ini adalah untuk mengenalpasti faktor dan kriteria untuk memilih stesen hidrologi sesuai untuk stesen mengukur kadar aliran air dan stesen kualiti air. Kesan akibat tidak mengikut kriteria stesen hidrologi kepada aliran air dan parameter kualiti air yang dipilih dapat ditentukan. Parameter yang akan di uji didalam kajian ini adalah kadar aliran air, Q (m^3/s), kadar pepejal terampai, TSS (mg/L), kadar oksigen kimia, COD (mg/L), dan kadar oksigen biokimia, BOD (mg/L). Tiga faktor yang terlibat dalam kajian ini adalah; i) ciri-ciri sungai, ii) terdapat halangan pada aliran air dan iii) jarak di antara dua stesen hidrologi. Kaedah 'Velocity Area Method' digunakan untuk menentukan kadar aliran keseluruhan sungai. Untuk kajian ini, Sungai Galing Besar telah dipilih sebagai kawasan kajian. Kajian ini menunjukkan bahawa stesen hidrologi yang tidak memenuhi criteria memberi kesan kepada bacaan parameter yang dipilih. Keputusan di stesen aliran melengkung menunjukkan halaju menjadi lebih rendah dan kadar TSS, COD dan BOD akan meningkat. Di stesen yang mempunyai halangan pada aliran air, halaju meningkat kerana luas keratan sungai mengecil. Jarak yang jauh di antara dua stesen hidrologi menyebabkan perbezaan bacaan parameter lebih berbeza. Bagi jarak sederhana, perbezaan bacaan adalah purata. Manakala bagi jarak dekat, perbezaan bacaan adalah terlalu kecil. Dari hasil kajian, jarak sederhana adalah sesuai diguna sebagai jarak antara dua stesen hidrologi. Oleh itu, kriteria stesen hidrologi perlu dipertimbangkan sebelum menjalankan kajian hidrologi untuk mendapatkan hasil yang tepat.

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LIST OF ABBREVIATIONS

DID	Department of Irrigation and Drainage
Q	Flow Rate of water (m^3/s)
A	Cross Sectional Area (m^2)
V	Actual Velocity (m^2/s)
s	Time in Second
m	Meter
mg	Milligram
L	Litre
d	Depth (m)
b	Strip Width (m)
S1	Station 1
S2	Station 2
S3	Station 3
S4	Station 4
TSS	Total Suspended Solid
COD	Chemical Oxygen Demand
BOD	Biochemical Oxygen Demand
Day 1	First day of collecting data
Day 2	Second day of collecting data
Day 3	Third day of collecting data

CHAPTER 1

INTRODUCTION

2.1 Introduction

Hydrology is often defined as a science dealing with the properties, distribution, and circulation of water on the surface of the land, in the soil and underlying rocks, and in the atmosphere. There are no exact methods for hydrologic analysis. Different methods that are commonly used may produce significantly different results for a specific site and particular situation. Although hydrology is not an exact science, it is possible to obtain solutions which are functionally acceptable.

The purpose of hydrologic study is to determine the type and amount of hydrologic data needed. Hydrologic studies involve learning about the properties of water and its maintenance. Those are vital to the health and sustainability of water resources, providing maintenance and management skills necessary for environmental protection. The hydrology work are such as managing lakes, rivers and oceans, monitoring the quality and quantity of surface and ground water, taking

samples and flow measurements, installing gauges and surveying cross-sections of water ways.

Knowledge and understanding of hydrology is important in many applications. For examples, flood mitigation engineer has to estimate the flood discharge and volume to size a flood storage pond and to determine channel capacity. The irrigation engineer needs to understand the rainfall pattern and its temporal variation, the evaporation and infiltration losses peculiar to his project area to estimate irrigation requirements. The water resources engineer needs to estimate the amount of flow available from the catchment of his proposed dam site, losses due to evaporation and seepage so that he can work out the dam storage capacity required to support a given flow abstraction rate.

