WATER (ANTAN RIVER

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ABSTRACT

Kuantan River is one of the important rivers in Pahang state which contributes many resources to the community. A study of the Kuantan River water quality was conducted during a period from September 2011 to November 2011. Three sampling stations were selected based on the topography characteristics of the river. A total of nine chemical water quality parameters and three physical parameters were measured. Three physical parameters measured were temperature, conductivity and suspended solid (SS). The nine chemical parameters were pH, dissolved oxygen (DO), biochemical oxygen demand (BOD), chemical oxygen demand (COD), chloride, nitrates, phosphate, and heavy metals, i.e. cadmium (Cd), copper (Cu), and lead (Pb). Parameters such as conductivity, dissolved oxygen, temperature and pH were analyzed in-situ measurement while the rest of the parameters analysis conducted in laboratory. The result obtained was compared to the National Water Quality Classes by DOE. In Conclusion, Kuantan River was classified as DOE NWQS Class II water body.

ABSTRAK

Sungai Kuantan adalah salah satu sungai yang terpenting di Pahang yang menyumbang banyak sumber kehidupan kepada komuniti. Satu kajian mengenai kualiti air Sungai Kuantan telah dijalankan pada bulan September 2011 sehingga November 2011. Tiga tempat pensampelan telah dipilih berdasarkan sifat topografi sungai tersebut. Sebanyak Sembilan parameter kualiti air kimia dan tiga parameter kualiti fizikal air sungai dikaji. Tiga parameter fizikal yang dianalisa ialah suhu, perihal pengaliran elektrik dan pepejal terampai. Sembilan parameter kimia yang dianalisa ialah pH, oksigen terlarut, kehendak oksigen biokimia, kehendak oksigen kimia, klorin, nitrat, fosfat dan logam berat; kadmium, kuprum, dan plumbum. Parameter seperti perihal pengaliran elektrik, oksigen terlarut, suhu dan pH dianalisis terus di tempat pensampelan manakala selebihnya dikaji di makmal. Hasil kajian dibandingkan dengan Kelas Kualiti Air oleh Jabatan Alam Sekitar. Kesimpulannya, Sungai Kuantan dikelaskan pada Kelas II oleh Kelas Kualiti Air Jabatan Alam Sekitar,Malaysia.

TABLE OF CONTENTS

CHAPTER 3 METHODOLOGY

CHAPTER 4 RESULTS AND DISCUSSION

CHAPTER 5 CONCLUSION AND RECOMMEENCATIONS

LIST OF TABLES

LIST OF FIGURES

LIST OF PICTURE

LIST OF SYMBOLS

mg	Miligram
mg/L	Milligram per liter
mm	Milimeter
nm	Nanometer
µL	Microlitre
M	Molar
ppm	Part per million
mM	Milimolar
MPa	Megapascal
°C	Degree Celcius

LIST OF ABBREVIATIONS

AAS	Atomic Absorption Spectroscopy
BOD	Biochemical oxygen demand
COD	Chemical oxygen demand
DO	Dissolved oxygen
DOE	Department of Environment
IC	Ion Chromatography
ICP	Inductive Coupled Plasma
MDL	Method detection limit
ND	No detection
NWQS	National Water Quality Standard
St 1	Station 1
St 2	Station 2
St 3	Station 3
USEPA	United States Environmental Protection Agency

CHAPTER 1

INTRODUCTION

1.1 INTRODUCTION

"Water quality" is a term used here to express the suitability of water to sustain various uses or processes. Any particular use will have certain requirements for the physical, chemical or biological characteristics of water; for example limits on the concentrations of toxic substances for drinking water use, or restrictions on temperature and pH ranges for water supporting invertebrate communities. Consequently, water quality can be defined by a range of variables which limit water use. Although many uses have some common requirements for certain variables, each use will have its own demands and influences on water quality. Quantity and quality demands of different users will not always be compatible, and the activities of one user may restrict the activities of another, either by demanding water of a quality outside the range required by the other user or by lowering quality during use of the water. Efforts to improve or maintain a certain water quality often compromise between the quality and quantity demands of different users. There is increasing recognition that natural ecosystems have a legitimate place in the consideration of options for water quality management. This is both for their intrinsic value and because they are sensitive indicators of changes or deterioration in overall water quality, providing a useful addition to physical, chemical and other information.

