COMPARISON OF ROAD TRAFFIC NOISE AT RESIDENTIAL AREAS IN NIBONG TEBAL, PENANG AND KLANG VALLEY

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COMPARISON OF ROAD TRAFFIC NOISE AT RESIDENTIAL AREAS IN NIBONG TEBAL, PENANG AND KLANG VALLEY

By

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ABSTRAK

Kajian in memberi tumpuan kepada pengukuran bunyi lalu lintas di Nibong Tebal, Pulau Pinang(kawasan berkepadatan sederhana) and Klang Valley (kawasan berkepadatan tinggi). Objektif kajian ini adalah untuk menentukan bunyi lalu lintas di kawasan berkepadatan sederhana dan kawasan berkepadatan tinggi dan menentukan komposisi lalu di kawasan kajian. Meter pengukur bunyi kelas pertama digunakan untuk merakam paras bunyi selama 15 minit untuk setiap kawasan kajian dan pengukuran bunyi dilakukan pada waktu 0800 – 0900 (pagi), 1400-1500 (petang) and 2200 – 2300 (malam). Paras bunyi ($_{LAeq}$) yang melebihi 10% daripada pengukuran bunyi (L_{10}), paras bunyi yang melebihi 90% daripada pengukuran bunyi (L_{90}) dan maksimum paras bunyi yang diukur di kawasan kajian. Pengiraan secara manual kepadatan trafik juga diukur serentak dengan pengukuran bunyi dah halaju kenderaan. Komposisi trafik dalam kajian ini terbahagi kepada empat jenis iaitu kereta, motosikal, lori kecil dan kenderaan berat berdasarkan kepada Arahan Teknik Jalan (8/86). Paras bunyi L_{Aeq} kajian direkodkan adalah dalam julat 62 dB(A) hingga 74.25 dB(A) untuk hari bekerja dan 61.2 dB(A) hingga 75.59 dB(A) untuk hari minggu untuk kedua-dua kawasan kajian. Kesemua data bunyi L_{Aeq} yang direkodkan melebihi nilai maksimum yang dibenarkan mengikut Garis Panduan Penggunaan Tanah untuk Perancangan dan Pembangunan Baru Bagi Had dan Kawalan Bunyi Alam Sekitar oleh Jabatan Alam Sekitar Malaysia.

ABSTRACT

This study focuses on the monitoring of road traffic noise between Nibong Tebal, Penang (Medium density) and Klang Valley (High density) study areas. The objectives of this study were to investigate the level of traffic noise at medium and high density studied site and to characterize the traffic composition on the road nearby study areas. A precision Sound Level Meter (SLM) Class One used in the measurements. The measurements were taken for 15 minutes (the sound level meter recorded every one-minute noise level) in the residential area and from 0800 – 0900 (morning), 1400-1500 (evening) and 2200 – 2300 (night). Equivalent Continuous Sound Level (L_{eq}), Sound Level exceeded 10% of the measurement period (L_{10}), Sound level exceeded 90% of the measurement (L_{90}) and maximum noise level (L_{max}) were measured to assist in assessing the existing noise level at the selected sites. Manual Traffic Count was measured simultaneously with noise level and speed of vehicle. Traffic composition data in this study is categorized into four types, which Car and Van, Motorcycle, Medium Lorries and Heavy Vehicles according to the Arahan Teknik Jalan (8/86), A Guide on Geometric Design of Roads. Heavy Lorries involves a vehicle with more than 2 axles such as Lorry and Buses. Result showed that the monitored noise levels in term of L_{Aeq} in residential area ranged between 62 dB(A) to 74.25 dB(A) for weekday and 61.2 dB(A) to 75.59 dB(A) for weekend for both study sites. These levels highly exceeded the Maximum Permissible Sound Level by Receiving Land Use for Planning and New Development.

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LIST OF ABBREVIATIONS

BESRAYA	Sungai Besi Expressway
dB(A)	A-Weighted Sound Level in Decibel
DOE	Department of Environment
DUKE	Duta-Kelang Expressway
ELITE	Central Link Expressway
GCE	Guthrie Corridor Expressway
KESAS	Konsortium Expressway Shah Alam Selangor
km	kilometre
km/h	kilometre per hour
L_{10}	10^{th} Percentile Noise Level
L_{50}	50^{th} Percentile Noise Level
L_{90}	90^{th} Percentile Noise Level
LDP	Damansara Puchong Highway
LEKAS	Kajang- Seremban Expressway
L_{Aeq}	Equivalent Noise Level
L_{max}	Maximum Noise Level
L_{min}	Minimum Noise Level
m	metre
MEX	Kuala Lumpur- Putrajaya Expressway
NKVE	New Klang Valley Expressway
NPE	New Pantai Expressway
SILK	Sistem Lingkaran Lebuhraya Kajang Sdn. Bhd.
SKVE	South Klang Valley Expressway

SPRINT Western KL Traffic Dispersial System

NOMENCLATURES

L_{Ai} = the noise level in dB (A) of the i^{th} sample

N = the number of sample during the period, t_1, t_2

P_0 = the reference sound pressure, 2×10^{-5} N/m^2

Pa (t) = the instantaneous A-weighted sound pressure at time t

t = times of the measurements

CHAPTER 1

INTRODUCTION

1.1 Background of the study

Sound is complex vibration propagated through via air, water, solid media for example wood, stone and metals which, reach to the receiver that can perceive as beautiful, desirable or unwanted. The movement of air is a sound waves consisting of alternating compression and expansion of air that radiating in specific directions from a source. The alternating compression and expansions can be delineated as a small different in pressure around atmospheric pressure (Vermeer and Passchier, 2000). Pollution means any contamination of this element likes air, soil, water and environment and noise is one of the environmental pollution that cannot be seen and only can hear. Noise pollution is dissatisfying human, animal or machine generated sound that disrupts the activity of human or animal life (Aziz, 2017).

