FLOODING ON HILL SITE OF BUKIT JAMBUL DEVELOPMENT AREA

ABDUL HAKAM AB HAMID

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To my lovely person in my life

Nur Arina Zainal Abidin

Nur ʿAuni Fahimah

Abdul Wafi

To my parents.

Ab Hamid Ismail

Wan Minah Wan Hamat

My teachers.

My siblings.

My friends.

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ABSTRACT

Hydrological consideration of a hill site development is important due to the development may subject to significant impact as a result of a huge water catchment from the uphill area. The study area is one of hill site development which suffer from flooding incident which occurred every years and it has marked the worst flooding incident on November 2015. Case study approach was carried out to determine the main cause of the flooding. Study of the site area revealed that the actual catchment for the site was significantly huge and the site is lies in between two major depressions point. Three streams was identified that contribute to the surface runoff. Two cases of analysis were adopted to simulate different rainfall that based on the water catchment area. First is consideration of water catchment within the site boundary and second is consideration of uphill water catchment and the natural streams and the peak discharge of the design rainfall was checked against the drainage capacity. The result of the analysis shows that the existing drainage capacity was only designed to cater maximum Q_{peak} of 1.71 m^3/s. However, with the consideration of water catchment from the uphill area the drain capacity has exceeded about 90% in order to flow a surface runoff Q_{peak} of 12.53 m^3/s The result of the study shows that the existing drainage system was not designed for the uphill catchment and caused the area to be flooded.

ABSTRAK

Pembangunan di tanah bukit memerlukan penelitian yang penting dari askpek hidrologi kerana ia akan melibatkan kawasan tadahan hujan yang besar dari kawasan berbukit yang tinggi. Kawasan kajian yang terletak di kawasan Bukit Jambul Pulau Pinang adalah kawasan pembangunan tanah bukit yang menerima impak banjir yang serius pada November 2015. Kajian kes dijalankan untuk menentukan punca banjir di kawasan kajian. Kajian terhadap sekitar pembangunan tersebut telah membongkarkan bahawa kawasan tadahan air hujan bagi kawasan kajian adalah sangat ketara dimana ianya terletak di lembah di antara dua bukit dan terdapat tiga aliran sungai semulajadi. Dua kajian kes dijalankan untuk mensimulasikan dua (2) jenis huan yang berbeza iaitu yang pertama adalah kawasan tadahan terhad kepada sempadan lot kawasan kajian dan yang kedua ialah dengan mengambil kira kawasan tadahan hujan dari tanah bukit dan aliran air semulajadi. Keputusan kajian menunjukkan longkang sediada di kawasan kajian direkabentuk untuk aliran puncak Q_{peak} of 1.71 m^3/s. Apabila kawasan tadahan sebenar diambil kira, kapasiti longkang tidak mampu menampung aliran puncak sebanyak 12.53 m^3/s dimana ia melebihi sebanyak 90% yang mengakibatkan kawasan kajian dilanda banjir

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Tr	-	Average Recurrence Interval, ARI (year)
P	-	Annual Exceedance Probability, AEP (%)
t_c	-	Time of concentration (minute)
t_o	-	Overland sheet flow travel time (minute)
F_c	-	Conversion factor, 58.5 when area A is in km^2
P_d	-	Design rainfall depth
I	-	Intensity
d	-	Duration
Q	-	Peak flow in (m^3/s)
So	-	Slope gradient (%)

CHAPTER 1

INTRODUCTION

1.1 Background of Study

Urbanisation of a hill-site clearing for the purpose of development had caused a significant impact to the natural environment of the hill. The process commonly involves the cutting of hill slope, chopping down of tress, and diversion of natural stream that replaced by the hard footprint of the development would affect the natural stability of the ecological system of the hill.

The process of the urbanisation has led to an increase of surface runoff due to less infiltrations of surface water into the ground. This was resulted from an increase of the hard footprint in the hill land area.

In Penang Island, the development of the hill land area nowadays is common due to the high density population at the low lying area especially at the eastern part of the Island. As the demand of the houses is increasing, the development was stated to take place in hill land area (JPBD, 2012).

In recent time, there are several flooding incident occurred in Penang Island especially when there is a heavy downpour event. The event had caused flash flood in several areas in the island as well on the hill site development. Rapid water flow as

a result from intense rainfall combined with the sloping terrain of the hill caused the water runoff on the ground surface become rapid increase in volume and its flow velocity.

The study area, is a hill land development located at Bukit Jambul area of Penang Island. The development comprise of 29 units of Semi-Ds and terrace houses, constructed on 2.5acres area at near-toe of Bukit Jambul hill. The highest ground elevation within the development area is 90m above mean sea level. Bukit Jambul hill was one of the famous hiking spot in Penang Island. The peak of the hill is at 240m above the sea level, can be reached by the natural hiking trails.

The construction of the study area was started in early year 2008 and completed in mid of 2010. The development was built at a higher level from its original ground which was raised on a filled platform. The ground terrain of the development compound was made much less steeper than the slope surrounding the development, except towards the entrance, there is a steep access road due to different level of the built platform and the original ground. The development also has provide green space area as part of the development approval conditions.

The drainage system that constructed for the development was a typical drainage system for a normal housing development. The drainage system comprise of the house internal drain and road side drain to flow the surface water towards the monsoon drain at the toe of the development. The monsoon drain was constructed to channel water from the hill site area of the Bukit Jambul. No retention or detention system in the record of the development.