1.2 PROBLEM STATEMENT

Water pollution is any chemical, physical or biological change in the quality of water that has a harmful effect on any living thing that drinks or uses or lives in it. According to the Malaysian Department of Environment's (DOE) 2002, 52 river basins were polluted with suspended solid resulting from poorly planned and uncontrolled land clearing activities; 18 river basins had low oxygen levels resulting from industrial discharges; and 33 river basins were polluted with ammoniacal nitrogen from animal husbandry activities and domestic sewage disposal. Continuous monitoring of Kuantan River water quality has not been done. Thus, this study contributes to a portion of community responsibility for nurturing such an important water body in Pahang State.

1.3 OBJECTIVE

Water quality monitoring is important in order to identify whether the water is highly polluted or not. It is hoped that this study will be useful for anyone concerned with water quality monitoring whether they have a scientific, managerial or engineering background and including, particularly, field staff and those who may not be in environmental area. The main focus of this research is to analyze the current condition of Kuantan River and make a comparison with Malaysian Water Quality Classes by Department of Environment.

1.4 BACKGROUND OF STUDY

This study is conducted at Kuantan River to determine its water quality using specific parameters. The value of the each parameter is evaluated against the National Quality Water Standard (NQWS) to identify the current status of the river whether polluted or not. Such an evaluation is essential because the sources of pollutants are increasingly varied in the river bodies for example the various toxic wastes from industries and sewage treatment plants.

The demand for clean and portable water has increased tremendously due to rapid development and a growing population (Aweng, E. R. et al., 2011).The demand is not only for human beings but also for aquatic life that use water or river as their habitats and this aquatic life eventually become a source of protein for humans. Thus, it is imperative that every effort should be made to protect and conserve existing water resources, namely our rivers, for present and future needs.

1.5 SCOPE OF STUDY

The study is limited to chemical and physical characteristics. The physical parameters computed of temperature, suspended solid (SS) and conductivity. The chemical parameters are pH, dissolved oxygen (DO), chemical oxygen demand (COD), biochemical oxygen demand (BOD), heavy metals; cadmium, copper and lead, anions; phosphate, nitrate and chloride.

CHAPTER 2

LITERATURE REVIEW

2.1 INTRODUCTION

Water is important to human life and the health of the environment as well. It makes water as a valuable natural resource, and comprising marine, estuarine, freshwater (river and lakes) and groundwater environments that stretch across coastal and inland areas. Water quality is commonly defined by its physical, chemical, biological and aesthetic (appearance and smell) characteristics. A healthy environment is one in which the water quality supports community of organisms and protects public health. Water quality in a body of water influences the way in which communities use the water for activities such as drinking, swimming or commercial purposes. More specifically, the water may be used by the community for supplying drinking water, wildlife's habitat, recreation and others. The water quality parameters are divided into physical, chemical and biological. As example in physical properties which is colour changing, biological properties which are fecal coliform and chemical properties which is dissolved oxygen.

2.2 WATER QUALITY

The term "water quality" is used to describe the microbiological, physical and chemical properties of water that determine its fitness for a specific use. These properties are determined by substances which are either dissolved or suspended in the water. Water quality should be assessed based on the characteristics of the water relative to the beneficial uses of the water. Water quality is not, as frequently used, a list of chemical constituent concentrations. In order to reliably assess whether the concentration of a constituent impairs the water quality - beneficial uses of a water body, it is necessary to evaluate on a site-specific basis whether the constituent is present in toxic or available forms at a critical concentration for a sufficient duration to be significantly adverse to aquatic life that is important to the beneficial uses of the water body.

2.3 THE PARAMETERS OF PHYSICO-CHEMICAL WATER QUALITY

The physical characteristics of water quality are temperature, conductivity and suspended solid. Temperature measurement can help detect sources of thermal pollution and suggest the size of habitat for organism that is more sensitive to temperature variation. Turbidity in water increases the amount of heat absorbed from the sunlight consequently makes the temperature of the water rise. Conductivity and suspended solid is correlated to each other. Total suspended solid, usually used to measure the total suspend solids in the river water. This solid may consist of inorganic and organic particles. Example of inorganic particles commonly found in water is clay, slit and other constituents meanwhile for organic particles is plant fibbers and biological solids found in water. Conductivity is a measure of the ability of water to pass an electrical current. The higher concentration of charges ions in the water, the higher is value of conductivity of the water.