2.2 Problem Statement

There are many type of hydrology station involve in hydrology field. The hydrology station is such as, water discharge station, water quality station, sediment station, weather station and water level station. The stations are classification according to the purpose of the station and the type of data needed.

Before getting a data, the ideal hydrology stations need to be selected for doing the fieldwork and taking the sample. The criteria of the hydrology station need to be considered while choosing the location of the hydrology station. The criteria are such as, the river stream should be straight, there are no obstruction on the water flow and must be using the appropriate distance between two hydrology stations.

Nowadays, there are lack of information and knowledge about the consideration of factor and criteria of the hydrology station among the researcher. The unfulfilled criteria of the hydrology station will affect the result of the research. To get the precise result from the research, the information about the factor and criteria of the hydrology station need to be consider.

2.3 Objectives

The objectives of this study are as follows;

1. To identify the criteria needed in selecting the best location for hydrology station.

2. To study the impact of unfulfilled criteria in selecting the hydrology station to the water flow and water quality data.

2.4 Scope of Study

The scopes of this study are as follows;

1. Sungai Galing will be the study area for this study.

2. This study is conducted to identify the criteria needed in selecting location for water discharge stations and water quality stations only.

3. Four parameters was selected which is water flow rate (Q) for analysis water discharge, total suspended solid (TSS), chemical oxygen demand (COD), and biochemical oxygen demand (BOD) for analysis water quality at Sungai Galing.

4. Three factors involve in this study are; i) river features, ii) existing of obstruction on the water flow and iii) the distance between two hydrology station.

5. Velocity Area Method will be use as the method to obtain the data for water flow rate.

2.5 Expected Outcomes

By doing the fieldwork at the river, site observation and literature study, the criteria for selecting the location of the hydrology station was identified. From the fieldwork, the impact of unfulfilled criteria in selecting the hydrology station to the flow rate and water quality result can be determined. It is expected for this study that will come out with the thesis that contains of criteria of the hydrology station and the factors to select the ideal hydrology station before start the hydrological studies. The results of this study will give guide to other researcher in selecting the ideal hydrology stations before start their research.

2.6 Significance of Study

Selection of ideal hydrology station is needed before starts a data collection for flood mitigation studies, river flow or rainfall. It is important to the researcher to choose the ideal area to do the fieldwork for taking a sample. The suitable location is one of the criteria that should be considered while choosing the hydrology station. It is because the unfulfilled criteria of the hydrology station will give effect to the parameters results. A researcher should have knowledge about the factor and criteria in selecting the hydrology station. This study will helps researcher to have a guided in selecting the ideal hydrology station.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

The term hydrology can be divided into two terms. Hydro relating to water, and loge, a Greek word meaning knowledge, thus hydrology is the study, or knowledge of water. Hydrology is a multidisciplinary subject that deals with the occurrences, circulation, storage, distribution and properties of surface and ground water on the earth. The domain of hydrology includes the physical, chemical and biological reaction of water in natural and man-made environment (Vidya, 2008).

Hydrological observations could be broadly defined as the scientific way for collection of flow data at a specific location along the river. The reliability of the data is an important attribute for assessing the water resources in terms of quantity, quality, distribution in time and space and its potential for planning and development of projects to meet different water demands. The observations at various

hydrological stations mainly include the gauge, discharge, suspended sediment, bed material and water quality (Sharma, n.d., p. 7).

Stream flow or discharge is the volume of water that moves through a specific point in a stream during a given period of time. Discharge is usually measured in units of cubic feet per second (cfs). To determine discharge, a cross-sectional area of the stream or river is measured. Then, the velocity of the stream is measured using a Flow Rate Sensor. The discharge can then be calculated by multiplying the cross-sectional area by the flow velocity.

2.2 Classification of Hydrology Station

The main criteria for classification of a site for hydrological observation will be the purpose for which it is established. Depending on the purpose, the hydrological observation station could be classified into three types (Sharma, n.d., p. 10).

2.2.1 Primary Station

These are also termed as key gauging stations, principal stations or bench mark stations and are maintained on long term basis to generate representative flow series of the river system.