Noise is an unwanted sound that can causes irritation to a listener and damage hearing ability of a person. According to the WHO (2011), ‘‘one in three individuals is annoyed during the daytime and one in five has disturbed sleep at night because of traffic noise”. There is a few classification of noise that comes from a different area such as community, transportation, construction and occupational. The noise emitted by a single vehicle is generated by three main sources: the engine, exhaust and transmission noise; the aerodynamic noise; and the noise generated by the interaction of the tyre with the road surface (Sandberg and Ejsmont, 2002; Rasmussen et al., 2007). Traffic noise is the one of the social concern due to rapid population growth and rapid urbanization and this problem will increase the challenge to road authority.

Noise is measured by a sound level meter in decibel dB(A). In the European Union, about 40% of the population is exposed to road traffic noise with an equivalent sound pressure level exceeding 55 dB (A) daytime and 20% are exposed to levels exceeding 65 dB (A) (Berglund et al., 1995). For Malaysia, the maximum permissible sound level (L_{Aeq}) by receiving urban residential for planning and new development for daytime is 60dB(A) and 50 dB(A) for night time (Malaysia Standard) (DOE, 2007).

Sometimes noise problem can be reduced through controlling the traffic. By prohibit usage of horns, maximum noise reduction of 10 dB(A) occurred (Halim, 2016). Apart from that, by passes of heavy vehicles should be created away from residential areas due to high level of noise produced by that type of vehicles (Halim, 2016). Install the noise barrier is one of the control measure that are possible to reduce noise impact. This barrier can be built out of wood, concrete, masonry, metal and transparent materials (FHWA, 2013).

1.2 Problem Statement

Noise disturbance has become serious social concern, due to massive traffic flows motor vehicles (motorcycles, cars, lorry, busses and heavy truck).The increased of outdoor noises are the result of the new road traffic flow and new construction development project within the area. Besides, traffic noise also have many negative impact to people that live near the busy road especially patients with existing clinical conditions are sensitive to noise exposure. Long exposure to noise pollution can cause hearing loss and increase stress level. Based on the DOE (2007) the maximum permissible sound level (L_{Aeq}) by receiving urban residential for planning and new development for daytime is 60dB(A) and 50 dB(A) for night time. People will start to complaint if the noise level exceed the permissible level. The Department of

Environment (DOE) has reported that the complaints about noise made by general public is getting increase (Sani, 1991)

Klang Valley is a city with a population of about 2 million and this city has been expanding continuously especially in the expansion of road network. This city is one of the possible place that have higher traffic noise. A research of traffic noise was carried out by Halim (2016) in Klang Valley at residential areas will be used as secondary data**.** Nibong Tebal is a small town in Penang. However, less research on traffic noise is carried out at residential areas in Nibong Tebal, Pulau Pinang. Therefore, this study is carried out to compare, the traffic noise levels near residential areas between Klang Valley(High density) and Nibong Tebal (Medium density).

1.3 Objectives

The aim of this study is to access traffic noise level at residential areas in Nibong Tebal, Penang and Klang Valley. This study is carried out in order to achieve the following three main objectives:

a) To investigate the level of traffic noise at medium and high density studied sites.
b) To characterize the traffic composition on the road nearby study sites.
c) To determine the relationship between noise level and traffic density between medium density and high density residential areas.

1.4 Scope of Study

This research is conducted to monitor traffic noise level at Nibong Tebal, Penang residential area and the result will be used to compare the traffic noise level gained from secondary data that has been carried out on 2011 in Klang Valley. The study sites in

Klang Valley located at Desa Tun Razak (DTR), Kinrara Court and Sentul Utama and for Nibong Tebal, Penang the selected study sites located at Taman Pekaka, Taman Ilmu Indah and Taman Seri Acheh. The scope of works focuses on collecting data of traffic noise and the traffic density data of the vehicles on the road network at the residential areas. The scope of work includes the site visit to the study area to determine a suitable location for the study.

All the data will be recorded periodically morning, evening and night and for both weekday (Tuesday) and weekend (Saturday).For noise level measurement the sound level meter (Class 1) Cirrus Research PIC equipment was used to collect data in this research. The method follows the noise measurement method in the Planning Guidelines for Environment Noise Limits and Control (DOE, 2007).

The traffic density data were attained based on the vehicle types according to the Arahan Teknik Jalan (8/86), A Guide on Geometric Design of Roads that consists of motorcycle, passenger car and vans, medium lorries and heavy lorries that were manually monitored in the morning time, evening time and night time for every 15 minutes at each study sites. The results obtained for the traffic density were converted into percentages and equivalent passenger car unit (PCU) by calculating PCU factor according to the Arahan Teknik Jalan (8/86), A Guide on Geometric Design of Roads.

The instrument for real time traffic recording included manual vehicles counts and speed gun meter. The manual count was used to measure traffic composition and volume on the road. Speed gun was used for measuring of traffic speed of vary types of vehicle on the roads.