The chemical parameters; pH of the pure deionized water contains equal numbers of H+ and OH- ions, and has a pH of 7. It is considered neutral, neither

acidic nor basic. If a water sample has more H+ than OH- ions, it is considered acidic and has a pH less than 7. If the sample contains more OH- ions than H- ions, it is considered basic with a pH greater than 7. Dissolved oxygen is essential for the maintenance of healthy lakes and rivers. The presence of oxygen in water is a good sign. The lack of oxygen is a signal of severe pollution. Rivers range from high to very low levels of dissolved oxygen. Sometimes the level gets so low that there is little aquatic life. Biochemical oxygen demand (BOD); when organic matter decomposes, it is fed upon by aerobic bacteria. In this process, organic matter is broken down and oxidized (combined with oxygen). Biochemical oxygen demand is a measure of the quantity of oxygen used by these microorganisms in the aerobic oxidation of organic matter. Chemical oxygen demand (COD) usually used to determine the amount of organic pollutants in the water. The amount of oxygen in the water used to oxidize all organic pollutants in the water. High level of COD can affect the ecosystem of the river especially for the aquatic lives. Anions analyses which are phosphate, nitrate and chloride in the river water is essential to identify its concentration in the river. Sources of these anions in the river water mainly from industrial wastes, agriculture run off, and poor septic system. Heavy metals determination including cadmium, copper and lead element in the water. Those metals distributed into the river from mining activities, battery cells disposal and pesticides usage.

Table 2.1: River Water Quality classes

Parameter	**Unit**	**Classes**				
		I	II	III	IV	V
Chemical Oxygen Demand	mg/L	>10	10-25	25-50	50-100	>100

Table 2.1: Continued

Biochemical Oxygen Demand	mg/L	<1	1-3	3-16	6-12	>12
Dissolved oxygen	mg/L	>7	5-7	3-5	1-3	<1
pH	mg/L	>7.0	6.0-7.0	5.0-6.0	<5.0	>5.0
Suspended solid	mg/L	<25	25-50	50-150	150-300	>300
Water Quality Index	mg/L	>92.7	76.5-92.7	51.9-76.5	31.0-51.9	<31.0

Source: http://www.wepa-db.net/policies/law/malaysia/eq_surface.htm.

Table 2.2: Description Classes of the Water Quality

Class	**Uses**
Class 1	Conservation of natural environment water supply I – practically no treatment necessary. Fishery I – very sensitive aquatic species.
Class IIA	Water supply II – conventional treatment required. Fishery II - sensitive aquatic species.
Class IIB	Recreational use with body contact.

Table 2.2: Continued

	Water supply III – extensive treatment required.
Class III	Fishery III – common of economic value and tolerant species livestock drinking.
Class IV	Irrigation.
Class V	None of the above.

Source: http://www.wepa-db.net/policies/law/malaysia/eq_surface.htm.

2.4 PREVIOUS RESEARCH

InfoWorks RS has been employed to develop a water quality model for the Juru River in Malaysia. The aim of the study was to define pollution levels in the river system and also to assess the impact of tides on pollution levels. The Juru River system is categorized as one of the most polluted in the country, with its reaches falling within categories four and five of the Malaysian Department of Environment's water quality index which looks at the traditional parameters of ammoniacal nitrogen, BOD, COD, dissolved oxygen (DO), total suspended solids (TSS) and pH (Hashim, N.,2008)

One other examples of study's river water quality is seasonal influence on water quality and concentration of heavy metals in Tasik Chini. In general, water quality index in Chini Lake varies with season (dry, normal or wet season) and the location of the sampling stations. During wet season, reverse flow of flooded water of Pahang River can contribute to high suspended solid (TSS and turbidity) and ammonia-N to the Chini Lake and the effect to the sampling stations near the Chini River will be affected (Shuhaimi-Othman, M. et.al.,2008).