2.2.2 Secondary Station

These are essentially short duration stations intended to be operated only for such a length of period as is enough to establish the flow characteristics of the river or stream.

2.2.3 Special Purpose Station

These are also termed as specific purpose stations or project stations or temporary stations meant for projects and are discontinued when the purpose is served. The purpose could vary from design, management and operation of the project to monitoring and fulfilment of legal agreement between co-basin states. The primary as well as secondary stations also many a times serve as special purpose stations.

2.3 Type of Hydrology Station

There are many type of hydrology station involve in hydrology field. The stations are divided according to the purpose of the station and the type of data needed.

2.3.1 Water Discharge Station

Water discharge stations or gauge station consist of records of stage and measurements of discharge of streams or canals, and stage, surface area, and volume of lakes or reservoirs. A stream gauge, stream gage or gauging station is a location used by hydrologists or environmental scientists to monitor and test terrestrial bodies of water. Hydrometric measurements of water surface elevation or volumetric discharge (flow) are generally taken and observations of biota may also be made.

2.3.2 Sediment Station

Sediment station is a area that vertical cross-sectional plane of a stream, usually normal to the mean direction of flow, where samples of suspended load are collected on a systematic basis for determining concentration, particle-size distribution, and other characteristics (McGraw, 2003).

2.3.3 Water Quality Station

Water quality station is the place that the equipment will be install to get the water quality data, the data were used to determine the water quality status weather

in clean, slightly polluted or polluted category and to classify the rivers in Class I, II, III, IV or V based on Water Quality Index (WQI) and Interim National Water Quality Standards for Malaysia (INWQS) (N.R.E, 2010).

2.3.4 Weather Station

Weather station is one of a network of observation posts where meteorological data is recorded. This station are used a device that contains many sensors (thermometer, rain gauge, barometer, etc.) to measure atmospheric data such as temperature, air pressure or humidity (Interglot, 2006).

2.3.5 Water Level Station

Water level station is a facility for the systematic measurement of the water levels of rivers, seas, lakes, and canals. It consists of a device for reading the water level and of bench marks, which are geodetic structures that fix the position of a point whose height has been determined. Staff gauges are equipped with a calibrated wooden or metal staff, which is vertically attached to a structure and pile gauges are equipped with piles that have been driven perpendicularly into the shore or bank ("Encyclopaedia," 2010).

2.4 Criteria of Hydrology Station Site

The purpose in establishing a river stage station is to obtain a truly representative record of river levels whether for the direct use of this information or as a step towards the measurements of the river discharge. Therefore the selection criteria must generally conform to certain ideals as advocated by the World Meteorological Organization (WMO) for the degree of reliability of observations will depend in part on these conditions being met.

One of the main criteria when selecting a suitable site for establishing a river stage station is would be to choose a stretch that has both firm and stable banks and bed, resistant to any scouring or erosion. Ideally there should be a straight section upstream at least five times the width of the channel and for downstream twice the width (DID Manual, 2009). Other researcher said factors in selecting a location for gaging station sites is the course of the stream is straight for about 300 ft upstream and downstream from the site (Robert, n.d.). According to the article from Kuusisto (1996) the cross-section should be located at a point where the stream is nominally straight for at least 50 m above and below the measuring station. Other than that, the reaches for upstream and downstream of the proposed station gauge are straight and uniform (Sharma, n.d., p. 11).

Next criterion for hydrology station site is the bed should also be free of any obstructions including vegetation and there should not be any structures e.g. bridges in proximity to the gauging station, both upstream and downstream (DID Manual, 2009). Other researcher said the streambed is not subject to scour and fill and is free of aquatic growth (Robert, n.d.; Kuusisto, 1996). According to article from Sharma (n.d., p. 11), the reach is free from rock outcrops, weed growth and pools.