1.5 The Importance and Benefits of this Project

The aim of this study is to compare the level of traffic noise at both residential area in Nibong Tebal, Penang and Klang Valley. Nibong Tebal was categorised as medium density and Klang Valley was categorised as high density area. Based on the Planning Guidelines for Environmental Noise Limits and Control, medium density is defined as areas with population of 75 to 200 persons per acre and high density areas is defined as area with a population exceeding 200 persons per acre. The maximum permissible sound level (L_{Aeq}) by receiving land use for planning and new development for daytime are 60 dB(A) (represent high density) , 55 dB(A) (represent medium density) and 50dB(A) (represent high density), 45 dB(A) (represent medium density) for night time. The value may not be applicable to this century due to increase in population growth as well as increase in number of vehicles on the road. This study will help to provide the level of the traffic noise at residential areas and to improve the guidelines to know the acceptable noise level at study area. The immediate and long term control can be suggested to help to solve this noise problem.

1.6 Dissertation Outline

This dissertation consist of five main chapters that explain in detail about the research project that have been conducted. Chapter 1 provides an overview on traffic noise pollution, maximum permissible limit for a certain place and noise pollution issue. The introduction describes follow by problem statement, objective, scope and benefit of this study.

Chapter 2 reflects the literature review of the previous research that related to the project study which explain the details on traffic noise pollution, worldwide traffic noise

pollution, traffic noise in Malaysia, effect of traffic noise on human and noise descriptors. Chapter 3 presents all the material and methods involved in this study. Furthermore, this chapter will provides information on the study area, data monitoring and method to analyse data.

Chapter 4 explains the results and discussion of this research. Chapter 5 concludes the research and recommendations to solve traffic noise pollution problems. Finally, reference and appendices are included at the last part of the dissertation.

CHAPTER 2

LITERATURE REVIEW

2.1 Traffic Noise Pollution

Noise is an undesirable or disturbance sound that can irritate a listener and potentially damaging to hearing ability. Noise is defined negative sound, distributive sound in wrong place and wrong time (Halim, 2016). Noise is any sound that gives psychological disturbance to a person, may give social effect to a group of people such as disturbance during conservation, working, resting, recreation, sleeping and other activities. Noise can be propagated via air, water, and solid media such as wood, metal (Aziz, 2017). World Health Organization stated that ‘‘Noise must be recognized as a major threat to human well-being’’ (WHO, 2000).

Noise pollution has become common encumber that has caused environmental issue especially to human and wildlife. Environmental noise includes noises from traffic, construction, industry, business and entertainment activities (Haron et al., 2015) . Noise pollution can cause irritation, combativeness, hypertension .It can also cause high stress level, tinnitus, hearing loss, sleeplessness (Elfaig et al., 2014)

Traffic noise is categories under transportation which is the noise generate from an engine of a vehicle, road tire intersection, vehicle honking sound, braking sound, and aerodynamics (Sandberg and Ejsmont, 2002; Rasmussen et al., 2007). Noise associated with road and railway traffic is even more frequent in many countries and especially road traffic noise has been researched intensely over the past years (Zeeb et al., 2017). Traffic noise as a problematic area for society and quality of living is known for quite a long

time. However, noise gain more attention as it contributes to environmental pollution and generates other environmental problems. Recently, transportation noise is identified as one of the big environmental problems and an increasing challenge to the national road authorities (Vaitkus et al., 2017).

2.2 Worldwide Traffic Noise Pollution

In Germany, the prevalence of hypertension in adults aged 18–79 years is about 30% for women, and 33% for men. A possible relationship between noise and hypertension is often explained by a chronic stress response to noise, involving the sympathetic nervous system as well as endocrine responses (Zeeb et al., 2017). Studies by Ramírez and Domínguez, (2013), Guarnaccia et al.(2014) ,Ingle et al.(2005) and Singh (2016) have shown that in many cases the noise levels are higher than the prescribed limits set by the regulating agencies, for a particular region. There have been numerous at-tempts across the globe, which have tried to find methods to study, predict and mitigate the road traffic noise levels (Kephalopoulos et al., 2014; Garg and Maji, 2014; Chevallier et al., 2009; Singh et al., 2016) .

More than 40% of the population in the European Union (EU) is exposed to day time traffic noise exceeding 55dB (A) in terms of L_{Aeq}, and 20% are exposed to levels exceeding 65dB (A) (WHO, 2000). With the implementation of European Directive 2002/49/EC on the management of environmental noise, data concerning the populations exposed to noise in Europe can now be produced from strategic noise maps using harmonised methods (Exposure Noise in Europe, 2010)

When all transportation noise is considered, more than half of all EU citizens are estimated to live in zones that do not ensure acoustical comfort to residents. In Japan, a study conducted by Yano et al. (1991) and Elfaig et al.(2014) show that noise pollution

is high especially at Kumamoto. The noise level recorded 75.2 dB (A) during daytime and 72.5 dB (A) for night time. The noise monitoring were taken on weekdays at road shoulder at a height of 2.8 meters. Such levels are extremely high and exceeded the 55dB (A) for day time and 45dB (A) for night time levels recommended by the WHO. In New Zealand noise problem situation was reflected by the number of people complaining to Christchurch City Council against noise, for example in 1981 the number of complaints was 127 person . Since then there appears to be an increase in the numbers of complaints received particularly in regard to noise from residential premises. Between the 1992 to 1996 total noise complaints rose by 69% Elfaig et al.(2014). According to Elfaig et al. (2014), in Netherlands 0.6% out of 4% people are exposed to traffic noise with L_{dn} amounts of more than 70dB(A).

