COMMUNITY PERCEPTIONS ON NOISE POLLUTION GENERATED BY AIRCRAFT IN CAPE TOWN

BY

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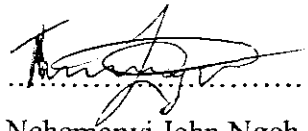
DECLARATION

I, Nchemanyi John Ngeh, hereby declare that; "Community perceptions on noise pollution generated by aircraft in Cape Town", is my own work and that it has never been previously submitted for any degree in any other university. Furthermore, it represents my own opinions and not necessarily those of Cape Peninsula University of Technology and that all the sources I have used or quoted have been indicated and acknowledged as complete references.



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ABSTRACT

Airport operations have become a major source of concern due to aircraft noise, particularly in areas close to airports and aircraft flight tracks. Public opposition to aircraft noise is a threat to the continued growth of civil aviation in South Africa. This study investigated the psychological effects of aircraft noise on residents and school activities at a neighbourhood close to the airport, particularly the area located under the flight tracks or adjacent to the landing and departure pattern of aircraft. Bishop Lavis was chosen as the experimental area and Kensington, about 17km away from the airport, was chosen as a control area. Questionnaires coupled with oral interviews and observations were used to gather information. The findings are focused on annoyance and disturbance. The study revealed that noise exposure caused annoyance, activity disturbance and some mild effects on school results, when compared with the control area. Disturbances were experienced in some activities that need concentration. Aircraft noise also caused communication interference, sleep deprivation and affected the teaching process. The community at the experimental area indicated some non-acoustical effects, such as fear of aircraft crashing over their homes but they indicated no willingness to leave the area. As such, it becomes essential when locating and designing airports to optimise flight paths in a way to reduce noise exposure to nearby communities. Recommendations for mitigation of noise exposure are proposed, which include operational procedure, banning chapter 1 and 2 aircraft, restricting night flights, proper land use planning and enforcing international environmental regulations.

KEYWORDS: *Aircraft, Noise pollution, Airport, Residents, Neighbourhood, Annoyance, Schools, Disturbance and Compatible-Planning.*

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LIST OF ACRONYMS

ACSA	Airports Company of South Africa
A-Weighted	Different Response Weighting Amount of Sound At Any Location (Weighting network)
BRE	Berkshire Research Ethics
CAEP	Committee of Aviation Environmental Protection
Chapter 1 & 2	Old Model Noisy Aircraft
CIA	Cape Town International Airport
CNEL	Community Noise Equivalent Level
CNR	Community Noise Rating
Controlled Area	Area in the Airport for Aircraft Noise Control
dB	Decibel (unit used to express sound intensity)
dBa	A-Weighting Rating Decibel (A Level)
DNL	Day and Night Average Sound Level
EPA	Environmental Protection Agency
Erf	Land Registration Number
FAA	U.S. Federal Aviation Act (1958)
FAR	Federal Aviation Regulations
HUD	U.S. Housing and Urban Development
IATA	International Air Transport Association
ICAO	International Civil Aviation Organization
INM	Integrated Noise Model
Key Person/s	Member of the Community with a Special Function for Example (Street Committee Member, Chair Person/s)
Km	Kilometers
Leq	Equivalent Sound Level
NEF	Noise Exposure Forecast
NNI	Noise and Number Index
PNdB	Perceived Noise Decibel
SABS	South Africa Bureau of Standards
SENEL	Single Event Noise Level
SLM	Sound Level Meters (Instrument used in Measuring Sound and Noise)

TNEL	Total Noise Exposure Level
TNL	Total Noise Loud
WECPNL	Weighted Continuous Perceived Noise Level
WHO	World Health Organisation

INTRODUCTION

1.1 BACKGROUND

Airplanes have become our most popular form of mass transit. Passenger and cargo aircraft, as operated by the airlines are rapid, efficient and relatively safe for people and goods. Commercial air transportation is now recognised as being essential rather than desirable. As the demand for air transportation has increased, along with the overall number of flights, flight corridors to and from airports have become congested (Lyle, 1990). These changes have created noise over previously quiet neighbourhoods. Among the major sources of environmental noise are aircraft, construction sites, mining and quarrying, utilities (like electricity generation and water pumping), factories, traffic, domestic and places of entertainment. Of these sources, aircraft are the highest noise-producing machines (Barber, 1992). The noise produced by aircraft during operations around airports can produce serious social, ecological, technical and economic problems (Fisher and Morfey, 1982).

Aircraft noise in the vicinity of airports started to become an issue about 40 years ago when the first jet engine passenger carrying aircraft were taken into service by airlines (Lyle, 1990). The general public started to complain, and these complaints have subsequently escalated. In 1966, one of the first international conferences, the London Noise-Conference, was held to debate the growing aircraft noise problem (South Africa Department of Transport, 1998a). In 1971, the International Civil Aviation Organisation (ICAO), a United Nations organisation, adopted noise limit rules for certifying commercial aircraft and since then aircraft noise in the developed world has been regulated (ICAO, 1993). Major airports have also taken initiative and created noise abatement offices, regularly producing reports on aircraft operations and planned developments (Airservices Australia, 1996; Heathrow, 1994, 1996, 1997, 1999, 2000; Munich Airport, 1993; Zurich Airport Authority, 1998).

In some parts of the world, aircraft noise is generally decreasing. This decrease can be ascribed to stringent and coordinated international efforts to deal with the problem (IATA, 1995). Amongst others, aircraft and engine manufacturers are building quieter aeroplanes, pilots are trained to fly more quietly, airports insist on the operational restrictions, town planners zone appropriate land uses under noisy flight paths, and international bodies such as ICAO and the IATA have been involved in reducing noise impact.

Noise pollution is an often forgotten environmental problem that is steadily growing in developing countries (Barboza et al., 1995). Everyday, thousands of people are experiencing excessive noise at airport neighbourhood when aircraft are taking off, landing or running up engines on the ground (World Airnews, 2001).

Aircraft noise pollution has been a major public health problem ever since jet aircraft began operating. A study carried out on people living close to London's Heathrow Airport showed that many people suffered from mental illnesses due to excessive exposure to noise, serious enough to require treatment, than a similar group of people living in a quieter area some distance away from the airport (Jones et al., 1972). The damage from noise to human beings can range from annoyance to insanity and it also causes interference with speech communication and prevents creative activities (Goodfriend and Kessler, 1973; Barboza et al., 1995).

1.2 A BRIEF DESCRIPTION OF THE AIRPORT AND ITS BOUNDARIES

Cape Town International Airport was opened in 1955 and the infrastructure was not designed to expand and accommodate the current and the future volumes of aviation traffic (Chittenden Nicks de Villiers and NM & Associates, 2001). The main runway alignment is towards Tygerberg Hills, with Bishop Lavis area being one of the immediate neighbours subjected to high noise level. Studies are currently underway for new dual-runway constructions in an attempt of ameliorating the effect of noise levels at its neighbourhood (Chittenden Nicks de Villiers and NM & Associates, 2001).

Cape Town International Airport is located approximately 20km from the Cape Town Central Business District. Bishop Lavis, Belhar, Delft, Philippi, and Cross-Road of Nyanga surround it. The site is linked to major connector routes, namely the N2 Freeway and Klipfontein Road to the South and the N1 Freeway and Voortrekker Road to the North via the R300 Freeway.

1.3 THE AREA UNDER INVESTIGATION

The area under investigation (Bishop Lavis) is situated under the probable flight path of landing and taking off due to the obstruction of the Tygerberg Hills and to an extent, the dominant south-easterly winds in summer and the north-westerly winds during winter that influence the flight path pattern. It is situated close to, and north of the Cape Town International Airport (Western Cape Province, South Africa). Residents here are exposed to high noise levels that may possibly cause hearing problems, disturbance, annoyance and other psychological effects. Bishop Lavis is not the only township close to the airport. Other residential areas as stated above include Belhar, New Cross-Roads, and Delft. These are the areas which face widespread unemployment and poverty. The particular problem of Bishop Lavis is that it is located under the pathway or flight tracks of aircraft landing and taking off as shown by FIGURE 1.

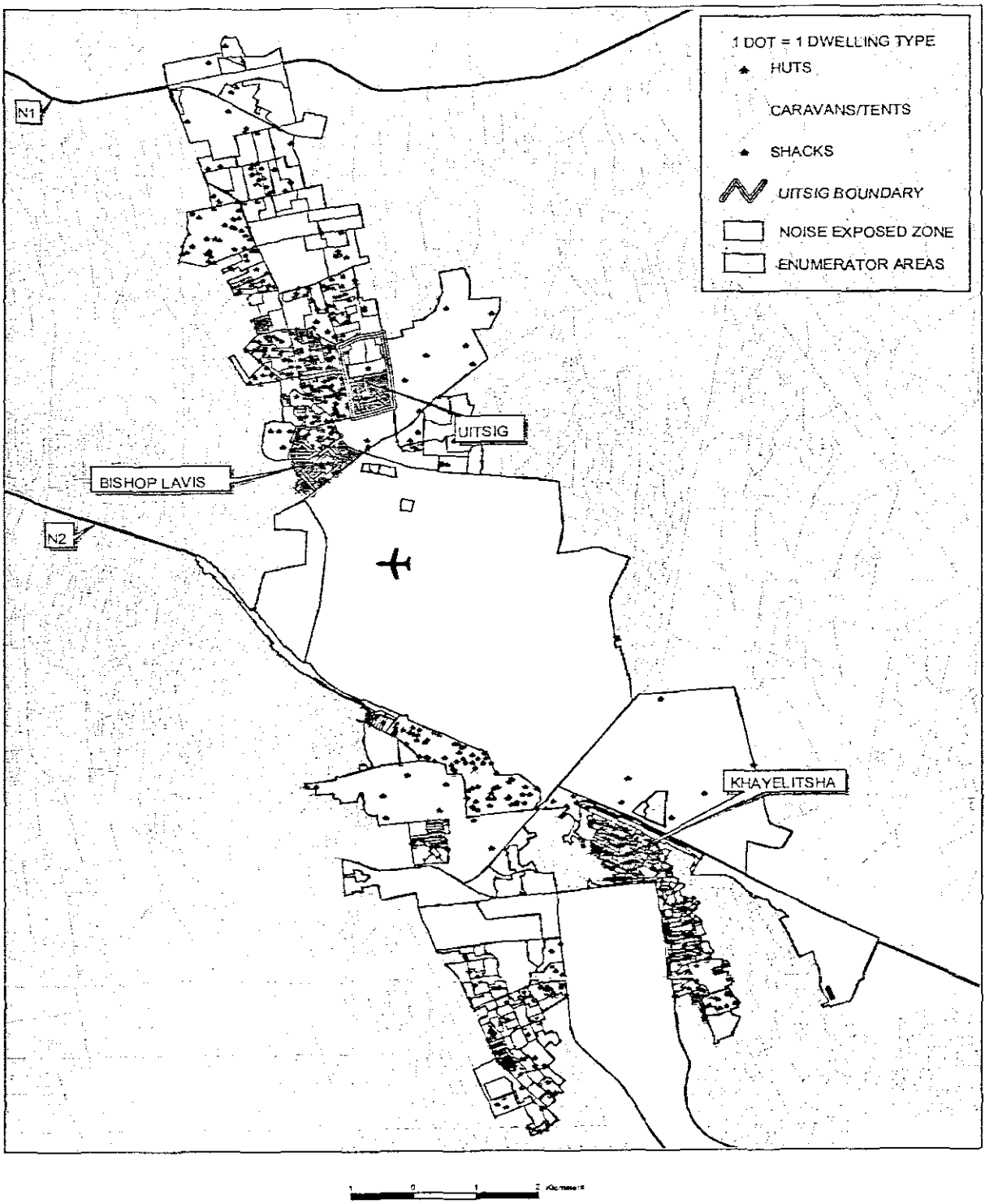

FIGURE 1: Area under investigation (Bishop Lavis)

Source: (Chittenden Nicks de Villiers and NM & Associates, 2001).

