FLOOD MAPPING FOR SUNGAI BUNUS

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Specially dedicated to *Nurashikin, Nurin, Nadia Mak and Abah,*

I love you all.

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ABSTRACT

Nowadays, the occurrence of flash flood in urban area in Malaysia has become major problem. . Flood Mapping is one of the method that shows the flood extent at the area that involve with flooding. There are a lot of beneficial on this flood inundation map. This flood mapping for Sungai Bunus were modelled using a HEC-GeoRAS two-dimensional hydraulic model to capture the hydraulic response of the river and its floodplains in extreme flooding condition due to major storm events. Digital terrain model (DTM) or LIDAR data are used for flood mapping process. The model is capable to predict flood depth and velocity magnitude of flood propagation. The flood mapping could assist local authorities to develop flood warning system at the flood prone area and prepare proper mitigation measures to prevent catastrophic damage and lost at the area where the flood frequently occur. This flood mapping was develop with two scenario which is existing river without flood pond and existing river with flood pond. The result shows significant reduction in flood water level if a series of pond from upstream was use as a flood mitigation measures.

ABSTRAK

Pada masa kini, kejadian banjir kilat di beberapa kawasan bandar di Malaysia telah menjadi masalah besar. Pemetaan banjir adalah salah satu kaedah yang menunjukkan tahap banjir di kawasan yang terlibat dengan banjir. Terdapat banyak yang kebaikan pada kaedah pemetaan banjir. Pemetaan banjir bagi Sungai Bunus telah dimodelkan menggunakan model hidraulik dua dimensi HEC-GeoRAS untuk manganalisis hidraulik sungai dan dataran banjir dalam keadaan banjir yang teruk disebabkan oleh peristiwa hujan lebat. Model rupa bumi digital (DTM) atau LIDAR data digunakan untuk proses pemetaan banjir. Model ini mampu untuk meramalkan kedalaman banjir dan magnitud halaju air banjir. Pemetaan banjir boleh membantu pihak berkuasa tempatan untuk membangunkan sistem amaran banjir di kawasan yang sering dilanda banjir dan menyediakan langkah-langkah tebatan yang betul untuk mengelakkan kerosakan dan kehilangan harta benda di kawasan yang sering berlaku banjir. Pemetaan banjir ini dihasilkan berdasarkan dua senario yang berbeza iaitu sungai sedia ada tanpa kolam banjir dan sungai sedia ada dengan kolam banjir. Hasil kajian menunjukkan pengurangan yang ketara dalam paras air banjir jika kaedah beberapa siri kolam takungan banjir bermula dari kawasan hulu digunakan sebagai langkah pencegahan banjir.

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LIST OF SYMBOLS

DID	-	Drainage and Irrigation Department
GIS	-	Geographic Information System
ARI	-	Average Recurrence Interval
HEC	-	Hydrologic Engineering Center
ESRI	-	Environmental System Research Institute
USACE	-	United States Army Corps of Engineers
1-D	-	One Dimensional
2-D	-	Two Dimensional
USGS	-	United States Geological Survey
FOTRAN	-	Formula Translating System
MS-DOS	-	Microsoft Disk Operating System
FEMA	-	Federal Emergency Management Agency
Ha	-	Hectare
Km^2	-	Kilometre Square
m^3/s	-	Metre Cubic per Seconds
TIN	-	Triangular irregular networks
LiDAR	-	Light Detection and Ranging

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CHAPTER 1

INTRODUCTION

This chapter consist of background of the problem, statement of the problem, objective of the study, scope of stdy and significant of study

1.1 Background of the Problem

In recent years there have been a number of significant riverine floods in the rest of the world, which resulted in tragic loss of life and in enormous material damage. In the past decades, thousands of lives have been lost, directly or indirectly, by flooding. In fact, of all natural risks, floods pose the most widely distributed natural risk to life today.

River flood risk management is the process under which different bodies try to reduce the current and the future vulnerability of human society to natural risks. Flood risk management measures can be structural where the risk is modified for example dam and reservoir construction, channel improvements, bypass channels and artificial levees. Non-structural where the flood damage and disruption is modified for example setting up flood plain management regulations such as zoning, building codes and measures where both the methods are applied. It is clear that no protection work can offer a hundred percent security against floods. There is always the possibility that a threshold is surpassed and that floodwater will enter into areas where it should not go, e.g. by overtopping or breaching of dikes.

In the past, structural and non-structural measures have been adopted for the flood control and flood management. Non-structural measures used to estimate the floods and their proper management has been accelerated in the last couple of decades throughout the globe in comparison to expensive structural measures. Non-structural measure includes evaluation of impact of rainfall on runoff of a catchment, return period of different magnitudes/frequency of floods and flood inundated areas, and socio-economic aspects of floods

Starting in the year 2000s, extreme rainfall events with high intensity are no longer a new issue in Malaysian urban cities, especially in the West Coast area This phenomenon is formed mostly through convection process (Embi , 2004). The main motivation of this research is an importance of river flood events in urban areas which cause in large number loss of lives and properties damages. Knowledge on the river basin response to rainfall events which is in the form of runoff is vital in engineering practices for urban planning and management. River flood modelling is a combination of hydrological modelling, hydraulic modelling and river flood visualization using GIS.