In Nigerian urban areas, residential areas can be grouped into two: the high-density areas (well developed areas with clustered buildings and high number of people living together) and low-density areas (developing areas with scattered buildings and few people living together). In a densely populated area, high noise levels are generated compared with those of a sparsely (low density) populated area. The major sources of noise in residential areas in Nigerian urban cities include noise from human conversation, noise from religious worship centers located around the residential areas, etc. All these contribute greatly to environmental noise pollution (Oyedepo, 2009).

2.3 Traffic Noise Pollution in Malaysia

Today, environmental noise has become a worldwide problem because it disturbs all the surrounding people mostly in the urban area to do activities and this problem is continuous until now especially for developing country (Halim, 2016). Majority of

people live in the urban residential area are exposed to the ill health effects of traffic noise (Halim, 2016).

Every year, there is an increase number of vehicle in Malaysia due to increase of population growth lead to increase in traffic noise pollution especially at the big city. Many complaint have been received by the DOE due to noise pollution at the Kuala Lumpur and Klang Valley. In Kuala Lumpur based a study conducted by Elfaig et al., (2014), the noise pollution in residential and school area (Blue Boy Mansion and La Salle Secondary School) is highly significant different with the WHO recommendation due to the land use pattern that is located near the busy main road area and business activities.

According to The Planning Guidelines For Environmental Noise Limits and Control by the Malaysian Department of Environment (DOE, 2007) defined the low density residential areas as areas with a population of less than 75 persons per acre, suburban residential (medium density) areas as areas with a population of 75 to 200 persons per acre while the urban residential (high density) areas as areas with a population exceeding 200 persons per acre. Next, Table 2.2 shows Conversion Factor to Passenger Car Equivalent (PCU) according to the Arahan Teknik Jalan (8/86), A Guide on Geometric Design of Roads.

Tale 2.1: Maximum Permissible Sound Level (L_{Aeq}) by Receiving Land Use for Planning and New Development in Malaysia Noise Guidelines (DOE, 2007)

Receiving Land Use Category	Day Time 0700-2200 (dB(A))	Night Time , 2200-0700 dB(A))
Noise sensitive areas, Low density residential, institutional (school, hospital)), worship areas.	50 dBA	40 dBA
Suburban residential (medium density) Areas, public spaces, parks, recreational areas.	55 dBA	45 dBA
Urban residential (high density) areas, designated mixed development areas (residential – commercial)	60 dBA	50 dBA
Commercial business zones	65 dBA	55 dBA
Designated industrial zones	70dBA	60 dBA

*****Medium density represent for Nibong Tebal * High density represent Klang Valley

Table 2.2: Conversion Factors to p.c.u's from Arahan Teknik (Jalan) 8/86, A Guide on Geometric Design of Roads

Type of Vehicle	Equivalent Value in p.c.u's for Rural Standards
Passenger Cars	1.00
Motorcycle	1.00
Light Vans	2.00
Medium Lorries	2.50
Heavy Lorries	3.00
Buses	3.00

2.4 Health Effect of Traffic Noise

The world is witnessing an urbanization is a global trend that affected human health because of rise in the number of vehicles on the roads that can lead to increase the traffic noise level. The high noise levels influence to the human health and can be annoyance especially those live near the busy road (Singh et al., 2016, Oftedal et al., 2015). Traffic noise can cause annoyance and sleep disturbance (WHO, 2011) and

(Oftedal et al., 2015) has related with cardiovascular disease (Roswall et al., 2016, Christensen et al., 2016), obesity, diabetes (Roswall et al., 2016) and markers of adiposity in adult and middle-aged populations (Christensen et al., 2016). Lately, road traffic noise associated with effect of cardiovascular although the action to give the putative mechanisms, it can cause type 2 diabetes (Sørensen et al, 2013). Based on the (Babisch et al., 2014; Recio et al., 2016) study, there is a possible relationship between noise and hypertension because of a chronic stress response to noise, involving the sympathetic nervous system as well as endocrine responses.

Moreover, exposure to noise during the night is thought to be particularly hazardous, as night-time noise at normal urban levels (45–65 dB) is associated with reduced sleep quality and duration (Monrad et al., 2016) . There is a study suggested that traffic noise and railway noise could rise the risk of breast cancer (Roswall et al., 2016). Normally, patients with existing clinical conditions are sensitive to noise exposure and less sleep quality and quantity cause endanger to patients (Roswall et al., 2016).

WHO stated that noise has bad effects on human health by set up physiological changes for example rise in stress hormones and sensitivity and damage of hearing function (Kim et al., 2017). Children that exposed to very high road traffic noise level tend to get abnormal blood pressure (Kim et al., 2017). In Slovakia, about 1,542 children (3-7 years) in kindergartens are possibly to have higher systolic and diastolic blood pressure because exposure to noisy environments which is more than 60dB(A) compared to those children did not exposed to noisy noise (Kim et al., 2017). The traffic noise will increase the environmental pollution (Kyçyku et al., 2016) as the road traffic produces a greater number of gaseous pollutants and generate ultrafine particles of atmospheric pollutants between 10mm-500mm diameter range (Morelli et al., 2015).