1.4 MOTIVATION FOR THE STUDY

Noise pollution can cause sleep disruption, speech interference and inability of individuals to enjoy leisure time, thus impairing their quality of life (Barboza et al., 1995). Airport noise pollution is a widespread and growing problem worldwide. Cape Town International Airport (CIA) as the second largest airport within the Airports Company South Africa (ACSA) is not different. This airport system has 16.7% of the total international and 30.3% of the domestic passengers passing through it (Chittenden Nicks de Villiers and NM & Associates, 2001). Cape Town is one of South Africa's economic capitals and a tourist destination will attract more direct and charter flights from other parts of the country and beyond to its airport. It is generally known that airport activities including take off and landing generate a significant amount of noise. Therefore, there is a possibility that the residents of Bishop Lavis may be affected in some way by aircraft noise pollution.

Failure by government to implement good acoustic rules and no respect of the Control Regulations of 1992 as set out in the SABS Code of Practice (0117-1974) that recommend limits for land use developments at the airport vicinity may be a contributing factor to aircraft noise problems. Despite the negative effect of aircraft noise to man and other environmental components, aircraft noise pollution, is often thought to be of less significant harm than air and water pollution (Fabos, 1985).

1.5 STATEMENT OF THE RESEARCH PROBLEM

Due to certain circumstances, areas around the Cape Town International Airport were taken up by residential areas (formal and informal). One of the residential areas, Bishop Lavis, is right beneath one of the aircraft tracks. It is generally known that aircraft generate a significant amount of noise. Like other environmental problems, aircraft noise may be harmful to human health, causing damage that occurs even in the absence of detectable hearing loss. It may affect children's learning ability, cause annoyance, communication and activities disturbance. Aircraft noise make speech communication

difficult and at times, impossible. The incessant raising of voice in order to be heard is not conducive to a peaceful home or to an effective learning atmosphere. It is not hard to understand the reactions of most people to these disruptions in their lifestyle. Little is currently known of the phychological effects of aircraft noise on residents close to Cape Town International Airport.

1.6 RESEARCH QUESTIONS

- What psychological effects do aircraft noise have on people at a neighbourhood close to the airport, and what are the responses of the community in this regard?
- Does aircraft noise have any effects on learning activities in schools situated within the vicinity of the airport?

1.7 AIMS

To investigate the psychological effects of aircraft noise on residents and schools in Bishop Lavis.

1.8 OBJECTIVES

- To determine the extent of annoyance and disturbance on residents of Bishop Lavis and the responses of the community affected by the aircraft noise.

- To determine the effects of aircraft noise on learning activities at schools in the area under investigation.

LITERATURE REVIEW

2.1 NOISE POLLUTION BY AIRCRAFT

Airport operations have become a major source of concern due to aircraft noise emission, particularly in locations close to the airport and under the aircraft flight tracks. Aircraft noise creates disturbance for people who live and work around airports. The problem of disturbance caused by aircraft noise became widespread in the 1950's with the introduction of jet aircraft into civil aviation (Hothersall and Salter, 1977). The aircraft noise problem is compounded by the fact that jet aircrafts are generally also the most common aircraft type's at large airports (World Airnews, 2001). A taking off jet aircraft is one of the highest noise producing machines with maximum levels of noise experienced when it is landing, taking off or running its engines on the ground (World Airnews, 2001). The first commercial jet, the British Comet began service in the early 1950's, powered by extremely noisy pure turbo jet engines (Brennan et al., 1991).

Opposition to aircraft noise has been vigorous and sustained ever since jet operations commenced (Horonjeff and Mckelvey, 1983). Potter (1970) voiced a concern about the severe and growing problem created by aircraft operating from major airports; while Horenjeff and Mckelvey (1983) stated that, the most serious problem facing aviation is aircraft noise. Reaction to aircraft noise depends on the way in which individuals' experiences undesirable noise (Kryter, 1985). Noise does not often produce visible effects, and there is usually no distinct cause-and-effect ("dose - response" in medical terms) relationship between a single noise event and clear adverse health effects. Some people believe that noise does not pose a serious risk to human health (Rosano et al., 1991). But evidence from a number of studies, especially on children at schools provides ample proof that noise harms human health and decreases quality of life and children's learning ability (Evans et al., 1995; World Airnews, 2001).

In 1971 in California U.S.A., legal action against aircraft noise was already being instituted (Blitch, 1976). In that year, 48 cases worth over $2 Billion were brought to trial by private individuals and municipalities concerning the invasion of acoustical privacy (*Bragdon*, 1973).

Existing airlines and airports are not the only targets of aircraft noise opponents. The construction or proposed construction of new airports has also been known to cause opposition. In 1971, during the phase of construction of Tokyo Narita Airport, confrontation broke out between environmentalists and police partly as a result of a dispute about airport noise. Upon opening, Narita Airport was forced to implement restrictive night curfews between 11 pm and 6 am to limit noise, and about 160 000 residences in the vicinity had to be soundproofed by the Japanese Government (Sekigawa, 1991). The next major airport constructed in Japan in 1994 (designed to supplement Osaka International Airport) was constructed at great expense off the Japanese coast, largely because of aircraft noise (Tohma and Yamamoto, 1990).

The frequency of operations has increased with time, and urban encroachment of land around airports continues to be a problem (Lipscomb and Taylor, 1978). For example, in 1970, a new runway was opened at Los Angeles International airport, which brought the intense noise of landing and taking off closer to home for people in the Westchester area which led to opposition. Angry crowds mobbed the meetings of the airport commissioners, protesting against the noise pollution (Jones et al., 1972).

Similarly in Los Angeles, California, a court awarded damages to District School/ teachers when they sued and claimed that it was impossible for them to teach in a school building located near the airport (Stansfeld and Haines 1997). Speech interference due to high levels of noise jeopardized the continuity, flows of the lessons, and was a nuisance that resulted in teacher and child frustration. Ko (1979) reported in a survey of 139 schools in Hong Kong that aircraft noise disrupted verbal communication, resulting in speech and teaching interference during lessons and that teachers suffered from noise annoyance. It is possible that aircraft noise may affect teacher's encouragement of

children, teacher's behaviour and may potentially or indirectly affects school results. Noise pollution can also cause anti-social behaviour, and can lead to chronic stress resulting in many secondary problems such as the ones associated with a reduction in children's learning skills (Lang, 1997). In a similar study an increase in birth defects in babies born to women that were repeatedly exposed to jet aircraft noise, were found to have some health effects (Jones and Nowell, 1978).

According to Horonjeff and Mckelvey (1994) the scope of the problem of aircraft noise pollution is affected by:

a) the number and type of aircraft using the airport (older aircraft types using low by-pass ratio turbojet engines are much louder than newer aircraft using high by-pass ratio turbofan engines);

b) the manner in which they are operated (many airports require aircraft to be operated in compliance with noise abatement procedures designed to reduce the ground noise impact);

c) the use made of adjacent land (i.e. whether non-noise compatible land use may be permitted to use land near airports);

Horonjeff and Mckelvey (1994) indicated that the impact of aircraft noise on communities is dependant upon several factors, including:

i. magnitude - the loudness of the sound;

ii. frequency - the composition of the sound, higher pitched sound being more irritating than lower frequencies;

iii. duration of the noise - the longer a sound persists, the more irritating it is;

iv. flight paths used during take off and landing - aircraft using the same routes on a continuous basis will create high noise levels for land users directly under these routes;

v. number of operations - the greater the number of flights, the higher the noise level;

vi. type of operations - aircraft departing or arriving create one noise event, aircraft being used for training create several noise events as they continually land and take off;

vii. operation procedures - noise abatement arrival and departure profiles may be flown, reverse thrust on landing may be prohibited, all which reduce the ground noise impact;

viii. aircraft mix - aircraft using old technology engines are noisier than aircraft using new technology engines;

ix. runway system utilization - if wind is not an influencing factor, runway use may be varied to distribute ground noise impact;

x. time of day and season - at night, people are generally more sensitive to intrusive noise, whilst during warm weather more people are expected to be outdoor, and therefore be more exposed to noise;

xi. meteorological conditions - strong wind can influence the amount of noise received upwind and downwind of the origin of noise;

2.2 TERMS USED TO DESCRIBE SOUND AND NOISE

2.2.1 Sound and noise

Sound is heard when there is a vibration in substances, such as air, water, or metal. When we talk or sing, we add energy to the air and cause it to vibrate. This energy spreads out from our mouths in the form of waves. If there is a receiver, such as someone's ear the sound will be heard (Kryter, 1985).

Noise is defined as "... an audible acoustic energy that affects the physiological and / or psychological well-being of people" (Kryter, 1985). Noise is unwanted sound and aircraft noise falls into this category of sound that is unwanted by most people, most of the time. Airport related noise includes the noise from aircraft, ground activity at the airport and traffic. The studies of the effects of noise are complex. This is partly due to the fact that the impact of noise varies depending on the characteristic of the noise, some of which are not completely understood. There are many sounds in the world, but not all pollute the environment and are therefore not term noise (Kryter, 1985).

2.2.2 Sound / noise measuring unit

The intensity of sound / noise is usually expressed in decibels (dB). The decibel unit is named after Alexander Graham Bell, a sound researcher who invented the telephone and also did valuable work with deaf people. By using decibels as the unit of measurement, the large range of sound intensities can be compressed into a scale with a range of 0 to about 150 dB. On this scale, when monitored from close range, a large commercial jet aircraft can generate over 100 dB. In comparison ambient noise in a residential area varies from 55 to 60 dB (Horonjeff and Mckelvey, 1983).

2.2.3 Sound / Noise measurement

Sound / Noise are measured with an instrument known as a sound level meter (SLM), which reads in decibels. The instrument indicates the total amount of sound present at any location, which is described as the overall sound pressure level. Typically, sound level meters (SLM's) contain different response weighting networks. The most commonly used being the A-weighting (dBa) since it corresponds with the response of the human ear to sound (World Airnews, 2001).

2.2.4 Aircraft noise measurements

Aircraft noise, particularly jet noise differs from other environmental noise by preponderance of the higher frequency sound, which the human ear finds especially annoying. In describing aircraft noise both the acoustic energy of the sound and subjective effect of sound on people are incorporated into a measure unit, which the aviation industry term "noise descriptors" (Kryter, 1985).

2.2.5 Noise environmental descriptors

Noise Environmental descriptors are average noise levels during a 24-hour day. They take into account not only the noise intensity of a single event but also its duration and the number of events occurring throughout a 24-hour period. Thus, these descriptors are also referred to as cumulative or composite noise scales. They are (1) DNL. Day - Night sound level, used by the U.S. Environmental Protection Agency (EPA) and by most local agencies in U.S.A., (2) Community Noise Equivalent level (CNEL), used by the State of California Division of Aeronautics, and (3) Noise Exposure Forecast (NEF), used by Housing and Urban Development (HUD) and the Federal Aviation Administration (FAA) in the U.S.A. The DNL and CNEL rating scales are based upon the A-weighted decibel (dBa), while the Noise Exposure Forecast (NEF) scale is based on the perceived noise decibel (PNdB). It calculates the impact of aircraft noise in the vicinity of airport. It is a measure of the daily cumulative effect of all aircraft noise averaged over a day. NEF

calculation is adjusted to take into consideration the fact that night-flights are more annoying than daytime ones. Other methods used are Noise and Number Index (NNI), Total Noise Exposure Level (TNEL) and the Total Noise Load (TNL) (Horonjeff and Mckelvey, 1983). These methods, while differing in technical details are conceptually very similar to one another and correlate well with each other. Both measurements emphasize the high frequencies to which the human ear is particularly sensitive.