2.5 SIGNIFICANCE OF STUDY

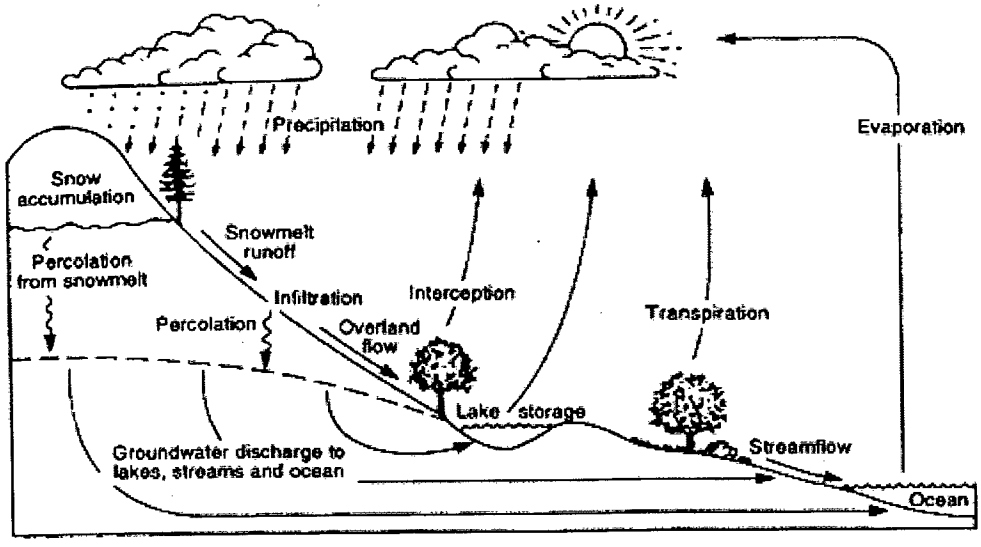


Figure 2.1: The variety of physical processes related to the movement water within the environment

Source: http://www.environment.nsw.gov.au/water/waterqual.htm.

An ecosystem is a community of organisms - plants, animals, fungi and bacteria - interacting with one another and the environment in which they live. Protecting aquatic ecosystems is in many ways as important as maintaining water quality, for the following reasons which are aquatic ecosystems are an integral part of our environment. They need to be maintained if the environment is to continue to support people. World conservation strategies stress the importance of maintaining healthy ecosystems and genetic diversity. Aquatic ecosystems play an important role in maintaining water quality and are a valuable indicator of water quality and the suitability of the water for other uses. Aquatic ecosystems are valuable resources and a major source of protein for humans. In most countries, commercial and sport which is fishing is economically important.

CHAPTER 3

METHODOLOGY

3.1 SAMPLING AND PRESERVATION METHOD

This research area was located at three different stations which are Kampung Kuala Kenau Seberang, Kampung Sungai Rimau, and front river Sungai Kuantan at Benteng. Kampung Kuala Kenau Seberang and Kampung Sungai Rimau classify as upper part of Kuantan River while the front river at Benteng is the lower part. Both Kampung Kuala Kenau Seberang and Kampung Sungai Rimau's river water comes from Sungai Lembing. Meanwhile the lower part of Kuantan River, is flowing directly to the South China Sea resulting the salt contains is higher than the upper part. The study area of Sungai Lembing is surrounded with the agriculture and mining activities with low density of population. Meanwhile the study area of Kuantan's station is surrounded with the industrial activities and high density of population.

Table 3.1: Number of sampling station and location

Station	Location
1	Kampung Sungai Rimau, Sungai Lembing
2	Kampung Kuala Kenau, Panching
3	Benteng,front river of Sungai Kuantan, Kuantan