2.5 Noise Descriptors

L_n is the percentile level where n may be any value between 0 to 100 of the measurement time period and the commonly used value of n are 10, 50 and 90 that represent sound level has been exceeded. (Halim, 2016). L_{10} means the A weighted sound level equalled or exceeded for 10 % of the measurement time and the L_{10} provides a measure of the maximum sound levels due to intrusive or intermittent noise. L_{50} is the A weighted sound level that is equalled or exceeded 50 % of the time and it represents the median of the fluctuating noise levels. L_{90} is the A weighted sound level equalled or exceeded 90 % of the time and it represent the background or ambient level of a noise environment.

2.5.1 Noise Equivalent Continuous Sound Level L_{Aeq}

L_{eq} defined as the constant average sound pressure level that hold the same value of acoustic energy as the discontinuous levels of noise in the period of time. In other words, noise fluctuate over a wide range with time. L_{eq} is used as standard descriptor to determine noise especially at the highways, residential and commercial areas. Moreover, L_{eq} is more functional and applicable and also internationally accepted for the traffic noise analyses (Ramírez, 2013). The L_{Aeq} is recognized as the descriptor of choice by many authorities in the world for traffic source in environmental noise assessments. L_{Aeq} , A-weighted sound pressure to the square of the standard reference sound pressure , the equivalent continuous level is given by :

$$L_{Aeq}\, L_{eq} = 10 \log\left(\frac{1}{t_2 - t_1} \int_{t1}^{t_2} \frac{{P_A}^2(t)}{{p_0}^2} dt\right) \text{ (theoretical formulation)} \qquad (2.1)$$

$$L_{Aeq} L_{eq} = 10 \log\left(\frac{1}{N} \sum_{i=1}^{i=n} 10^{\frac{L_{Ai}}{10}}\right) \text{ (practical formulation)} \qquad (2.2)$$

Where t_1, t_2 = the start and finish times of the measurements

P_0 = the reference sound pressure, 2×10^{-5} N/m^2

Pa (t) = the instantaneous A-weighted sound pressure at time t

N = the number of sample during the period, t_1, t_2

L_{Ai} = the noise level in dB (A) of the i^{th} sample

CHAPTER 3

METHODOLOGY

3.1 Introduction

This chapter describes the method used to carry out the monitoring of road traffic noise and traffic composition data. The steps involve to achieving all of the objectives of this study as shown in the flow chart (Figure 3.1) and the both Klang Valley and Nibong Tebal was conducted as in Figure 3.1.

3.2 Study Areas

Nibong Tebal is located in the northern hemisphere at coordinates 5.165862, 100. 477927. Nibong Tebal is a small town with a population of about 40 thousand people. Klang Valley is a relatively large city with a population of about 2 millions. This city has been expanding continuously especially in the expansion of road network. The highways in Klang Valley including LEKAS, Kajang SILK, GCE, KESAS, LDP, NPE , SPRINT, ELITE, NKVE , SKVE , BESRAYA, MEX, and DUKE. Klang Valley is located in the middle of Selangor state in west of Peninsular Malaysia, covering an area of 2790 km^2. In this study, six locations of residential area were chosen for data collection.

Study areas chosen involve three residential area at located at Nibong Tebal and the other three located in Klang Valley. These residential areas were chosen due to the location of the areas, the availability and accessibility. Furthermore, the distance of these areas from Universiti Sains Malaysia Kampus Kejuruteraan are also the selection factors to carry out this study. The research areas are shown in Figure 3.2 and 3.3.