Although a number of measures using different units are shown, it is clear that for each measure, at a certain value, the amount of noise exposure become unacceptable approximately at the division between moderate and significant noise exposure. Horonjeff and Mckelvey (1983) have tabulated a land use guidance chart, which outline the exposure associated with noise levels of a number of the different metrics. An adapted version is shown in TABLE 1.

TABLE 1: Comparison between noise metrics and noise exposure (adapted from Horonjeff and Mckelvey 1983).

Noise Exposure	**DNL**	**NEF**	**CNR**	**CNEL**
Minimal	0-55	0-20	0-90	0-55
Moderate	55-65	20-30	90-100	55-65
Significant	65-75	30-40	100-115	65-75
Severe	75 and higher	40 and higher	115 and higher	75 and higher

There is no universally accepted measure for conducting airport noise studies. Individual nations have developed their own noise indices according to their own requirements. As already mentioned above, some of these include the Noise and Number Index (NNI)

(United Kingdom), Storindex (Germany), Indice Psophique (France), Korsten Unit (Netherlands), DNL (Day-Night Level) (USA) and Leq (Equivalent level) European Economic Community (Large and House, 1981).

All the methods are supported by the Integrated Noise Model (INM), which has been developed by the U.S. Federal Aviation Act (FAA) for the analysis and prediction of noise impacts from aircraft operations on communities in the vicinity of an airport. As mentioned above, all these methods are conceptually similar, the primary difference being the unit of measure (Horonjeff and Mckelvey, 1983). It is up to the user to choose which unit of measurements to be use. Of all the noise measures mentioned, the DNL measure is in common use for airport land use compatibility studies, and is recommended by the FAA and the United State Environmental Protection Agency (Horonjeff and Mckelvey, 1983; Nelson, 1987). Nelson (1987), states that no one universal noise index is used, although the DNL measure is well recognized. DNL is a cumulative measure, used to indicate the total amount of noise exposure in an area, over a sufficiently long period-usually one year. The DNL measure is derived from measurements made in dBa. As mentioned previously, although dBa is not the best measure for assessing aircraft noise, it is considered adequate for the purposes of land use planning.

2.3 LAND USE AND AIRPORT NOISE

Land use compatibility is defined as the extent to which neighborhood land uses contribute jointly to, and do not mutually or singly detract from promoting the quality of life for those living within that environment (U.S. Department of Transportation, 1999). In this section land use compatibility is discussed in terms of residential environmental quality, the compatibility of airports, noise compatibility planning, and the varying noise sensitivity of different land use types.

The geographic areas where aircraft noise becomes a major nuisance are to be found where aircraft are relatively close to the ground, and where frequency of aircraft occurrence is high (U.S. Department of Transportation, 1999). According to Hothersall

and Salter (1977) the majority of people who are seriously affected by noise are found within a 15km radius of major airports. This is not to say that all people who live and / or work within a 15km radius will be affected. The people who will more likely be affected are those who are located under the airport's approach and departure routes. People who are located within the 15 km radius but not under the approach / departure paths are usually not disturbed by aircraft noise.

As the extent of the noise problem, and its effect on people become measurable, private and government organizations have established environmental noise control efforts, particularly on land use zoning, to protect those people who are exposed to aircraft noise (Horonjeff and Mckelvey, 1983).

2.3.1 Urban environmental quality through land use compatibility

The quality of the environment in an urban residential area influences the quality of life of its residents, workers and visitors. Grimwood (1993) stated that "three factors have a particular bearing on urban environmental quality: public health and safety; provision of an efficient urban infrastructure which facilitate human activities and movement; and the creation of an environment which maximises people's comfort and enjoyment of living". Another factor closely related to urban environmental quality within the urban area is the juxtaposition of land uses. According to Powell and Shepherd (1989), "past and present built forms are not always good neighbours". The more suitable and similar two adjacent land uses are, the more compatible and in harmony with each other they will be. Conversely, if two adjacent land uses are in conflict, they are viewed as being incompatible with each other and perceived as "bad neighbours".

The Environment Conservation Act 73 of 1989 was the fundamental piece of environmental legislation in South Africa until very recently. Though largely unused for the purpose for which it was designed (Glazewski, 1994), it is still the most in force. It is now to be read in conjunction with and as glossed by the Environmental Management Act no 107 of 1998. Pollution is one of the factors that can create conflict between land

uses and affects the kind of "neighbours" a certain type of land use will be and, therefore, its compatibility. Examples of incompatible land uses include sewerage plants, power lines or railway shunting yards, which adversely affect the smell, sight, and hearing of residents located close to these land uses. This brings us to the question of how noise pollution from aircraft affects the compatibility of an airport and its neighbours.

Section 24 in the Bill of Rights in the Constitution of South Africa (Act 108 of 1996) state that; "everyone has the right to an environment that is not harmful to their health or well-being". The Environmental Management Act no 107 of 1998, coupled to the Environment Conservation (Act 73 of 1989) makes the provision for the inclusion of noise pollution as an environmental concern in section 2 (c) and (d), which state that the Minister may determine the policy to be applied with a view to: "(c) the protection of the environment against disturbance, pollution as a result of man-made processes or human activities", and (d) the establishment and maintenance of acceptable human living environments in accordance with the environmental values and the environmental needs of the communities".

2.3.2 Can an airport be a "good neighbour"?

According to the U.S. FAA (1958), a compatible land use is defined "as one located adjacent to an airport that does not endanger the health, safety, or welfare of the owners, occupants, or users of the land because of exposure to levels of noise, vibrations or the risk of personal injury or property damage created by the operations of the airport, including the taking off and landing of aircraft". This should include the social utility of aviation, the legitimacy of aviation as a business, the distance of the airport from the owner's property or residential areas, and the overall impact of the noise on the property owner or residents. Therefore, if an airport creates nuisance that lead to annoyance and affects the environmental quality of urban areas close to it to such an extent that residents no longer feel safe, healthy or enjoy their everyday lives, the airport can be viewed as a "bad neighbour". "Noise nuisance" is the substantial and unreasonable interference or impairment of the convenience or peace of any person (Jack, 1977). Once such

interference is consistent and exceeds the ambient noise levels, it becomes a "disturbing noise" and may lead to annoyance (Jack, 1977). Annoyance is defined as "the general reaction of the community or person to a condition which threatens the general health of the community, either by creating displeasure, interference with specific activities or creating a general threat to well-being of the community" (SABS, 2003).

Stansfeld et al. (2000) noted that while having the airport environment totally devoid of development may be ideal from a land use compatibility perspective, it is seldom a realistic objective, as existing development already makes such sterility impossible to achieve at most airports. Even in sparsely populated areas, trade-offs must usually be made between an ideal degree of land use compatibility and the community needs for land use development. Despite the foregoing, it is important to ensure that the development that does occur is in harmony with airport operations and residents at the airport vicinity.

Effective land use management in the noise-exposed areas near airports is essential for both the continued viability of the airports and the comfort of the residents. The FAA believes that communities and airports have worked at cross-purposes in the past due to a lack of communication and a lack of information on noise compatibility planning (U.S. Department of Transportation, 1999).

Many diverse parties are affected by noise-based land use planning, action or lack thereof. According to Paullin (1971) these parties can be grouped into: airlines, passengers, airline operators, airport operators, aircraft and engine manufacturers, residents in the vicinity of the airports, taxpayers of the community in which the airport is situated, and the local business community. Given the many negative effect of aircraft noise on residents and public health and well-being one would expect the government to regulate noise pollution just as stringently as it does to other forms of pollution. Perhaps the group most negatively impacted by aircraft noise are residents who live in areas surrounding airports and who are exposed to noise at times when its impact is most noticeable at night and over the weekend.

There are conflicts between the advantage of conveniently locating an airport and consequences of noise pollution. Major cities want their airports as close to the town area as possible for the convenience of business travelers who help to increase the prosperity of the area. Some property owners want new airports to be located close to their holdings because the commerce that usually spring up around airports is likely to push up the value of their property. While other property owners, especially those who own homes near the airport area, want the airport as far away as possible to avoid noise.

Berglund et al. (1990) suggested a number of methods for decreasing the noise exposure. These include the implementation of noise abatement operational procedures, decreasing the number of noise events, and introducing barriers between the source and receiver. They conclude by stating that, "A proper land use planning (keeping distance) seems to be the best answer to the problem of noise annoyance", but unfortunately, zoning regulations are not often and respected.

Even when an airport is built far away from residential areas, problems can still arise. In New Orleans for example, a new international airport was built 20 miles out of town to protect citizens from noise pollution, and no zoning laws covered the areas along the road from airport to the city, property owners moved in, and housing development went on rapidly. A residential area now exists close to the airport despite the good intention of the original planners (Jones et al., 1972). Complete avoidance of people to construct around the airport is more of a theoretical attempt than practicable because the decision to either, (1) allow further residential encroachment on an airport by allowing construction for families, usually of low or middle-income, who want a home regardless of its noise environment, or (2) reject the pressure of developers or planners and would-be homeowners and thereby maintain a healthy environment for the community, is a difficult one.

2.3.3 Noise compatibility planning at airports

The California Department of Transportation (2000) stated that the objective of noise compatibility planning is to minimize the number of people exposed to frequent and / or high levels of airport noise capable of disrupting noise-sensitive activities. The same department maintains that the basic strategy for achieving noise compatibility in the vicinity of an airport is to limit development of land uses that are particularly sensitive to noise. The most acceptable land uses are the ones that either involve few people (especially people engaged in noise-sensitivity activities) or generate significant noise levels themselves (such as transportation facilities or some industrial uses).

Airport noise compatibility planning addresses both existing and future aviation noise impacts. Knowledge of future exposure provides a basis for long-term local planning and investment in noise mitigation for particular noise sensitive areas, including how to compatibly develop any vacant land or to redevelop older areas around the airport into compatible uses (U.S. Department of Transportation, 1977).

Just as there are no absolute determinants of the noise level at which an individual person will be highly annoyed, there are no absolute scientific measures for establishing which land uses and noise exposures are or are not compatible with one another. The best that can be hoped for is that compatibility criteria will reflect what is appropriate for the communities involved. It is important to remember, however, that what may be acceptable levels of noise to a reasonable person will not satisfy 100% of the public (California Department of Transportation, 2000).

Accordingly, exposure forecasts become essential when noise is a significant factor in urban development near airports. Prediction of aviation noise depends on the number of factors including aircraft movement, fleet composition, runway utilization and geometric configuration, flight paths from different runways, airspeed, engine power settings during approach and landing procedures, as well as meteorological conditions such as

atmospheric pressure, temperature distribution, as well as wind direction and velocity (Horenjeff and Mckelvey, 1983).

2.3.4 Varying noise sensitivity of different land types

There is a relation between the noise sensitivity of land use types and the resulting compatibility thereof. The less sensitive a land use is to noise, the more compatible it will be. Therefore, land use compatibility planning is important in guiding noise-sensitive land uses away from the noisier areas and encouraging non-sensitive land uses (Fabos, 1985). Four types of land uses are defined as incompatible (and, therefore, are the most sensitive) by the (California Department of Transportation, 2000);

- residents of all types (living space)
- public and private schools (educational space)
- hospitals, clinics and convalescent homes (health facilities); and
- churches, synagogues, temples, and other places of worship (religious activity).

Noise compatibility standards have placed primary emphasis on residential areas - where people rest and live for extended periods. The sensitivity of residences can also be attributed to the fact that residential contribution usually provides less sound attenuation than typical commercial construction, and windows are more likely to be open. Furthermore, people are particularly sensitive to noise at night when they are trying to sleep and out door activity is a significant aspect of residential land use (California Department of Transportation, 2000).

2.4 NOISE SENSITIVITY CLASSIFICATION IN SOUTH AFRICA

Several regulations regarding noise in South Africa have resulted in a number of land use compatibility tables. The Noise Control Regulations of 1992 refer to standards set out in the SABS Code of Practice (0117-1974) that recommend limits for land use developments. These regulations place a general prohibition on the erection of

educational, residential, hospital, church or office buildings within a "controlled area" unless special acoustic screening measures are applied to ensure that acceptable interior noise levels can be maintained. The limits can be seen in TABLE 2.