Another criteria is the flow should not under any circumstances by pass the station e.g. via outflow stream(s) upstream. The water surface in this reach should be steeper than the gradient, downstream of this reach (DID Manual, 2009). Banks are permanent, high enough to contain floods, and free of brush, permanent, stable control that is effective at all stages, and gage site is far enough upstream (Robert, n.d.) the velocities at all points are parallel to one another and at right angles to the cross section of the stream, the depth of flow is greater than 30 cm, the stream does not overflow its banks (Kuusisto, 1996).

Besides the criteria already mentioned for selecting suitable locations for stage monitor and cableway systems, the following items should be also be considered during this process which is the vehicle and personnel access to the site during inclement weather, personnel access to equipment for operation and maintenance, power supply to the site, protection of the equipment and instrumentation from weather, wildlife and vandalism (DID Manual, 2009).

2.5 Impact of Unfulfilled Hydrology Station's Criteria

Stream flow has two components. The first is flow velocity, and the second is the volume of water in the stream. Flow velocity is influenced by the slope of the surrounding terrain, the depth of the stream, the width of the stream, and the roughness of the substrate or stream bottom. The substrate of the stream bottom also affects the flow velocity since water moves faster over a smooth surface than a rough surface. Flow velocity is greater when the stream bottom is comprised of sand and clay and lower when it is cobble, rock, and boulders (Millikan, n.d., p. 16).

The volume of water in the stream is affected by the climate of the region. Areas with more rain and snow will have more water draining into surrounding streams and rivers. Seasonal changes affect stream volume as well. In the summer there will be less water in the stream compared to the winter. The number of tributaries that merge with a stream or river contribute more water to the system, increasing the stream volume. Humans are also responsible for altering the volume of water in streams (Millikan, n.d., p. 16).

The stage-discharge relation at some stream-gaging stations is affected by backwater from reservoirs, tributary streams, or other sources. Such an occurrence necessitates the use of the slope method in which the slope or fall in a reach of the stream is a factor in computing discharge (Washington, 2003).

At some stations, stage-discharge relation is affected by changing stage. At these stations, the rate of change in stage is used as a factor in computing discharge. At some stream-gaging stations in the northern United States, the stage-discharge relation is affected by ice in the winter; therefore, computation of the discharge in the usual manner is impossible (Washington, 2003).

Next is the stream bottom factor account for the friction of the water flowing past the stream substrate, with the assumption that average stream velocity is only 80% to 90% of the surface velocity. Rough bottom streams interspersed with submerged plants or rocks have slower water velocities as compared to smooth mud or bedrock. Thus, streams with cobble or gravel substrates or many aquatic plants have a bottom factor of 0.8, whereas streams with a smooth mud, silt, or bedrock substrate have a factor of 0.9 (Wisconsin, 2003).

Sediment is transported downstream either suspended in the water column (suspended-sediment transport) or moving along bottom of the channel in contact with the bed (bedload transport). Suspended-sediment transport is determined by

collecting representative samples to determine the average concentration of the sediment in suspension. Suspended sediment moves with the flow. Suspended sediment moves faster in areas of the stream having higher velocities than in areas of the stream having lower velocities (Robert, n.d.; Holmes, n.d., p. 50).

Sedimentation of streams can have a pronounced effect on water quality and stream life. Sediment can clog and abrade fish gills, suffocate fish eggs and aquatic insect larvae, and cause fish to modify their feeding and reproductive behaviours. Sediment also interferes with recreational activities as it reduces water clarity and fills in water bodies. In addition to mineral soil particles, eroding sediments may transport other substances such as plant and animal wastes, nutrients, pesticides, petroleum products, metals, and other compounds that can cause water quality problems (Clark, 1985; Neary et al., 1988).

In addition, stream flow has significant impacts on other water quality parameters. Fast-flowing, turbulent water at riffles increases dissolved oxygen levels through aeration. In contrast, low flow conditions typically result in higher water temperature and decreased oxygen levels. Periods of increased flow may result in greater turbidity, because the fast moving stream has enough energy to displace larger quantities and sizes of sediment particles (Wisconsin, 2003).

2.6 Velocity Area Method

A variety of methods are used to measure flow rate in open channels. Many different factors help determine which method is best for given application. These