Floods can also be very incremental to the primary effects, as the affected region takes much time to recover where diseases and epidemics outbursts are frequent. Floods are usually recurrent and have massive impacts on agriculture based economies, which is the case of most small islands. Thus small countries and islands suffer a heavy burden from such events on the economic aspect. Thus, flood studies can be very useful in alleviating the already stressed economies of the insular countries. The study of floods helps to understand the characteristics of the floods, their cause and thus provide relevant data in assessment of these events.

A flash flood is characterized by a rapid stream rise with depths of water that can reach well above the banks of the stream. Flash flood damage and most fatalities tend to occur in areas immediately adjacent to a stream. Additionally, heavy rain falling on steep terrain can weaken soil and cause mud slides, damaging homes, roads and property.

Flooding is one of the major natural hazards affecting communities across Malaysia and has caused damages worth millions of dollars every year. The required allocation for flood mitigation projects has increased almost 600% (RM 6000 million) for the 8th Malaysian Plan compared to RM 1000 million during the 7th Malaysian Plan (Abdullah, 2000).

Knowing the fact that the floods are part of human being life and that this natural phenomena can't be fully controlled, it's important to focus and improve knowledge about the prevention. In order to achieve this issue it is crucial that, more specific and scientific work must be developed to a better understanding of the flooding phenomena and their related geographical, hydrological and geomorphologic causes. (Vaz (2000 and Jaarsma et. al. 2001) emphasized, respectively, the need to define a strategy that includes a judicious combination of structural and none structural measures, based on a careful analysis of the past floods and improvements in floods forecasting.

The main objectives of flood mapping can be sorted as follows: to prevent loss of life, to minimize property damage, to minimize social disruption and to encourage coordinated approach for land/water use. The role of flood mapping in river engineering is an important feature in planning and management: basis for managing flood plains, engineering & planning tool, first step in flood plain management, part of legislation for regulating development and basis for pursuing structural and non-structural measures.

1.2 Statement of the Problem

A flash flood produced by a rainfall event which is due to flood mitigation measures failure and poor drainage system. In a flash flood scenario, the subsequent flood wave develops over a relatively short time and flows rapidly through the downstream area as opposed to a rainfall event that would propagate more slowly through the downstream area.

When a flash flood happened or is deliberately demolished, large quantities of water are suddenly released, creating major flood waves capable of causing disastrous damage to downstream valley. Major flood waves may seriously damage or destroy power plants, industrial plants, roads and bridges and may cause loss of life, adverse ecological and environment impact.

1.3 Objectives of the Study

Followings are the objectives proposed for this study:-

a) To determine water surface profiles at specific locations along the stream network using the HEC River Analysis System (HEC-GeoRAS).
b) To establish river flood delineation mapping in Sungai Bunus river basin.
c) To predict river flood risk map in Sungai Bunus river basin.

1.4 Scope of the Study

The scope of this study is within this related area:-

a) Data collection and analysis
b) Flood hazard map analysis with HEC-RAS and HEC-GeoRAS modeling

The flood hazard maps modelling will be conducted to determine the flood inundation extents of a failure of the flood mitigation measures. Unsteady flows HEC-GeoRAS Model are developed for a sunny day failure, raining day and during maximum flood failure. The development of accurate flood hazard maps requires high-resolution topographic data of known accuracy. More accurate topographic data lead to more accurate flood-inundation maps (Horritt and Bates, 2001). Field

surveying produces the most accurate elevation data but can be time consuming and expensive.

Light detection and ranging (lidar) is an airborne laser-profiling system that produces location and elevation data to define the surface of the Earth and the heights of aboveground features. Lidar can produce a digital elevation model (DEM) with 1-foot (ft) contours that can be imported to a geographic information system (GIS) in a relatively short amount of time.

The flood hazard maps indicate areas that would be flooded as a result of a failure of flood mitigation measures. The inundated areas depicted on flood-inundation maps are approximate, and accuracy of such maps is a function of the accuracy of the topographic data, the hydraulic models on which the maps are based, the assumptions made about the dam failure mode, and the initial flood wave. For this report, lidar data with a vertical accuracy of about 3.3 inches (in) were used to develop a 1-ft contour elevation map for the study area. The Hydrologic Engineering Center's River Analysis System (HEC-RAS) modeling software developed by the U.S. Army Corps of Engineers, a standard for flood-inundation models, was used to perform unsteady-flow simulations to model the dynamic nature of the flood wave produced by a dam-breach scenario (Hydrologic Engineering Center, 2010).

1.5 Significance of the Study

The significant of the study is to develop the river hydraulics model, simulate a flood mitigation measures failure and map the resulting flood wave. The proper modeling of the hazards associated with flood mitigation measures will assist in land use planning and developing emergency response plan to help mitigate catastrophic loss to human life and property.

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