TABLE 2: Noise limits for land use development (South African Department of Transport, 1999).

LAND USE DEVELOPMENT	**NOISE INDEX (NI dB)**
Schools, Universities, Churches, Hospitals	Max 60
Residential areas	Max 65
Residential areas with acoustical buildings	Max 75 (20 dBa difference between inside and outside)
Industrial areas	Max 85
Forbidden areas: no residential/commercial/ Industrial uses	More than 85

2.5 AIRCRAFT NOISE POLICY IN SOUTH AFRICA

In 1974, the South African Bureau of Standards published a Code of Practice for the determination and limitation of disturbance around an aerodrome due to the noise from aeroplanes (SABS, 1974). In an attempt to reduce or protect the general public from noise and vibration impacts, to the level more acceptable for residential development, a Code of practice 0117-1974 and a South African National Standard (SANS 10117 - 2003) were introduced. The later Code of practice was for the calculation and prediction of aircraft noise to protect the general public from noise associated with airports and controlling land use in affected areas around airports. However, it should be noted that other mechanisms for reducing aircraft noise impact were not covered in these documents.

A further relevant development in South Africa was the adoption of a "White Paper on National Policy on Airports and Airspace Management", published in March 1998. In this document, a section was devoted to integrating the airport into its environment, and

deals in general terms with the environmental impact of airports (South Africa Department of Transport, 1998a).

Recognising the need to prevent serious problems with airport noise, the South African government produced another White Paper (Draft) dealing specifically with aircraft noise and engine emissions (South Africa Department of Transport, 1998b). In this policy specific guidelines were laid down for aircraft and airport operations (curfews, noise abatement departure and arrival procedures, preferential runways, minimum noise routes, runway operations, etc.), noise modeling, monitoring and track keeping, and land use planning (Chittenden Nicks de Villiers and NM & Associates, 2001). The policy also developed a South African position on the non-addition of Chapter 2 aircraft to the fleet, and a phase-out of Chapter 2 aircraft. The non-addition rule was supposed to be enacted on 1st January 2001 and the phase-out schedule to commenced on 1st January 2003 and be completed within seven years. As of January 2002, the policy had still not been enacted, meaning that airlines were still able to continue adding noisy aircraft to their fleets.

When the "White Paper" was released for comments the airlines industry reacted to the proposals, contending that the policy would place undue economic hardship on them by forcing them to replace aircraft which still have thousands of flying hours left on the airframe. The government has since held back on implementing the policy, and bureaucratic red tape has stalled further developments (Chittenden Nicks de Villiers and NM & Associates, 2001).

As the extent of the noise problem, and its effect on people become measurable, private and government organizations have established environmental noise control efforts, particularly on land use zoning, to protect those people who are exposed to aircraft noise (Chittenden Nicks de Villiers and NM & Associates, 2001). Two issues are having negative effects on preventing the growth of aircraft noise pollution in South Africa. On the one hand, developed nations have responded to complaints about aircraft noise from their citizens, and taken steps to limit noise by complying with ICAO rules. The ICAO mandated phase-out and non-addition rules may be making a difference in developed

nations, but on a global scale the rules result in a shifting of noise from one part of the world to another where the rules have not been adopted. On the other hand, bureaucratic inertia is preventing a policy from being enacted, and which will afford some protection to land users around airports (Chittenden Nicks de Villiers and NM & Associates, 2001).

At the international scene, strategies have been put in place to combat or minimize aircraft noise problems. The U.S. Committee of Aviation Environmental Protection (CAEP) has been meeting to continue developing rules for aircraft noise reduction (European Federation for Transport and Environment, 2001). Developing countries are being left further and further behind in the effort to reduce aircraft noise exposure. Airports in South Africa are by law responsible to monitor aircraft noise at airports from 1st January 2003 with a permanent noise monitoring and flight tracking system (Chittenden Nicks de Villiers and NM & Associates, 2001). This should enable the airport environmental committee to revise and plan for the long-term mitigation of aircraft noise around the airport.

It should, however, be noted that no authority monitored or controlled the growth in aircraft noise since 1988. This situation will only change when the National Policy on Aircraft Noise and Engine Emissions is legislated assigning responsibilities to various levels of government (Chittenden Nicks de Villiers and NM & Associates, 2001).

2.6 AIR TRAFFIC GROWTH IN CAPE TOWN

In 1994, South Africa elected its first representative multi-racial democratic government. Prior to the election of the new government, the country had been subject to political pressure in the form of sanctions and boycotts, which also had the effect of suppressing growth in air traffic. As the political climate improved in the country, the rest of the world began to ease the pressure.

One positive consequence of democratization was an increase in air travel to, from, and within the country. The number of passengers is a function of the number of flights. By

all indications international tourist numbers to Cape Town have been increased and at about this time, the airline industry was also deregulated, resulting in non-state owned airlines entering the industry. Cape Town and Johannesburg International Airports, South Africa's major hubs experienced an increase from some 110000 movements in 1993 to 144000 movements in 1998, an increase of 93 movements per day (Cape Town Traffic Department, 2003). An analysis of foreign arrivals on international flights at Cape Town International Airport in 2002 indicates strong growth in foreign arrivals to the Western Cape. Data from the Airports Company South Africa shows an increase of 140000 in 2001 that is, from 356000 to 370000 at Cape Town International Airport (Cape Town City Council, 2002). Some of the movements were created by new airlines operating to South Africa; others were caused by local airlines making better utilization of aircraft (flying more hours per day), and by the acquisition of additional aircrafts (World Airnews, 1996).

The circumstances were fortunate for South African airlines at that time when they were experiencing an increase in demand for seats. Therefore, additional aircraft from airlines in noise-restricted countries were purchased because they were forced to reduce their stock of non-noise complaint aircraft. South Africa had not adopted a position on Chapter 2 aircraft (non-noise certificated aircraft such as Boeing 707, Douglas DC-8) and so South African airlines were free to acquire additional aircraft from the increasing supply of non-noise compliant aircraft. Foreign airlines had a ready market for their Chapter 2 aircraft, and many of these have been sold to South Africa (World Airnews, 1996).

A breakdown of Chapter 2 aircraft being operated by major South African airlines reveals that in 1996, there were some 19 Boeing 737-200, five Boeing 727-200, and seven BAC 1-11 aircraft being operated by the major airlines for a total of 31 Chapter 2 (World Airnews, 1996). Five years later, in 2001 there were 35 Boeing 737-200, 10 Boeing 727-2000 and 11 BAC 1-11, which totals 56 Chapter 2 aircraft (World Airnews, 2001). There are now at least 25 more Chapter 2 aircraft operating in South Africa than they were five years previously. This increase in Chapter 2 aircraft has taken place at the time when ICAO member states were reducing their stocks of Chapter 2 aircraft.

2.7 CAPE TOWN INTERNATIONAL AIRPORT AND NOISE POLLUTION

In the months of June, July and August Cape Town normally experience the wettest conditions of the year. The condition is aggravated by the regular development of an inversion layer over the Cape Flats. This atmospheric pollution sometimes deprives quick landing and taking off due to low visibility and this result into increasing the time of noise intrusion at the airport neighbourhood (Chittenden Nicks de Villiers and NM & Associates, 2001). Another contributing factor is the demarcation of a "controlled area" where aircraft noise exposure projected over 15 years exceeds a certain level and aggravating the noise problem (Chittenden Nicks de Villiers and NM & Associates, 2001). Although the legal powers were available since 1992 no such "controlled area" exists for CIA and it is the responsibility of the City of Cape Town to declare such a zone. There are, however, a number of outstanding issues that need to be attended to before the City can officially declare this "controlled area" (Chittenden Nicks de Villiers and NM & Associates, 2001).

People who live close to airports suffer more than mere annoyance from ascending and descending aircraft. Aircraft noise may significantly impact the mental and physical health of people who live below the flight paths of commercial and private airplanes. Since the 1970s, numerous studies have found aircraft noise linked to stress, hypertension, sleep disturbances, work-related performance, learning and academic performance. The adverse effects of aircraft noise (psychological effects) will be briefly explained, that the reader may understand the urgency for careful planning of urban development when an airport is operating close to residential areas.

2.8 PSYCHOLOGICAL EFFECTS OF AIRCAFT NOISE

2.8.1 Annoyance and activity disturbance

Annoyance is a common psychological response to noise (Mclean and Tarnopolsky, 1977; Tarnospolsky et al. 1980) and is defined as feeling bothered by noise disturbance or

displeasure associated with any agent or condition, such as conversation, rest interference, (WHO, 1980) fatigue or headache (Stansfeld et al., 1985). Daily exposure to environmental stressors can create annoyance and decrease the quality of life for those who view it as unnecessary and uncontrollable (Cohen et al., 1986).

There are extensive reviews of studies on people disturbed by noise from nearby highways, railways and airports (Tempest, 1985; Fay, 1991; Kryter, 1994; Berglund and Lindvall, 1995). The Health Council of The Netherlands (1999) in its report entitled "Public Health Impact of Large Airports" summed up the findings of numerous noise related health studies as follows: "The reported non-auditory effects in noise range from social-psychological effects such as annoyance, effects on mental health, effects on sleep, effects on performance to stress-related health effects such as hypertension and ischaemic heart disease".

Potential psychological effects associated with noise include interference with speech communication, sleep disturbance, learning effects, disturbance and work performance effects. Many findings from previous studies report that there is little reliable evidence on the relationship between noise exposure and mental health (Taylor et al., 1987). Despite the need for additional research linking noise to health, Passchier-Vermeer and Passchier (2000) still concluded that exposure to noise constitutes a health risk.

Even if we believe that the link between noise and health has not yet been strongly affirmed, we cannot deny the fact that individuals exposed to repeated aircraft noise experience a poorer quality of life. Asked how noise interfered with their lives, people living near airports reported that they cannot keep their windows open, sleep, listen to radio or television, and talk on the telephone or converse with others in their homes (Bronzaft, et al., 1998). The nearly seventy percent of the people in the Bronzaft et al. (1998) study who answered that they were bothered by aircraft noise could be characterised as suffering from fatigue, aggravation, and anger leading to annoyance. Similar findings were reported by the Okinawa Prefectual Government (1999).

2.8.2 Sleep disturbance

Disturbance of sleep by noise is often the underline reason for noise annoyance (Stream, 1980). Sleep disturbance is a major noise concern of residents near airports. Exposure to any noise source and in particular in this case aircraft noise, can induce disturbance to sleep in momentary alterations of natural sleep patterns or depth, and awakenings (Berglund et al., 1990). Sleep is essential for good physical and emotional health and noise can interfere with sleep even when the sleeper is not consciously awakened by noise. The extent to which environmental noise affects human sleep patterns varies from individual to individual. Whether an individual is aroused by a noise depends upon the individual's sleep state and sleep habits, the loudness or suddenness of the noise, the information value of the noise, and other factors. When the noise source emanates from outdoors, as is the case with aircraft noise, additional factors affect the loudness of the noise as heard indoors. The noise level reduction provided by the type of structure is one of these determinants. A greater variable though, is whether windows are open or closed. In addition, most people adapt over time to increased levels of noise during sleep (California Department of Transportation, 1993).