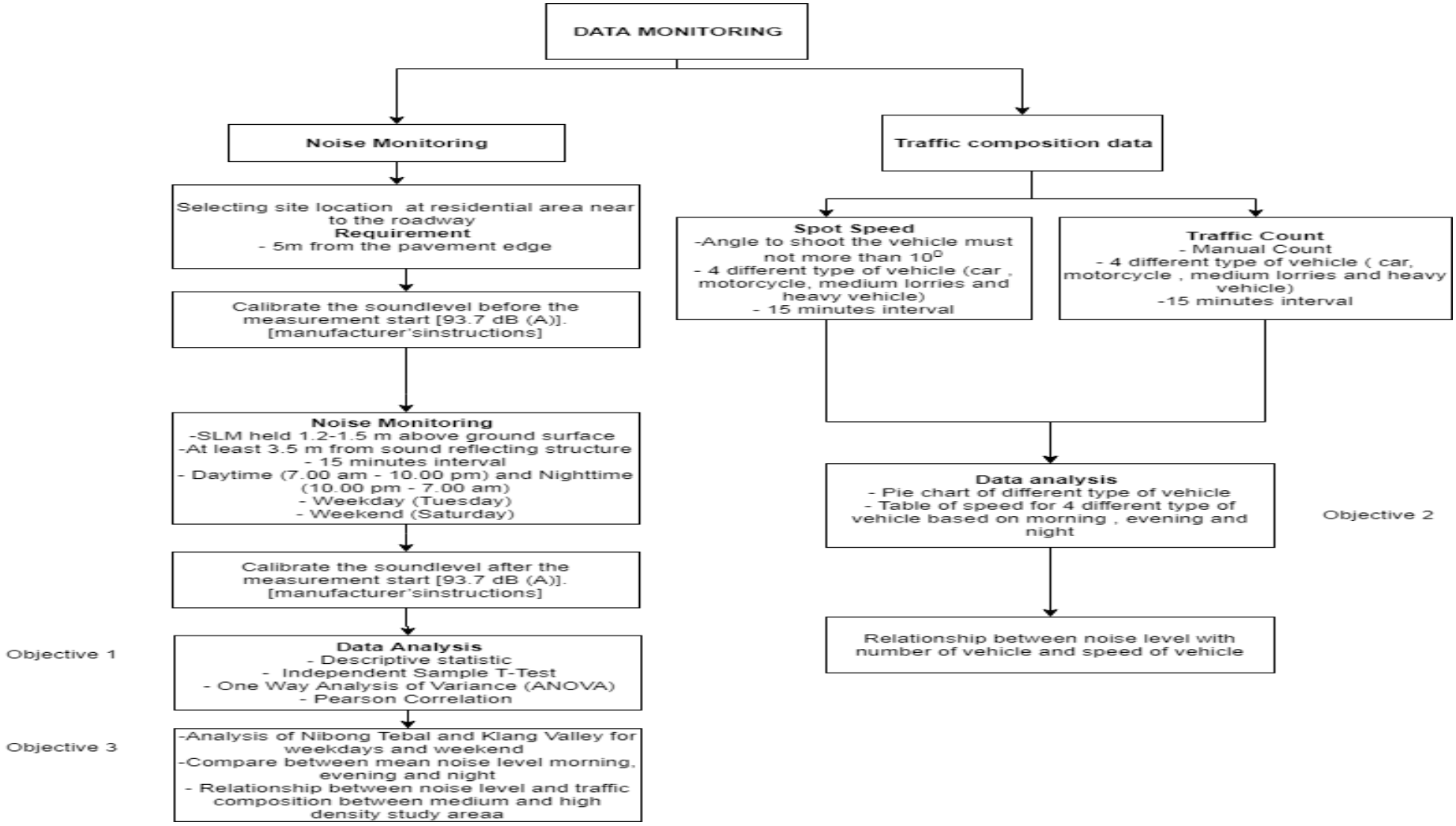

Figure 3.1: Flow Chart of Work

Figure 3.2 shows the locations of the study sites on the maps for residential areas in Nibong Tebal, Penang.

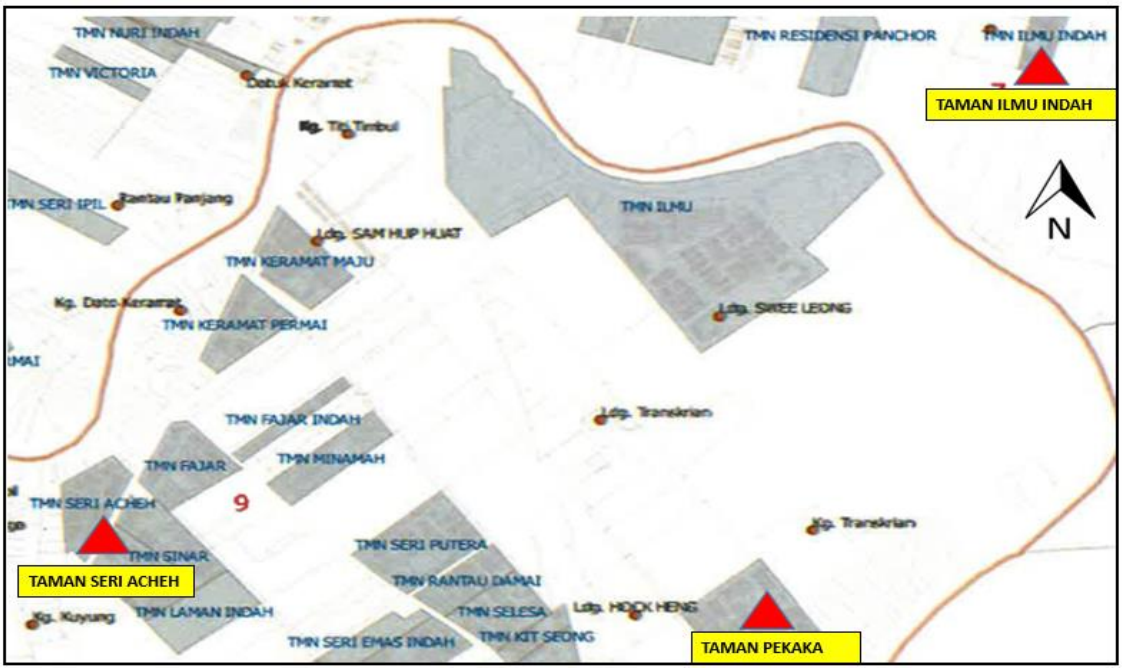

Figure 3.2: Study areas in Nibong Tebal

[Source: Majlis Perbandaran Seberang Perai]

Figure 3.3 shows the single carriageway at Federal Route 283 .

Figure 3.3: Single Carriageway at Federal Route 283 (Taman Pekaka)

Figure 3.4 shows the location of Taman Pekaka and Federal Route 283 .