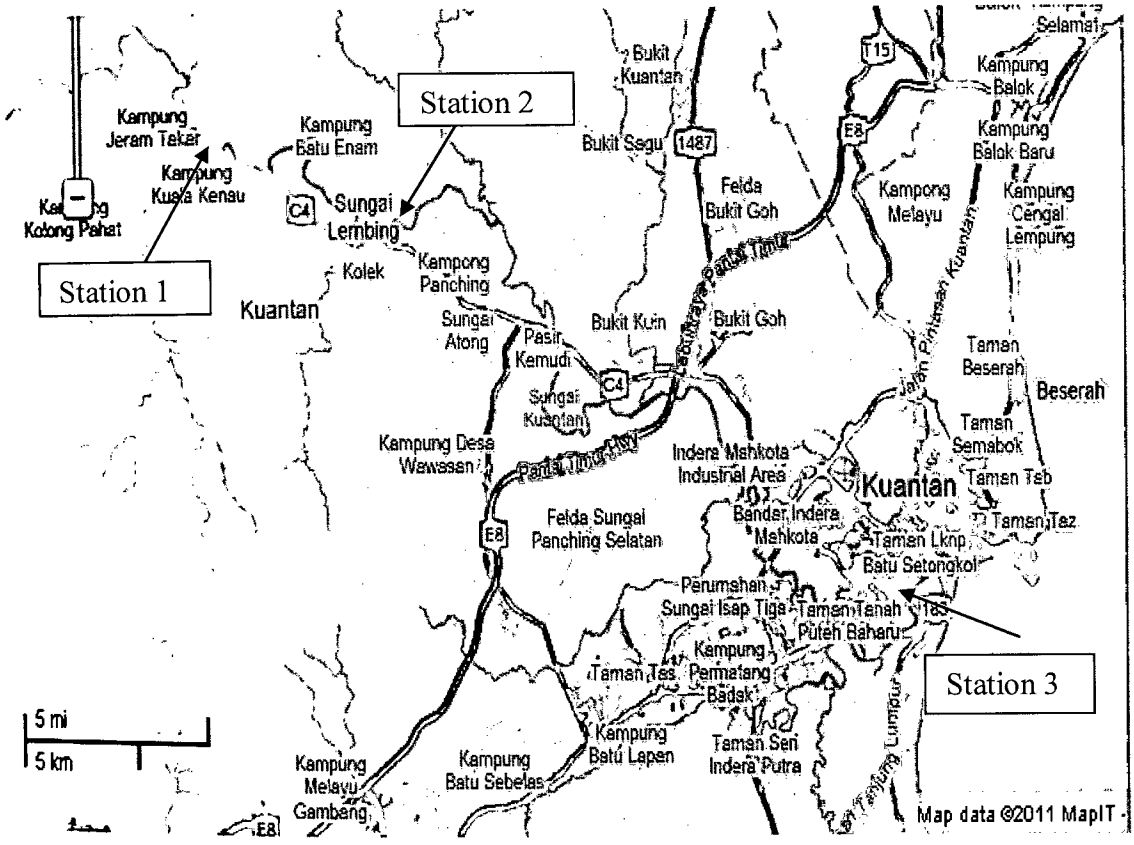


Figure 3.1: Sampling location

Source: Google map (2011)

Water samples were collected using acid wash polyethylene bottles. Samples were collected in prewashed bottle in order to produce homogeneous medium. The samples then were stored in an insulated icebox prior to laboratory analysis plus to preserve the samples from being infected by the surrounding. The frequency of sampling is five times within the three months. The water sample is filtered to remove particulate matters and stored in the cool condition, 4°C. Maintains the pH of water sample in acidic condition by adding diluted acid.

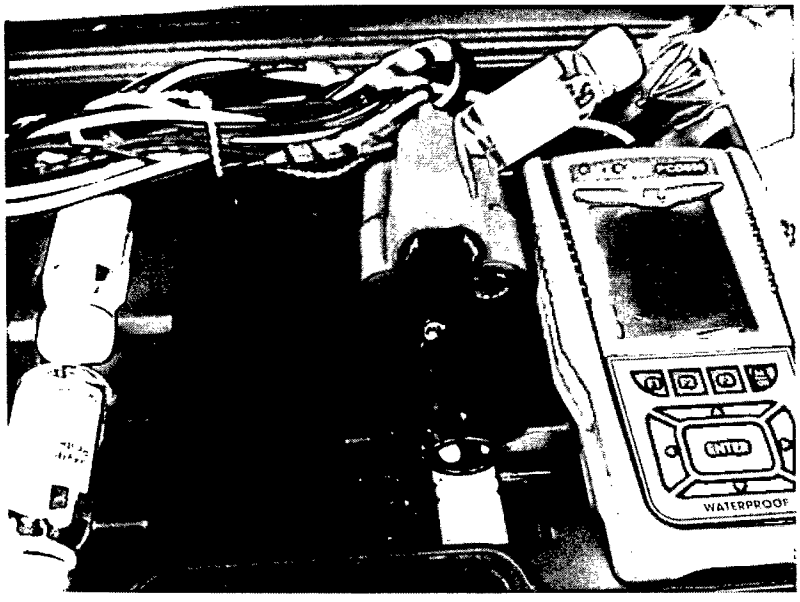
Table 3.2: Sample holding time

Parameter	**Holding time**
pH	Analyze immediately
BOD	48 hours
COD	48 hours
Anions (phosphate, nitrate, chloride)	7 days
Heavy metals (cadmium, copper, lead)	7 days
DO	Analyze immediately
SS	Analyze immediately
Conductivity	Analyze immediately

3.2 EXPERIMENTAL PROCEDURES

3.2.1 Real Time In-situ Measurements

Temperature, conductivity, pH and dissolved oxygen (DO) are measure directly at sampling site using kit probe.



Picture 3.1: Kit probe instrument used in-situ measurement

3.2.2 Biochemical Oxygen Demand, (BOD)

Two dissolved oxygen bottles (one clear and one black) are filled with sample water by holding them for two to three minutes between the surface and the river bottom. The gloves are used when the sampling been done using hands. The