2.8.3 Interference with speech communication

One of the most prominent effects of noise on human activities is the interference with speech communication. Speech interference by noise is also annoying (Mulholland and Attenborough, 1981) and communication interference by noise causes widespread annoyance (Loeb, 1986; Smith 1991). Residents around two airports in Canada, Toronto (International) and Oshawa (Municipal) (Taylor et al. 1981) showed the percentage of people highly annoyed was considerable for both airports. In France, The Netherlands and the UK, 80 per cent of people were annoyed at 55 NNI (Vallet et al., 1988). Speech communication interference may reduce understanding of conversation in classrooms and classroom teaching (learning effects) and performance of work involving speech communication with 100 percent intelligibility throughout a typical residential room (talker/listener separation greater than approximately 3.5 feet) is 45dB. A 95 percent intelligibility, considered to be "satisfactory conversation" can be obtained with a steady

sound level of up 64dB. When the noise level approaches 80dB, intelligibility drops to near zero even when a loud voice is used (U.S. Environmental Protection Agency, 1978). The interference of speech associated with aircraft noise is a primary source of annoyance to individuals. The disruption of leisure activities, such as listening to the radio, television, music, and conversation, gives rise to frustration and irritation. Adequate speech communication is important in classrooms, homes, offices, and industry settings. The degree to which noise interferes with indoor speech depends not only on physical factors such as noise levels, distance between the speaker and the listener, and room acoustics, but also on non-physical factors such as the speaker's enunciation and the listener's interest in, and familiarity with, the topic (Vallet et al., 1988).

2.8.4 Performance effects

Work performance can also be potentially affected by aircraft noise through speech communication interference, and increased fatigue. A specific relationship between intermittent aircraft noise and decreased work performance has not been documented (Evans et al., 1995).

Epidemiological studies have shown that people in noisy residents have significantly higher rates of cardiovascular problems than those in quiet homes (Evans et al., 1995). Other studies on metabolism, body steadiness, distance judgement, and many other activities show no evidence of any disturbance by noise. Many dose- response relationships have been studied on long-term exposure in residential areas that causes annoyance and complaints. While no dose-response relationship has been found relating noise and health effects, excluding hearing loss, there have been levels of sound identified that are considered safe (Evans et al., 1995).

2.8.5 Effects of aircraft noise on children's learning

Well designed and controlled studies have demonstrated that exposure to high levels of aircraft and environmental noise can adversely affect reading ability in school-age children. Maser et al. (1978) reported that children who attended school beneath the

Seattle-Tacoma airport paths showed a deficit on standardized tests of scholastic achievement compared to students in quiet schools.

Interference with classroom activities and learning from aircraft noise has been the subject of much research recently. Some interference with classroom activities can be expected from noise events that interfere with speech. Speech communication interference begins at 65 dB, which is the level of normal conversation. Typical classroom construction attenuates outdoor noise by 20 dB with windows closed and 12 dB with windows open. Therefore, some interference in classroom activities can be expected at outdoor levels of 77 to 85 dB (Fidell et al., 1995). A complicating factor in research regarding schools and aircraft noise is the extent to which background noise from within the classroom affects the results. Additionally, the quality of schools and socio-economic factors are difficult to isolate and control for in research (Fidell et al., 1995).

A study performed on children at four elementary schools exposed to greater levels of aircraft-related noise suggest that the exposure to aircraft noise affects the motivation and cognitive abilities of children. The study suggests that the exposure to high intensity of noise can induce feelings of helplessness, which occur when an individual cannot control or change a stressful event. This feeling of helplessness can decrease the motivation to initiate a new task. The study also suggests that children who grow up in noisy environments become inattentive to sound by tuning it out. When this inattention leads to tuning of speech, it may lead to reading and learning problems (Cohen et al., 1980).

A Cornel study suggests that children who attend school in areas affected by aircraft noise have more difficulty with language acquisition. The researcher suspect that other factors at schools in neighbourhoods exposed to aircraft noise may affect learning, including teacher and parent irritability and their reluctance to talk, due to interference with speech communication (Evans et al., 1995).

A study performed with children near Munich International Airport indicated selective impairment in cognitive functioning among children from communities with high noise

levels of aircraft noise. This study also indicated that children may cope with noise by developing cognitive strategies of tuning out noise, which may affect their language acquisition and speech processing (Evans et al., 1995). Studies performed at Heathrow Airport in London, suggest that chronic exposure to aircraft noise is associated with school performance in reading and math, but that this association is influenced by socio-economic factors (Stanfield et al., 2000).

Evans and Lapore (1993) found that children living or attending school near a major airport were more likely to have elevated blood pressure. When a new airport was opened in Munich, Evans and his colleagues were able to demonstrate a relationship between chronic noise exposure and elevated neuroendocrine and cardiovascular measures (Evans et al., 1995). Also addressing the impact of aircraft noise on children is the study by the Okinawa Prefectual Government (1999) that found that children exposed to aircraft noise are likely to: "...easily catch cold, have a poor appetite, and take a long time to make friends."

METHODOLOGY

3.1 RESEARCH DESIGN

This was a descriptive study that used unstructured oral interviews, observations, an open-ended and closed structured questionnaire, to ascertain the responses of residents and schools to the aircraft noise (APPENDIX 4A and 4B). Bishop Lavis was chosen as an experimental area and Kensington as a control area. According to Huysamen (1994) questionnaires are used to obtain information from respondents about biographical particulars (age, education, qualification, etc), typical behaviour (what they favour), opinion and attitude. The data was collected between April and July 2004.

3.2 PILOT STUDY

A pilot study to test the procedure, the questionnaires, and its reliability was conducted at Delft as an experimental area and Langa as a control area on 40 residents and 2 schools respectively. These were not part of the sample residents. The questionnaire was modified accordingly. The response rate of the pilot study was 65% and 60% at Delft and Langa respectively which was adequate, but it was felt that further action needed to be taken to improve this response rate to the estimate of within 80-94% as anticipated. This involves choosing nonworking days (weekends) for the administering of the questionnaires to ensure that nearly everyone targeted might be at home.

3.3 STUDY POPULATIONS AND SAMPLING

The study populations were 800 and 838 households, which were the numbers of households that fall within the study area of Bishop Lavis and Kensington, respectively. Both in the experimental area and the control area, the lists of households were extracted from maps received from the Cape Town City Council. The lists contained land

registered numbers (erf) and house / streets numbers (APPENDIX 1A and 1B). To avoid bias a random number table (APPENDIX 2) was used to draw a random sample to represent households from the study areas. The house numbers that were taken into consideration since one erf number could carry more than one house as in the case of flats or maisonettes. Some of the erf numbers were for houses used only as offices some not even built or occupied by dwellers. House numbers that appeared repeatedly were chosen only once and others ignored. This strategy was employed to ensure that the final sample was representative of the population. There were no differences in socio-demographic variables between the experimental area and the control area.

The choice for the experimental area was based on: (1) its location close to the airport; and (2) for the fact that it lies under the flight path of aircraft arrival and departure. While the control group was chosen because: (1) its distance away from Cape Town International Airport (17km); (2) an assumption that airport aircraft noise may not have any serious effects at such a distance. From previous studies as cited by (Berglund et al. 1990), complaints appear to be received as far away as 7 to 10km away from major airports.

Both at the experimental area and at the control area, a sample size of 40 people that was pilot-tested at Delft and Langa was deemed inadequate to be the representative of the population. Since a 50% non-response rate was anticipated, the sample size was doubled. The total sample was worked out to be 83, composed of 80 households and 3 schools at Bishop Lavis (experimental area) and Kensington (control area), respectively.

3.4 SELECTION OF SCHOOLS

It was important that bias should not be introduced in the selection of schools. The method used to select the schools to take part in the study was done through a site inspection in both potential experimental and the control area schools. The author discovered only three high schools located within each of the study areas. Only the head teachers were asked to respond on behalf of their respective schools.

3.5 PROCEDURE AND ETHICAL MEASURES

Letters were addressed to the targeted groups at Bishop Lavis and Kensington on the 20th of May 2004 by the author seeking their consent to take part in this research. Their contact addresses were obtained during the handing out of these letters. After a week the residents were contacted telephonically to make appointments for the 5th or 6th of June 2004. At the experimental area, the whole process took place from 9 am. to 5 pm., and the control area's data was collected in the following weeks.

The questionnaires were designed in English and were self-administered by the researcher. Spaces were provided where respondents' opinions or comments were ticked or filled in with a pencil, giving room for corrections if necessary. In situations where language problems were encountered an instant interpreter was negotiated for assistance though this was not commonly experienced.

The local residents and head teachers were approached and asked for permission to conduct the study in their residents and schools, respectively. Ethical measures that were used in this study included residents and schools gave written consent for participation; the said participants were free to withdraw from the study at any point and did not have to answer any question they did not want to. The study was introduced as "effects of noise in the environment" to the participants (APPENDIX 3). This introduction did not focus on aircraft noise. This was done to avoid response bias, a technique successfully used in previous studies (Job et al., 1991). Many procedures were adopted to increase the likelihood of obtaining reliable results. Question order effects were accounted for by controlling, and modifying it as far as practically possible. Aircraft noise questions were embedded in the health question sections and other types of environment noise question sections to counter the possibility of "halo effects" biasing responses.

3.6 DESCRIPTION AND CHARACTERISTICS OF THE QUESTIONNAIRES

The questionnaire was designed similar to and based on earlier investigations by (Mclean and Tarnopolsky, 1977; Tarnopolsky and Morton-Williams, 1980) Jue et al. 1984; Diamond and Rice, 1987) with standard commonly used questions. It was designed in a form that made it easy for residents to answer the question. Social surveys to assess human reaction (Hade and Bullen, 1982; Huysaman, 1994) require respondents to give the rating of their feelings in relation to particular annoying factors. Questions should therefore include the word directly relate to psychological effects "annoyance". This recommendation was adopted in the Tehran survey. Residents were encouraged to include individual perceptions on health, communication and satisfaction in relation to aircraft noise and to rate their feelings using the descriptive phrase "never" "rarely" "occasional" "often" "very often".

Noise characterisation is essential if we are to begin to understand which types of noise evoke the most complaints. For example, it is possible that the content and character of the noise may be more important than the actual noise level. Consideration must also be given to factors such as the time of day that the noise occurs and the duration of each occurrence, since it is likely that both of these may moderate the effect of the noise (Berglund et al., 1990).

3.6.1 Psychological effects

Psychological effects of aircraft noise deals with the reaction of the mind and how it works, and how the noise is perceived in relation to mental characteristics and internal feelings such as stress, emotion, irritation, anger, annoyance etc (Fields et al., 1998).

3.6.1.1 Annoyance

Annoyance is the most commonly cited outcome of disturbance by noise (Fields, 1992). Noise annoyance is measured in this study using the question format proposed by Fields et al. (1998), which includes both verbal (never, rarely, occasional, often, very often) and

numerical (1 to 10 scale where 1 equals not at all annoyed and ten equals extremely annoyed), rating scales to assess the level of annoyance caused by each specific noise source and the overall level of noise. For the purpose to check for within-test reliability or internal consistency, the numerical disturbance scales have also been included as suggested by Hall and Taylor (1982) (1 to 10 scales where one equals not at all disturbed and ten equals extremely disturbed) for specific sources and overall level of noise. In an attempt to overcome the confounding effects of response bias and practice effects, the later scales appeared separately from the other annoyance scales, appearing later in the questionnaire following the questions relating to activity disturbance.

3.6.1.2 Activity disturbance

Activity disturbance is an important effect of exposure to noise. This is particularly true since the amount of activity disturbance may influence the level of annoyance experienced. It may also be the case that different noise sources are differentially disturbing for different activities. The categories of activity disturbance included in the questionnaire are essentially the same as those utilised by the Berkshire Research Ethics Committee (BRE) in the Noise Attitude Survey and the Sydney Quality of Life Survey 1994 (Stansfeld and Haines, 1997). The Jenkins Sleep Scale (Jenkins et al. 1988) is a five-item scale to measure annoyance on sleep disturbance, incorporating items on difficulty getting to sleep, early waking in the night and post-sleep fatigue. In this study the five-item of Jenkins et al. (1988) was used which includes the endorsement of the options (very quiet, quiet, loud, very loud, leaves a ring in my ears). Sleep disturbance is another commonly reported outcome of exposure to unwanted noise. Sleep is a physiological necessity, which, if insufficient, can have an adverse impact on health and well-being and may influence other variables such as annoyance.

