CHAPTER 1

INTRODUCTION

1.1 Background of Study

Global temperature has increased ≈ 0.2°C per decade in the past 30 years, similar to the warming rate predicted in the 1980s in initial global climate model simulations with transient greenhouse gas changes (Hansen et al., 2006). The continued rise in greenhouse gas emissions in the past decade and the delays in a comprehensive global emissions reduction agreement have made achieving this target extremely difficult, arguably impossible, raising the likelihood of global temperature rises 3°C or 4°C within century (New et al., 2011). Furthermore, due to climate change temperatures have been increasingly globally. This climate change is projected to continue and increased by 1.4 – 5.8°C (Haines et al., 2005).

More intense, more frequent, and longer heat-wave are expected in the future due to global warming, which could have dramatic ecological impacts (Wang et al., 2017). This condition of prolonged heat will lead to El Nino occurrence. High temperatures also common during El Nino events, had an independent negative effect on breeding success and might have partly offset the positive effects of high rainfall (Holmgren et al., 2001). The climatic regime determines the vegetation in a region and hence, plays a dominant role in creating fire prone areas. The drier the climate is in a particular region, the more fire prone the site will be. The study area has a dry subtropical climatic regime, making it vulnerable to forest fires (Jaiswal et al., 2002). A study researched by (Rees & Ali, 2012) stated that, the presence of vegetation increased slope stability by about 8%. Plant growth and development on slopes under favourable environmental conditions can also provide long-term mitigation measures for soil protection (Cao, 2006). In other words, in absence of vegetation and factor that Malaysia through changes in monsoon season between August and November, it will lead to direct contact of precipitation on burned or dried slopes and cause to erosion and surface runoff.

Climate change is projected to cause increases in wildfire activity in this region (Hushaw, 2016). Although an entirely natural and essential agent responsible for shaping vegetation dynamics in fire-prone environments, wildfire is also frequently regarded as a major agent of soil erosion and land degradation (Trabaud, 2002). Post-fire intense rainfall events typically increase soil erosion to many times that experienced during pre-burn conditions or that experienced in similar unburned sites (Ferreira et al., 2008). With large rainfall events that exceed the storage capacity of an ash layer if present, erosion rates usually increase markedly due to destruction of the vegetation layer, the availability of highly erodible material and any changes in soil physical and hydrological properties, leading to an increase in runoff and a decrease in the strength of the soil surface that increases the detachability and transportation of sediment (Lloret et al., 2009)

Fire affects both soil chemical properties and nutrient availability. Soil properties most affected by burning are organic matter, pH, cation exchange capacity, nitrogen, sulphur, divalent cations and potassium. When organic matter is destroyed by fire, plant nutrients are released and become highly available for plant growth or loss by erosion (Debano et al., 1979). Many physical, chemical, mineralogical, and biological soil properties can be affected by forest fires. The effects are chiefly a result of burn severity, which consists of peak temperatures and duration of the fire (Certini, 2003). The spatial distribution of soil properties within a soil profile determine to a large extent, the magnitude of change occurring in a particular soil property during a fire. For example, those soil properties located on or near, the soil surface are more likely to be changed by fire because they are directly exposed to surface heating (Debano et al., 1979)

Temperature profiles in the organic horizons and the mineral soil depend on the intensity of the fire, fuel loads, duration of the burning, and antecedent soil moisture. With low-severity soil heating, mineral soil temperatures typically do not exceed 100°C at the surface and 50°C at 5 cm depth. However, where severe soil heating occurs (e.g. underneath slash accumulations, slow-moving fires, etc), temperatures can be nearly

700°C at the soil surface, yet can reach temperatures >250°C at a depth of 10 cm, and exceed 100°C as far as 22 cm belowground surface (Daniel et al., 1999)

The deterministic analysis of slope stability basically involves the calculation of the factor of safety for trial slip surface and the search for a slip surface with the critical for minimum factor of safety. The factor of safety calculation can be based on wide range of methods such as the Bishop's modified method, Morgenstern and Price's, Spencer's and the two edge method dependent on the likely mode of slope failure and the user's option (Nguyen et al., 1985). The risk of slope failures and erosion is enhanced when the vegetation cover is removed. The stability of slopes is governed by load which is the driving force that causes failure and the resistance which is the strength of the soil root system (Morgon et al., 1995). SLOPE/W has been designed and developed to be a general software tool for the stability analysis earth structures. This study aims to determine the effect of fire on the properties of unburned and burned soil and at the same time the effects of erosion on the changes visible through the factor of safety that is computed by using SLOPE/W software.

1.2 Problem Statement

Slope stability is challenging task due to the global warming trend is increasing and expected to continuously which will increase the frequency, duration, and intensity of extreme weather, wildfires and rainfall events which allowed to cause of slope failure or landslide. There is no exception for slope along the highway which has been experiences deep excavation are very vulnerable to slope failure, an engineer need to make sure the design was totally safe for the consumers. Thus the sample from Jalan Gambang, Kuantan were collect to analyse the factor of safety of unburned and burned soil for that slope to define the effect of slope erosion caused by wildfire on the stabilization of the slope.

1.3 Research Objective

The objective of this research were as follows: (i) To determine the effect of fire on the properties of unburned and burned soil (ii) To measure parameter shear strength of the unburned and burned soil for making a simulation model of factor of safety unburned and burned soil for slope at Jalan Gambang, Kuantan using SLOPE/W