1.2 Problem Statement

After 4 years of the completion of the development, the study area experienced numerous kind of natural incidents. Most of the incidents occurred was

heavy flow of surface water within the development area which had cause the area to be flooded in several times (Jabatan Kejuruteraan MBPP, 2014). Most significant flooding incident was occurred on 29 November 2015. Surface water was reported to be flooding in the resident's houses as a result from the heavy flow. It was recorded the raise of water flow would at least about 3 feet from the original ground. Trace of vegetation bend at the green area of the development could indicate that the flow of the water was high in volume and fast in velocity.

Beside the flooding incidents, the presence of sinkholes has created uneasy feeling for the study area residents. The sinkhole developed near the road side drain would become a hazard for the resident especially for the children. Repair of sinkhole was carried out by the local Authority. However, the hole observed has been redeveloped and the size of the hole was getting bigger.

Apart from the incident mentioned above, several of houses within the development experienced settlement and crack.

The incident occurred had created a lot of problems to the study area residents. The incidents has repeated over years especially during heavy downpour event. Actions taken by the Local Authorities i.e. ensuring the drainage system within the development area in proper conditions (Jabatan Kejuruteraan MBPP, 2014) seems could not resolve the problem.

1.3 Objectives of the Study

In order to determine the cause of the flooding at the hill site at the study area, the objective of the research is to achieve the followings :

(a) To verify the drainage design for the development area in accordance to MSMA,

(b) To identify the water catchment of the development area to identify possible source of natural water flow from hill site area towards the development area, and

(c) To identify the possible underground flow within the site area.

1.4 Scope of the Study

The scope of the study will be focused on the development and its surrounding area. The study area is presented in Figure 1.1 and Figure 1.2 below.

Figure 1.1 Satellite Image of Penang Island

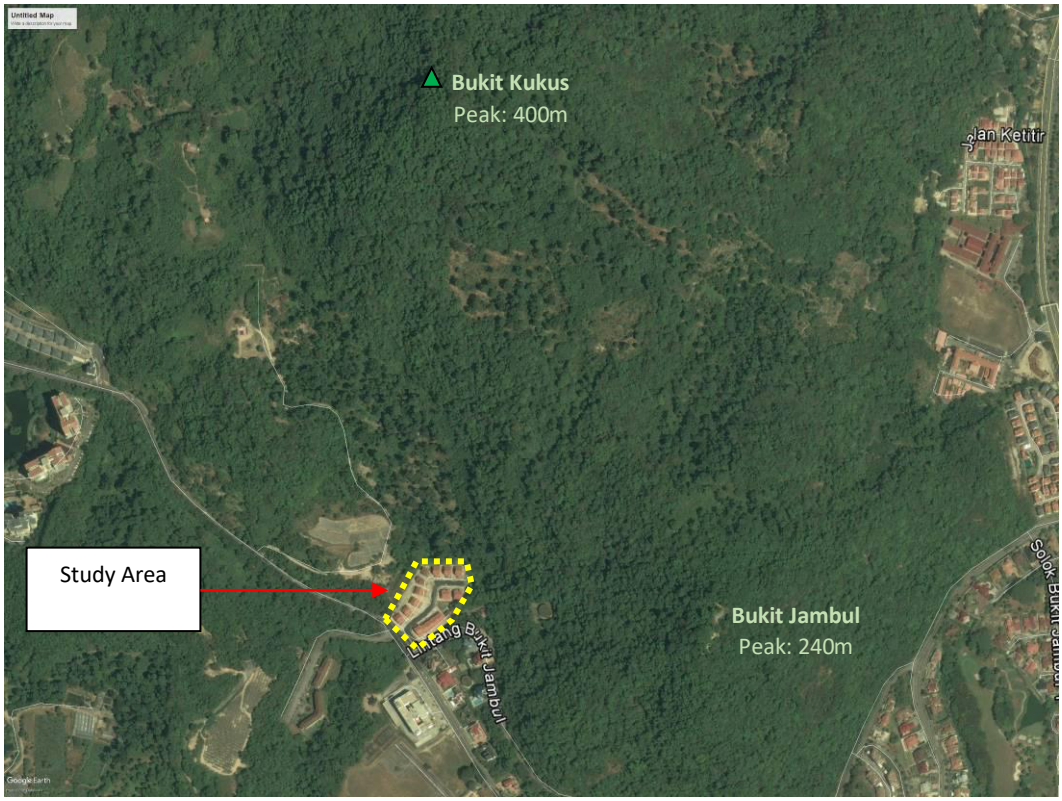

Figure 1.2: Close-up view of the study area. The satellite image is dated June 2010 where the construction of study area was just completed

As the most significant flooding incident occurred on the 29 November 2016, the study will be focused the caused that occurred on the date. Its deemed to be most critical incident within the site area.

1.5 Expected Finding of the Study

The expected finding of the study are as follows:

(a) The increase of surface water within the development area could contributed by the uphill natural stream flows which possibly under

estimated or does not taken into consideration during the early stage of the development.

(b) Inadequate of drainage system within the development could cause the flooding within the development area

(c) There are possible disturbance to the existing ecological system of the hill site uphill from the development area which in result the increase of surface water

(d) Possible underground flow within the site area.

1.6 Significant of Study

As the main cause of the flooding of the hill site development will be known, the study will be a future reference in taking consideration possible natural flow from up hill area, especially when the proposed development is located within valley area. The study also will highlight the importance to study water catchment outside from boundary area of the proposed development.

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