3.6.1.3 Emotional response

Emotional response to aircraft noise is a further outcome variable that must be considered if we are to have an adequate understanding of the subjective nature of the effects of noise. Unwanted noise can elicit a number of emotional reactions, including anger, fear or depression to name a few. It is likely that the overall effect of the noise will depend to

some extent on which of these the participants' experiences. Previous research has shown, for example, that more annoyance is experienced when the noise makes the individual feel fearful (Fields, 1992). Furthermore, it is likely that noise that makes a person feels depressed, for example, will be more prejudicial to health than a noise which merely causes mild irritation. The emotional response scale is similar to that used in the BRE National Noise Attitude Survey but with the omission of positive response options which were felt to be inappropriate in this context since participants are unlikely to experience favourable emissions when subjected to the noise about which they are complaining.

3.6.2 Coping Strategy

To assess coping strategy the respondents were asked to state those behaviours in which he or she engages when the noise occurs. This includes avoidance, ignoring the noise / denial that the noise does not harm, closing their windows and doors etc. Coping with the noise, or rather the strategy employed by resident in his/her attempts to cope with the noise has been shown to have an effect on subjective health outcomes (Lercher, 1996). These strategies are associated with significantly higher degree of annoyance. Noise sensitivity is a concept that was invoked to explain the considerable difference in noise tolerance between individuals at a given level of noise exposure (Stansfeld, 1992). It is a concept that has proved difficult to define. However, according to Job (1999), "noise sensitivity refers to the internal states (be they physiological, psychological (including attitudinal), or related to life style or activities conducted) of any individual which increase their degree of reactivity of noise". Noise sensitivity is important because health effects of noise have been found to correlate more closely with reaction than with actual noise exposure. In this study, as is usually the case, noise sensitivity is measured by the responses of the respondents on aircraft noise impact. Due to constraints upon the time taken to complete the questionnaire, it was not considered possible or appropriate to include a multiple-question scale of noise sensitivity. However, in an attempt to improve reliability, two single numerical rating scale a verbal "degree of annoyance" question

measures of noise sensitivity have been incorporated as opposed to one (Tarnopolsky and Morton -Williams, 1980).

3.6.3 The environment

Various environmental factors that may potentially influence the effect of aircraft noise are covered by the questionnaire. These include the number of people living in the household, number of learners in schools, health, general neighbourhood satisfaction, duration of occupancy, etc. This information is essential if we are to understand which environmental factors increase vulnerability to noise and the likelihood of a complaint being made.

RESULTS

4.1 GENERAL COMMUNITY RESPONSES

From a sample of 80 people in the experimental group, a total of 68 were successfully interviewed, giving a response rate of 85%, representing 9% of the total population of the experimental group. At the control group, from a sample of 80 people, 70% were successfully interviewed giving a response rate of 88%, representing 8% of the total population intended for the study. It was not possible to establish whether the non-respondents of 15% and 13%, experimental and the control area respectively, would have biased the outcome. The response rate of the study in both the experimental area and control area as evident in TABLE 3 was high. There was possibility that the result could be interpreted.

TABLE 3: The community response rate in the experimental area compared to that of the control area.

	Experimental group (Bishop Lavis) ELEGIBLE SAMPLE (N = 80)	**%**	**Control group (Kensington) ELEGIBLE SAMPLE (N = 80)**	**%**
Participated	68	85	70	88
Non response rate	12	15	10	13

TABLE 4: Length of time residents are living in the experimental area compared to that of the control area.

Number of years	**Experimental area**	**Control area**
1 to 5	38 (55%)	35 (50%)
6 to 10	30 (44%)	35 (50%)

TABLE 5: Number of persons living in a household at the experimental area compared to the control area.

Number of persons	Experimental area (N = 68)	Control area (N =70)
1 to 4	48 (71%)	45 (64%)
> 5	20 (29%)	25 (36%)

TABLE 6: The number of children > 5 years in a household at the experimental and at the control area.

Number of children	Experimental area	Control area
> 5 years	6	4

TABLES 4, 5 and 6 show the general information regarding the households from which respondents were drawn.

TABLE 7: Responses on general complaints related to noise at the experimental area compared to the control area.

Complaints	Experimental area (N =68)	Control area (N =70)
Hearing problems	4 (6 %)	1 (1%)
Sleeping	40 (59%)	12 (17%)
Communication	39 (57%)	8 (11%)
Domestic animals disturbance	2 (3 %)	0 (0 %)
Cracks on the wall	3 (4%)	0 (0 %)

TABLE 7 contains complaints from respondents from both the experimental and control area. It is noticeable that sleeping and communication problems were the main complaints among respondents from the experimental area. Cracks were not noticeable on houses in the control area.

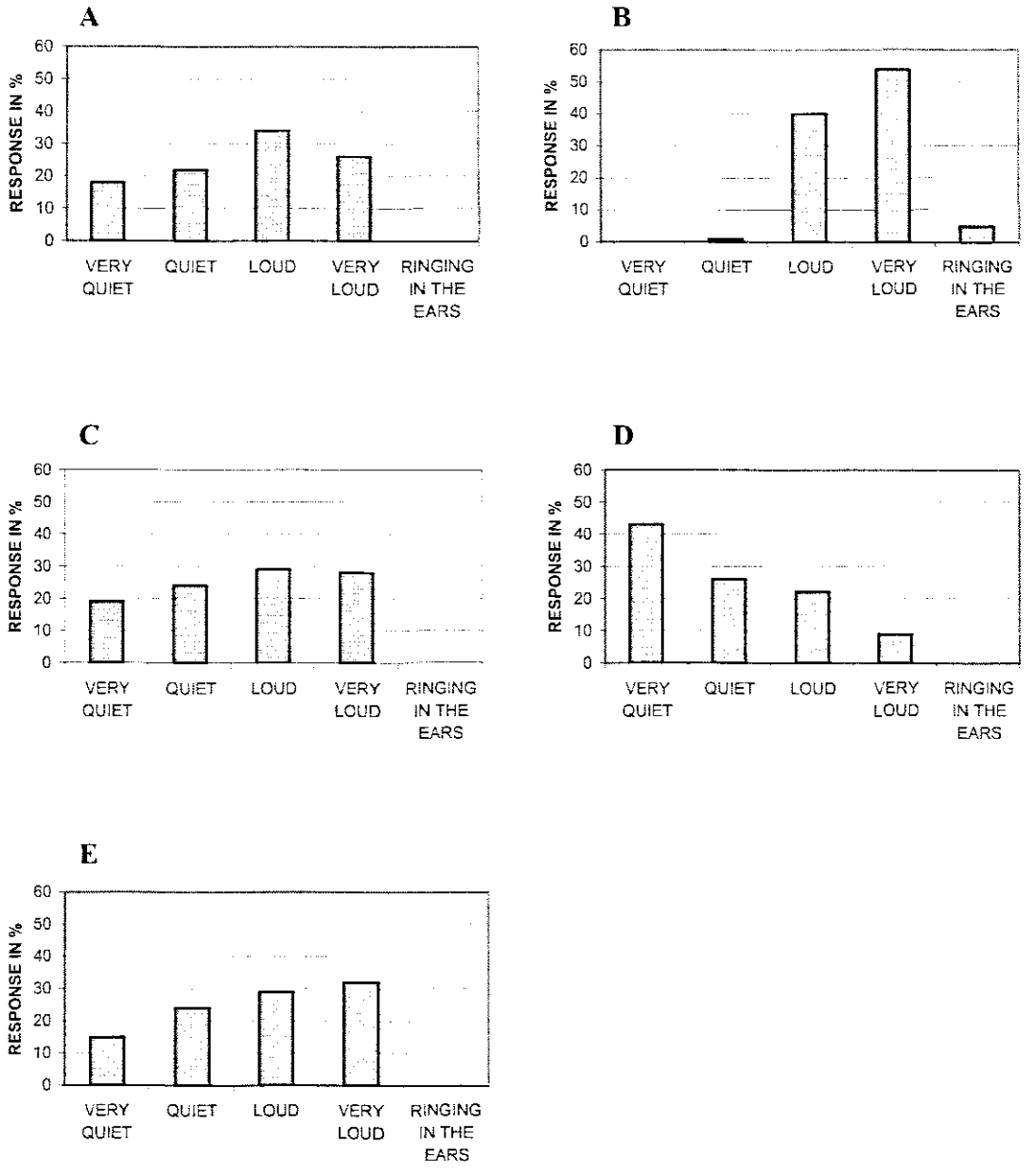

FIGURE 2 A: Responses on the feelings of loudness when exposed to different types of noise sources at the experimental area (N = 68). A = Noise in general, B = Aircraft noise, C = Traffic noise, D = Train noise, and E = Neighbourhood noise.

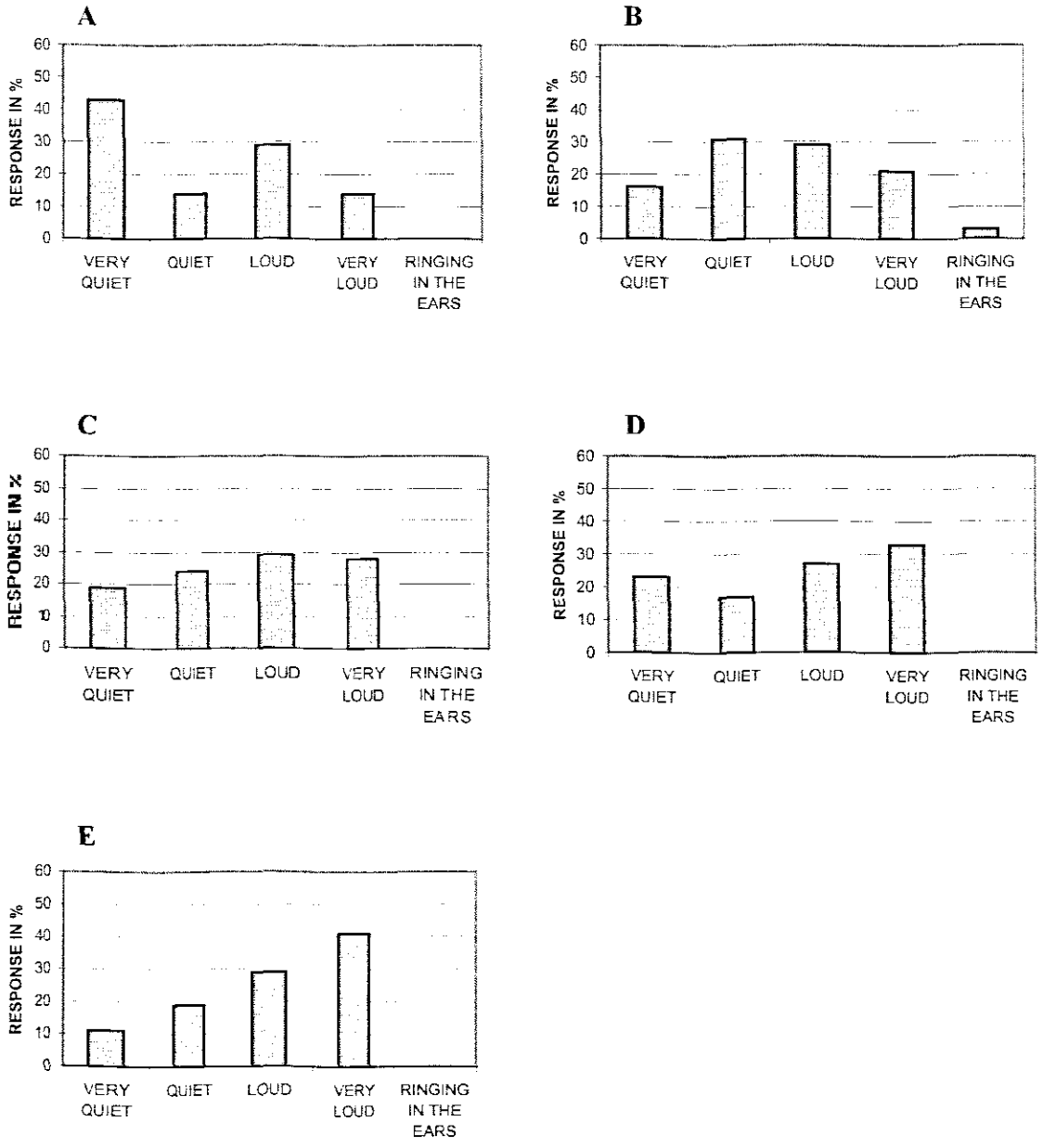

FIGURE 2 B: Responses on the feelings of loudness when exposed to different types of noise sources at the control area (N = 70). A = Noise in general B = Aircraft noise, C = Traffic noise, D = Train noise, and E = Neighbourhood noise.