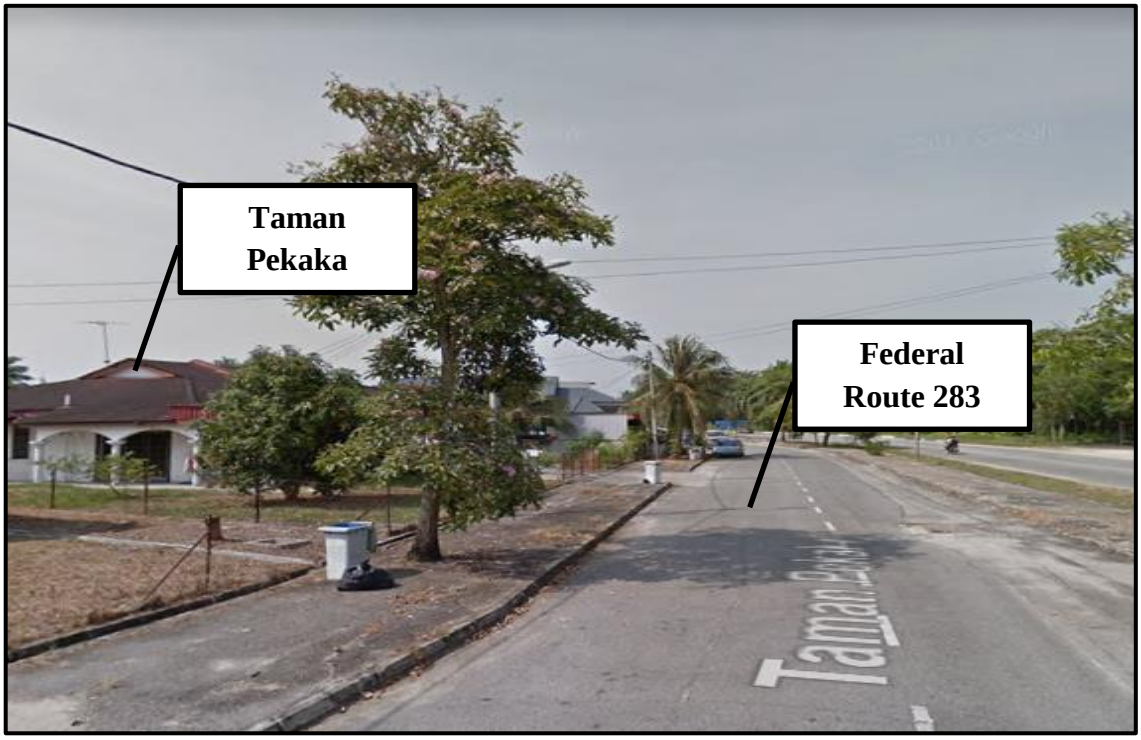

Figure 3.4: Location of Taman Pekaka and Federal Route 283

Figure 3.5 shows the Dual Carriageway at Federal Route 282 at Taman Ilmu Indah

Figure 3.5: Dual Carriageway at Federal Route 282 (Taman Ilmu Indah)

Figure 3.6 shows the location of Taman Ilmu Indah and Federal Route 282.

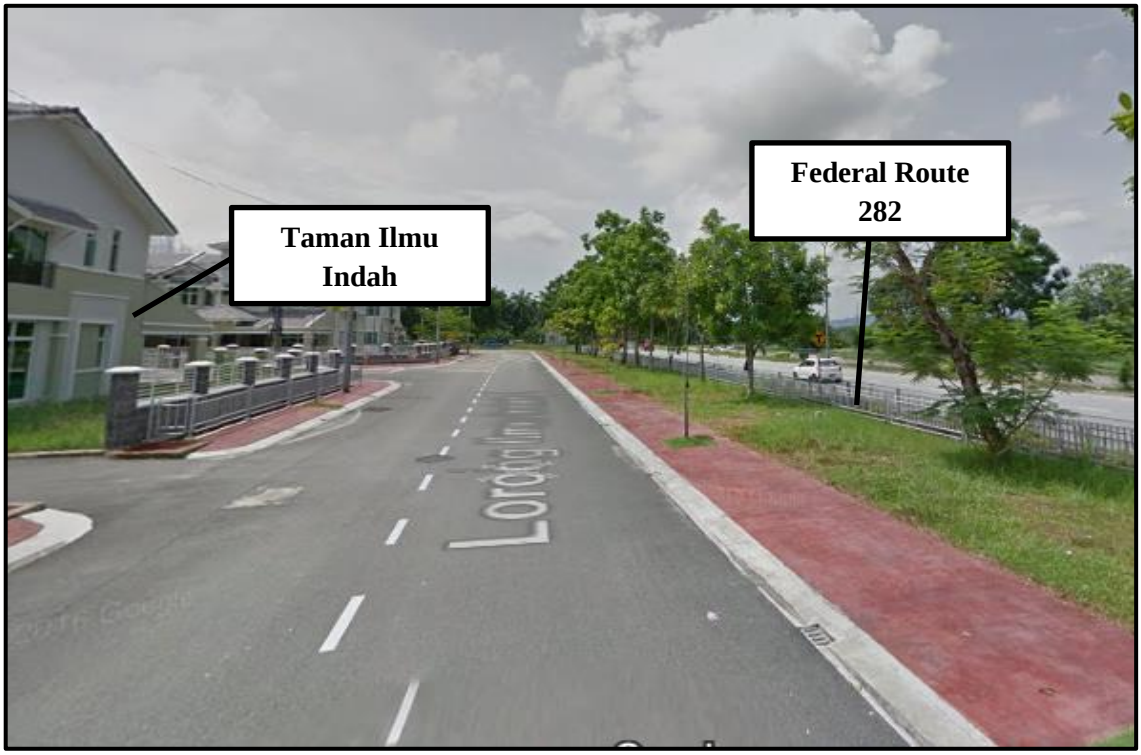

Figure 3.6: Location of Taman Ilmu Indah and Federal Route 282

Figure 3.7 shows the Dual Carriageway located at Federal Route 1 at Taman Seri Acheh

