CHAPTER 1

INTRODUCTION

1.1 BACKGROUND OF STUDY

An estuary is a part of the river or a tidal branch of the sea that is affected by the tide (Deynooit, 2011). Due to the geographic location, the estuary is prone to salt intrusion problem. Salt intrusion in estuary is the process of salinity entering a river system which is induced by the tide. Excessive extraction of fresh water for water supply purposes at the upstream area results in less river discharge into the downstream part. This phenomenon allows the salt water to travel further into the river system. The situation is worst during the dry season. Therefore, it is important to model the salinity in the estuary to ensure the sustainability of the fresh water supply and preserve the estuarine ecosystems.

There are many studies available on the salt intrusion globally such as in the Pungue Estuary (Graas and Savenije, 2008), Red River Delta (Ca, 2013), Tan Shui River (Liu et al., 2004) and Mekong River (Nguyen et al., 2008). In the Pungue Estuary, the saltwater intrusion reaches the intake station and interrupted the pumping system during spring tide in dry season. Pungue River is the main source of drinking water to the Beira and Dondo cites in Mozambique. This problem affected the water supply to Beira and Dondo cities as well as the production of Mafambisee sugar estate (Lamoree and Nilsson, 2000). In the Red River Delta, the discharge of freshwater from the upstream is very large in rainy season. Hence, the salt intrusion problem does not occur. However, in the dry season, saline intrusion occurs due to very small discharge of freshwater from the upstream is very small. This condition impacted to the agricultural activities along the river delta. (Vu, 1996).
In Malaysia, salinity studies had been carried out for several estuaries such as the Rompin Estuary, Ulu Sedili Besar Estuary (NWR, 2000), Selangor Estuary (Van Breemen, 2008), Perak Estuary, Bernam Estuary, Muar Estuary, Kurau Estuary, Endau Estuary (Gisen, 2014), and Kuantan Estuary (Wallingford, 1978). In the Peninsular Malaysia, the fresh water discharge during the dry season is very low forcing the water intake point to be located as downstream as possible. Consequently, the intake stations are open to salt intrusion problem. For the Kuantan Estuary, a salt intrusion study was conducted after the water intake station located at Kg.Kobat which is nearly 17.32km from mouth was threatened by salt intrusion. The total length of salt water travelled into the river system was recorded about 32km from the water intake station. Hence, a barrage was built near Kg. Kobat to control the flow of saline water from moving further upstream.

There are many types of salt intrusion models available in the market. Different model have different method to determine the relationship between saline and fresh water in estuaries. Hashim and Division (2011) proposed a hydrodynamic numerical modelling to access the parameter that governed the amount of salt in estuary for the Selangor River. Pinho and Vieira (2007) a two-dimensional hydrodynamic and mass transport model in the estuary of the river Lima to analyze the heights of the tide and river discharges which are the main causes affecting salinity intrusion in the river. Breemen (2008) used the numerical modelling software Delft3D to simulate the salinity around the downstream part of the Selangor River and assessed how the decrease in discharge affects this part of the river. Vaz et al. (2009) also used a 3D model to study the patterns of saline water in the Espinheiros tidal channel. The result indicates that the model underestimated the salinity distributions for high river inflow. Besides 2D and 3D models, ID analytical salt intrusion model is also used in salt intrusion study. Gisen et al. (2015) applied the 1-D model to investigate the salt intrusion condition in six Malaysian estuaries. The results obtained show that the model is sufficiently applicable to be used in simulating the salt water distribution in the estuaries.

1.2 PROBLEM STATEMENT

Salt intrusion study was done in the Kuantan Estuary in the year 1978 when the water intake station located at nearly 17.32km from the estuary mouth was affected by saline water. According to the study, the salt water travelled up to about 32km further from
the water intake station. Due to this reason, a barrage was built just downstream of the water intake station to restrict the saline water from entering the intake area. After the construction of the barrage, there is no salt intrusion study conducted to monitor the condition of the salinity level in the Kuantan Estuary. In the recent years, when Malaysia was hit by the El-Nino phenomenon, the water intake station at Kg. Kobat has pumped in saline water into the water supply system. This is confirmed when the water authority received complaints from the citizen that the tap water was salty. Besides the climate change effect, human activities along the estuary also have deteriorated the natural habitats in the estuarine region. Extreme flood event, dredging for harbour and port development, and construction of barrage have changed the geometry of the channel, which affect the tidal and hydrodynamics in the estuary system. This subsequently changed the salinity distribution pattern and usually induced further salt intrusion or higher salinity concentration. Hence, it is important to re-investigate the salt intrusion condition in the Kuantan Estuary after nearly 40 years.

1.3 OBJECTIVE

I. To investigate the salinity distribution in the Kuantan Estuary during the dry season at high tide.

II. To test 1-D analytical salt intrusion model in the Kuantan Estuary.

III. To calibration and validate the 1-D analytical salt intrusion model in the Kuantan Estuary.

1.4 SCOPE OF STUDY

This study is to investigate the current condition of the longitudinal salinity concentration in the Kuantan Estuary. The covered area of this study began from the estuary mouth until the downstream of the barrage. Salinity studies were conducted during dry season at spring tidal cycle as salt intrusion is most crucial at this condition. The salinity measurement along the estuary and variation of the water depth were measured by using moving boat technique. A 1-D analytical salt intrusion model was applied to simulate the salinity profile along the Kuantan Estuary. Results obtained from this study were compared to the study conducted in 1978 to evaluate the changes in the salinity distribution in the Kuantan Estuary after nearly 40 years.