4.2 LOUDNESS OF DIFFERENT SOURCES OF NOISE

The respondents' "feelings of loudness" when they are exposed to various sources of environmental noise at the experimental area is shown in FIGURE 2 A. Respondents rated aircraft as worst in terms of loudness with 54 % claiming that they perceive aircraft noise "very loud" and 5% saying that it leaves a ringing sound in their ears, while all other noise sources registered nothing on this particular question option. Aircraft noise is followed by neighbourhood noise, traffic noise and noise in general in terms of loudness (FIGURE 2 A [a, c & e]). Not a single respondent rated aircraft noise as "very quiet" and only one respondent rated it as being "quiet" at the experimental area.

The "feelings of loudness" of respondents at the control area for various sources of environmental noise is shown in FIGURE 2 B. Respondents rated neighbourhood noise as the worst problem, followed by traffic noise. Aircraft noise was rated as the fourth worst problem. Unexpectedly 3% of the respondents at the control area claimed that aircraft noise leaves a ringing sound in their ears. However, 43% and 14% of respondents rated aircraft noise as being "very quiet" and "quiet", respectively.

4.3 ACTIVITY DISTURBANCE

TABLE 8 A: Activities disturbance by the aircraft noise at the experimental area (N =68).

Activities	**Never**	**%**	**Seldom**	**%**	**Some-times**	**%**	**Often**	**%**	**Very Often**	**%**
Listening to T.V, Radio, Music	4	6	2	3	6	9	25	37	31	46
Having Conversation (Including Phone)	2	3	4	6	10	15	18	26	34	50
Sleep /Resting	3	4	5	7	13	19	20	29	27	40
Having Meals	30	44	18	26	8	12	7	10	5	7

TABLE 8A: Shows how activities were disturbed by aircraft noise in the experimental area. Most activities were disturbed by aircraft noise, with "often" and "very often"

receiving the most responses. The only listed activity that was not significantly affected by aircraft noise was "having meals".

TABLE 8 B: Activities disturbance by the aircraft noise at the control area (N =70).

Activities	Never	%	Seldom	%	Some-times	%	Often	%	Very often	%
Listening to T.V, Radio, Music	35	50	14	20	11	16	7	10	3	4
Having Conversation (Including Phone)	37	53	15	21	12	17	5	7	1	1
Sleep /Resting	40	57	16	23	10	14	3	4	1	1
Having Meals	47	67	12	17	7	10	2	3	2	3

Aircraft noise did not disturb activities to a significant degree in the control area. Between 57% and 23% of the respondents felt that aircraft disturbed activities "never" or "seldom" for each of the activity choices. More or less 10% of the respondents felt that aircraft noise disturbed their activities "often" or "very often" (TABLE 8 B). 67% felt that aircraft noise "never" disturbed them when they are "having meals".

4.4 EMOTIONAL RESPONSES

TABLE 9 A: Emotional responses to aircraft noise at the experimental area (N =68).

Emotions	Never	%	Seldom	%	Sometimes	%	Often	%	Very Often	%
Irritated	1	1	1	1	4	6	25	37	37	54
Annoyed	2	3	7	10	5	7	21	31	33	49
Stressed	4	6	9	13	12	18	18	26	25	37
Depressed	3	4	2	3	7	10	22	32	34	50

The emotional responses of respondents to aircraft noise at the experimental and control area were measured in terms of being irritated, annoyed, stressed and / or depressed (Tables 9 A and B). At the experimental area 37% and 54% of the respondents felt that

they were "often" and "very often" irritated and depressed respectively with aircraft noise. Forty nine percent of the respondents felt annoyed "very often", while 31% were "often" annoyed. The majority of the respondents at the experimental area were stressed because of the aircraft noise exposure. Twenty six percent of the respondents felt that they were "often" stressed while 37% felt that they were "very often" stressed. Aircraft noise made 50% of the respondents "very often" depressed, 32% "often" depressed, and 10% "sometimes" depressed (TABLE 9 A).

TABLE 9 B: Emotional responses to aircraft noise at the control area (N =70).

Emotions	Never	%	Seldom	%	Sometimes	%	Often	%	Very Often	%
Irritated	23	33	20	29	19	27	5	7	3	4
Annoyed	38	54	21	30	6	9	4	6	1	1
Stressed	40	57	20	29	8	11	2	3	0	0
Depressed	37	53	17	24	9	13	4	6	3	4

In contrast to the experimental area, respondents in the control area reacted very differently in terms of emotional responses to aircraft noise. Less than 10% of the respondents felt that they were "often" or "very often" irritated, annoyed, stressed or depressed due to aircraft noise. More than 50% of the respondents felt that they were "never" annoyed, stressed or depressed due to aircraft noise (TABLE 9 B).

4.5 ANNOYANCE

TABLE 10 A: Annoyance when exposed to aircraft noise and other different sources of noise at the experimental area (N = 68).

Sources of noise	Never	%	Rarely	%	Occa-sional	%	Often	%	Very Often	%
Noise in general	4	6	2	3	8	12	34	50	20	29
Aircraft noise	0	0	3	4	10	15	24	35	31	46
Traffic noise	9	13	5	7	12	18	20	29	22	32
Noise from train	18	26	16	24	22	32	7	10	5	7
Noise from neighbours	2	3	5	7	14	21	27	40	20	29

TABLE 10 B: Annoyance when exposed to aircraft noise and different sources of noise at the control area (N =70).

Sources of noise	Never	%	Rarely	%	Occa-sional	%	Often	%	Very Often	%
Noise in general	15	21	7	10	10	14	22	31	16	23
Aircraft noise	25	36	18	26	7	10	8	11	12	17
Traffic noise	12	17	8	11	11	16	16	23	23	33
Noise from train	5	7	12	17	19	27	9	13	25	36
Noise from neighbours	3	4	6	9	19	27	27	39	15	21

When the level of annoyance due to aircraft noise is compared between the experimental area (TABLE 10A) and the control area (TABLE 10B), it is noticeable that respondents from the experimental area are more annoyed by the aircraft noise than those from the control area (Table 10 A & B). A puzzle in this finding was on train noise at the control area, where 36% of the respondents felt annoyed despite their far distance from the rail track.

TABLE 11 A: A single numerical rating scale to test the "degree of annoyance" and "disturbance" of aircraft noise sensitivity by the respondents at the experimental area (N =68).

1 = Not at all annoyed					**10 = Extremely annoyed**				
1	2	3	4	5	6	7	8	9	10
2	2	4	6	8	5	4	7	12	18
(3%)	(3%)	(6%)	(9%)	(12%)	(7%)	(6%)	(10%)	(18%)	(26%)
N = 22 (32%)					N = 46 (68%)				

1 = Not at all disturbed					**10 = Extremely disturbed**				
1	2	3	4	5	6	7	8	9	10
2	4	4	8	5	4	3	6	14	18
(3%)	(6%)	(6%)	(12%)	(7%)	(6%)	(4%)	(9%)	(21%)	(26%)
N = 23 (34%)					N = 45(66 %)				

On a 1 – 10 scale, respondents from the experimental area rated aircraft noise to be generally annoying. 68% of respondents rated aircraft noise between 6 and 10 on the annoyance scale (Table 11 A). Twenty six percent of the respondents rated aircraft noise as 10 and 18% rated it at 9. The third highest rating, namely 12% was interestingly enough at the middle of the scale at 5. A low percentage on the opposite side of the scale indicates that they are "not at all annoyed" by aircraft noise. On the disturbance scale 66% of the respondents rated aircraft noise between 6 and 10. The highest ratings went to 9 and 10 receiving 21% and 26% respectively (TABLE 11 A). Responses on the less disturbed side of the scale were significantly lower.

TABLE 11 B: A single numerical rating scale, to test the "degree of annoyance" and "disturbance" of aircraft noise sensitivity by the respondents at the control area (N =70).

1 = Not at all annoyed					**10 = Extremely annoyed**				
1	2	3	4	5	6	7	8	9	10
7	12	10	11	13	3	2	5	4	3
(10%)	(17%)	(14%)	(16%)	(19%)	(4%)	(3%)	(7%)	(6%)	(4%)
N = 53 (76%)					N = 17 (24%)				

1 = Not at all disturbed					**10 = Extremely disturbed**				
1	2	3	4	5	6	7	8	9	10
5	3	11	15	25	2	1	0	3	5
(7%)	(4%)	(16%)	(21%)	(36%)	(3%)	(1%)	(0%)	(4%)	(7%)
N = 59 (84%)					N = 11 (16%)				

At the control area, aircraft noise received very different ratings on the annoyance and disturbance scales (TABLE 11 B). Seventy six percent of the respondents rated aircraft between 1 and 5 in terms of annoyance. Eighty four percent rated aircraft noise between 1 and 5 in terms of disturbance.

4.6 COPING STRATEGY

Most of the responses on coping strategy at the experimental area indicated that they ignore and pretend that the noises do not bother them and that they "are use to" it. However, 15% did mention that they close their windows and doors to reduce the noise intrusion in their homes. No coping strategy was being employed at the control area since they do not experience high level of aircraft noise.

4.7 RESPONSES AT SCHOOLS

Teachers of children at schools of the experimental area had been teaching in these schools between 6 to 8 years while those of the control area had been teaching in the schools for a period of between 4 to 12 years. Of the six teachers that responded on behalf of their schools, three were at Bishop Lavis schools and three at Kensington schools. Student enrolment at the experimental area and the control area ranges between 1500 and 2000 students.

4.7.1 School results

TABLE 12: Percentage pass rates of schools at the experimental area and the control area.

BISHOP LAVIS (N = 3)					**KENSINGTON (N = 3)**			
Year	School 1	School 2	School 3	Av	School 1	School 2	School 3	Av
1999	90 %	88 %	91 %	90	92 %	92 %	95 %	93
2000	92 %	91 %	80 %	88	93 %	89 %	91 %	91
2001	93 %	89 %	87 %	90	96%	94 %	94 %	95
2002	89 %	94 %	90 %	91	90 %	92 %	89 %	90
2003	94 %	92 %	84 %	90	88 %	93 %	95 %	92

The average academic results of the three schools at the experimental area (TABLE 12) were as follows: 1999 - 90 %, 2000 - 88 %, 2001 - 90 %, 2002 - 91 % and 2003 - 90 %, while at the control area the average schools results were as follows: 1999 - 93%, 2000 - 91 %, 2001 - 95 %, 2002 - 90 %, 2003 - 92 %. There was no significant difference between the school results of the experimental area and the control area from 1999 to 2003, except for 2001 where the schools at the control area had a higher pass rate. One of the head teachers at the experimental area stated that three children were having hearing problems. However, no medical test had ever been done to confirm the causes.

Two head teachers at the experimental area responded that they always stop lectures for a moment when aircraft pass overhead. This was not the case at the control area where the response on that question item was 0%. One of the coping strategies as mentioned by one teacher is that they always close the windows and the doors to reduce the noise impact of a passing aircraft and nothing was recorded at the control area since they do not experience such high levels of an aircraft noise. From personal observation, there was a crack on the wall of one of the school buildings at the experimental area, of which one of the head staff attributed it to aircraft noise vibration but this type of damage was not noticed at the control area.