Figure 3.7 : Dual Carriageway at Federal Route 1 (Taman Seri Acheh)

Figure 3.8 shows the location of Taman Seri Acheh and Federal Route 1

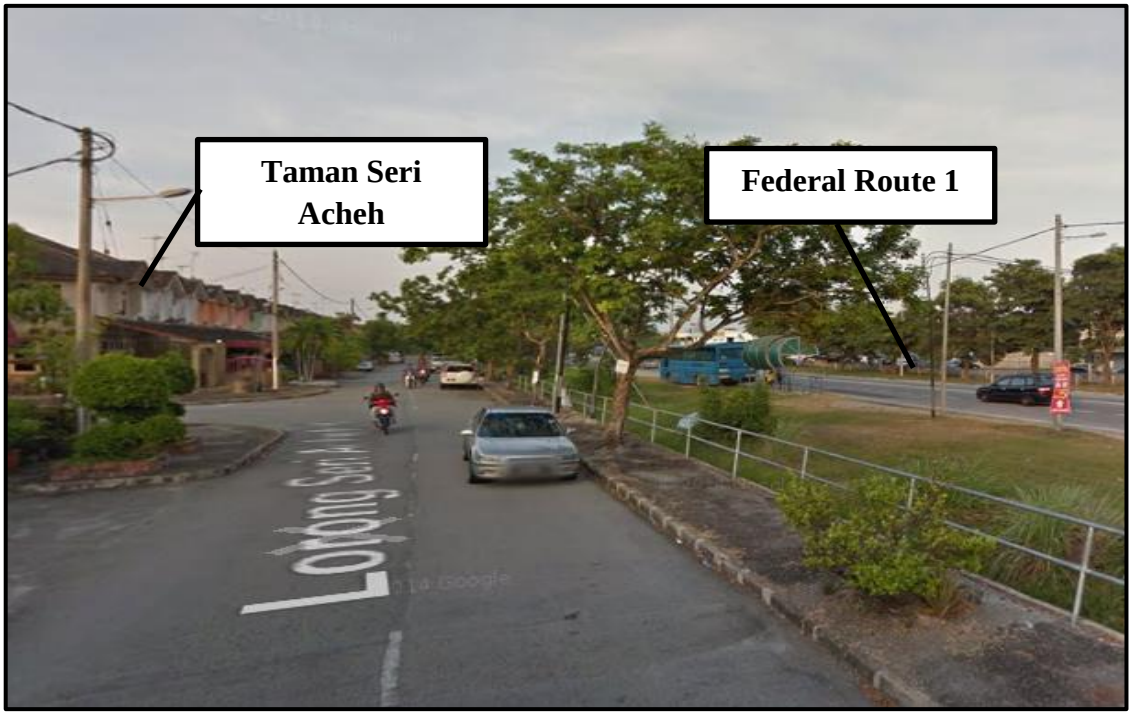

Figure 3.9 : Location of Taman Seri Acheh and Federal Route 1

Figure 3.10 shows study areas located in Klang Valley which are Sentul Utama, Desa Tun Razak and Kinrara Court.

Figure 3.11: Study areas in Klang Valley

Figure 3.10 shows the KESAS Highway at Kinrara Court

Figure 3.12 : KESAS Highway at Kinrara Court

Figure 3.11 shows the location of apartment and KESAS Highway

Figure 3.13: Location of apartment and KESAS Highway

Figure 3.12 shows the Dual-three lane carriageway at BESRAYA Highway

Figure 3.14: Dual-three lane carriageway at BESRAYA Highway

Figure 3.12 shows Dual- three lane carriageway at BESRAYA Highway

Figure 3.15 : Location of Desa Tun Razak Residential Area and BESRAYA Highway

Figure 3.14 shows Dual Three-Lane Carriageway at DUKE highway

Figure 3.16: Dual Three-Lane Carriageway at DUKE highway

Figure 3.15 shows the location of Taman Sentul Utama and DUKE Highway.

Figure 3.17 : Location of Taman Sentul Utama and DUKE Highway

Based on the Table 3.1 shows the Classification of residential area based on Planning Guidelines for Environmental Noise and Control for Low density, Medium density and High density.

Table 3.1: Classification of residential area based on Planning Guidelines for Environmental Noise and Control

Density	Person per acre
Low	< 75
Medium	75 -200
High	> 200

Based on the Table 3.2, the total housing unit were manually counted at the study areas with assumption be made that one housing unit equivalent to 5 residents.

Table 3.2: Classification of Study Areas

No	Residential Area	No. of Resident	Areas (m^2)	Area (acre)	Density (Person/acre)	Density
1	Taman Pekaka	385	13,49344	3.33	99	Medium
2	Taman Ilmu Indah	280	11,487.21	2.84	100	Medium
3	Taman Seri Acheh	560	18197.98	4.50	124	Medium
4	Desa Tun Razak (DTR)	1600	3473.51	0.86	1860	High
5	Sentul Utama	1040	14543.45	3.6	289	High
6	Kinrara Court	3900	26661.43	6.6	591	High

3.2.1 Taman Pekaka

Jalan Transkrian is located in front of Taman Pekaka where it is a single carriageway Federal Route 283 in Penang and Perak that was built by Jabatan Kerja Raya to connect Nibong Tebal, Penang and Parit Buntar, Perak. This federal route segment transverse through Caltex Gas Station and Universiti Sains Malaysia.