4.7.2 Annoyance at schools

TABLE 13 A: Responses at schools on level of annoyance when exposed to different noise sources at experimental area (N = 3).

Sources of noise	**Never**	**%**	**Rarely**	**%**	**Occa-sional**	**%**	**Often**	**%**	**Very Often**	**%**
Noise in general	0	0	0	0	0	0	1	33	2	67
Aircraft noise	0	0	0	0	0	0	0	0	3	100
Traffic noise	0	0	0	0	1	33	1	33	1	33
Noise from train	0	0	1	33	2	67	0	0	0	0
Noise from neighbours	0	0	0	0	0	0	1	33	2	67

TABLE 13 B: Responses at schools on level of annoyance when exposed to different noise sources at the control area (N =3).

Sources of noise	**Never**	**%**	**Rarely**	**%**	**Occa-sional**	**%**	**Often**	**%**	**Very Often**	**%**
Noise in general	0	0	0	0	0	0	2	67	1	33
Aircraft noise	2	67	1	33	0	0	0	0	0	0
Traffic noise	0	0	0	0	0	0	0	0	3	100
Noise from train	0	0	1	33	1	33	1	33	0	0
Noise from neighbours	0	0	0	0	1	33	1	33	1	33

Annoyance levels to aircraft noise were significantly higher as revealed by the responses at the experimental area (TABLE 13 A), while that of the control group (TABLE 13 B) was low. The respondents at schools in Bishop Lavis rated annoyance due to aircraft noise at 100% for "very often". At Kensington for which 67% of the respondents stated that, they have "never" been annoyed by aircraft noise. On the contrary, at the control area it was traffic noise that was rated as 100 % for "very often" annoying. At all three schools in the control area, aircraft noise was perceived rarely or never annoying (TABLE 13 B).

DISCUSSION

5.1 GENERAL COMMUNITY RESPONSES

Airport noise is particularly problematic in that impact areas are huge and airports located far from urban centres tend to attract residential areas. The type of land which airports require (cheap and flat) also attracts informal single-family dwellings. As a result, airports are often surrounded by land use types, such as residential areas, which are most unsuitable for residential purposes due to the aircraft noise. Land use planning and management should be effective to ensure that activities nearby the airports are compatible and the goal should be to minimize the population affected by aircraft noise. This could be achieved by introducing land use zoning and ensuring that the compatibility should not be offset by further residential development. The levels of noise in a community can have an impact on the quality of life of the people. Noise pollution has previously been recognised as a serious health hazard (Bies and Hensen, 1996). Thus, if commercial and general aviation are going to expand, or at least continue to operate without public nuisance, a solution must be found to the noise problem. Although in the present study, complaints were received from areas as far as 17km (control area) from the airport where 3% respondents stated that aircraft noise cause "ringing in the ears" (FIGURE 2 B [b]). The majority of the respondents both at experimental and control area respectively were people who have been living in the areas long enough to be able to rightly give their opinion about the areas (TABLE 4).

Most communities situated close to the Cape Town International Airport are mostly people with relatively low income and often have more pressing problem to deal with than the aircraft noise. They can be expected to grudgingly tolerate a noisy home/ environment if this is the only place where they can have their homes. According to Johnston (1989) this apparent apathy is more likely a manifestation of Maslow's hierarchy of needs: "A community will remain relatively insensitive to noise as long as

its more basic needs, such as food, shelter, security and employment are not adequately met". In the present study residents of the experimental area are not much inclined to leave the area despite the high levels of aircraft noise that they are complaining. This might have been due to social and economic ties amongst these residents. Through casual conversation a number of respondents in the experimental area expressed concern about aircraft crashing in their area, although the main points of concern were interference with sleeping, hearing problems, disturbance during communication both telephone/conversation and concentration on reading (TABLE 7). According to one resident at Bishop Lavis "every time an aircraft flies over the house the television loses its signal and the house shakes and rattles". Other residents stated that houses in Bishop Lavis were poorly equipped to provide any insulation against aircraft noise. It is therefore clear that even in low socio-economic status neighbourhood, aircraft noise is a serious problem and perceived as such. It can be hoped that the more basic needs will be satisfied ultimately, but in the meantime vulnerable communities should be identified and measures such as improving the quality of housing infrastructure and services put in place to reduce this already exposed vulnerability and the noise ills.

Concern over aircraft noise led the United States Air Force to sponsor a series of investigations on the response of residents of an airport neighbourhood (Galloway and William, 1974). Community reactions were measured through interviews and attitude surveys and through observation of overt citizen actions. Reactions ranged from sporadic complaints to co-ordinated group efforts to shut down airports. Rosenblith and Stevens (1953) established a model for relating aircraft noise intrusion and the probable community reaction. The model specified eight factors, which influence community response: (1) magnitude of the noise with a frequency weighting relation to human response; (2) duration of the noise; (3) time of the day the noise occurs; (4) frequency of repetition of the noise; (5) background noise level in the community; (6) time of year (window open or closed); (7) history of the prior exposure to the noise source and attitude towards its producer; (8) existence of pure-tone or impulsive character of the noise. In late 1960's the Tracor Corporation made an intensive study of resident's attitudes regarding airport noise at eight United States airports (Tracor Corporation, 1971). Similar

studies were done by Borsky (1969) and several non-acoustic influences were found to affect subjective responses to aircraft noise; fear of aircraft crashing in their neighbourhood, susceptibility to noise in general, noise adaptability, distance from the airport, city of residence, belief in misfeasance by those able to do something about the noise problem, extent to which airport and air transportation are seen as important, types of living activities affected, extent to which other things are disliked in the environment and belief about the effect of noise on general health.

The California Department of Transportation (2002) maintains that complaints cannot necessarily always be equated to annoyance rates within a community. Annoyance can exist without resulting in complaint, and complaints may occur even without a high rate of annoyance. Moreover, there is not necessary a correlation between complaints and noise exposure. At many airports, residential areas subjected to the highest noise levels produce relatively few complaints, perhaps because of adaptability of the events. It is more common for the majority of complaints to originate from locations outside the defined noise contours. Most complaints tend to be associated with: exceptionally loud, large, or low-flying aircraft which are not normal for the airport; changes in flight patterns which cause increased noise impacts; or a small number of people who frequently complaint about airport noise.

There is a conflict between the interests of the residents whose quality of life and environment deteriorates as a result of exposure to aircraft noise, and those with an economic interest in airports. Noise levels in some communities near major airports have become so intolerable that many residents cannot continue to live in those communities (Anthrop, 1991). This situation illustrates what is perhaps the basic conflict over aircraft noise, namely that one group of people enjoys the economic benefits of the air transportation industry while a different group, which derives no benefits, is subjected to the noise. It's worth to note that airport authorities stands to benefit at the expense of residents and this could account for why they have little incentives to desist.

Domestic Fauna like the dogs, horses and cats, the subject of extreme residents' emotional attachment and care in some cases, ironically does not receive the protection and consideration it deserves as an integral part of our everyday natural environment. The negative impact of noise on animals' well-being is well documented. Animals respond to noise with instructive reaction of fear in just the same way as human beings. One of the respondents at Bishop Lavis reported his observation about his horses and dogs that: "they raise up their ears and jump up in fear for a moment when an aircraft is passing". This confirms the scientific evidence that noise affects the behaviour of animals. In one experiment, rats lost their ability to function sexually after prolonged exposure to noise. Some became homosexual, others turned cannibal and ate their young. On the continuation of the exposure to noise, the rats eventually died of heart failure (Jones et al., 1972). In another study by these authors at Minnesota, a farmer claimed when sonic booms had caused his chickens to panic and suffocate themselves against a wall. He took his case to court and won damages for this loss.

5.2 LOUDNESS OF DIFFERENT SOURCES OF NOISE

The common medical term to describe what people are experiencing with louder aircraft noise is stress - stress that can bring about increases in blood pressure, a rise in the level of cholesterol, or take the form of a changed heart beat (Andren et al., 1982). They stated that if this stress were to continue day after day, as it does in the lives of people who live with aircraft noise, then there is the possibility of cardiovascular, circulatory, digestive or respiratory problems. Fabos (1985) pointed out that there have been no dramatic episodes of illness and death (as has occurred for example with air and water pollution) caused by noise, but there are three biological effects caused by noise namely physiological, psychological and auditory. This is partly due to the fact that the impact of noise varies depending on the characteristic of the noise, distance of the area from the airport and some other reasons that are not completely understood.

Several effects of noise exposure on the auditory system and annoyance have been documented. Audiograms obtained from homemakers (housewives) and men living near

the Santa Monica Airport revealed that the housewives had a significant hearing loss at 4000Hz and annoyance caused by aircraft noise (Kryter, 1970 as cited by Berglund et al., 1990). Exposure to aircraft noise can also aggravate existing hearing difficulties. In a field study carried out by Tarnopolsky and Morton-Williams (1980) acute as well as chronic tinnitus (ringing in the ears), was frequently reported among subjects exposed to aircraft noise. Berglund et al. (1990) do however state that it is difficult to draw definite conclusions on the adverse effects of aircraft noise, but indicate that exposure to aircraft noise cannot be excluded from giving rise to hearing problems / difficulties.

At the experimental area, aircraft noise is seen as significantly louder than the other sources of noise, while at the control area aircraft noise is comparable with other sources of noise in terms of loudness (Figure 2A and 2B). Neighbourhood noise had similar response ratings at the experimental and control area (29%) for the "loud" option. Interestingly 3% of the respondents at the control area noted that aircraft noise leaves a ringing sound in their ears, (FIGURE 2 B). At the control area 16% of the respondents rated aircraft noise as "very quiet" and 31% as "quiet". On the other hand, in terms of noise sources being "loud" at the control area, aircraft noise was rated equally to noise in general and neighbourhood noise at 29%. It can safely be said that people living closer to the airport are more exposed to intruding aircraft noise than those in the control area, as indicated by the results. Meecham-William (1978) reported that the death rate in a neighborhood directly beneath the landing patterns of Los Angeles International Airport was 19% higher than six miles (9.66km) away from the airport. A control group was selected to be similar to the experimental group in population, ethnic make-up, and economic levels. Residents of the noise-impacted area suffered more deaths due to stroke, heart diseases and cirrhosis of liver than did the control group.

5.3 ACTIVITIES DISTURBANCE

There are well documented association between noise exposure and activities disturbance, changes in performance, sleep disturbance and emotional reactions such as annoyance. Moreover, annoyance is associated with environmental noise level and

psychological and physical symptoms, psychiatric disorder and the use of health services. It seems likely that existing psychiatric disorder contributes to high level of annoyance. Interference with activities might be a source of greater annoyance wherein successful achievement of the activity is highly valued by the subjects (Stansfeld et al., 1985). From (TABLE 8 A and B) it can be observed that activities were more disturbed by aircraft noise at the experimental area than at the control area. The relationship between annoyance and activity disturbances is not necessarily direct, but the most important interference with activities at the experimental area seems to be with listening to TV, radio and music (46%), and having conversation / telephonic (50%), as well as with doing other activities that requires concentration like reading.

Most respondents in Bishop Lavis expressed their annoyance arising from aircraft noise exposure at 46% and rated it as "very often" annoyed, "especially those aircraft arriving early in the morning when most people are asleep" as stated by some "key persons". Those who experienced great annoyance stated that their annoyance was caused by noise from low flying aircraft especially the night flights. This is logical because a low flying aircraft normally generates very loud noise along its noise footprint. Some people at the experimental area were permanently afraid, whereas others worry about the increasing number of flights, or are concerned in case of unusual events. Respondents who lived at greater distance from the airport runway were not too much affected by the noise and vibrations from the landing and take off of aircraft and felt safe "very often" (TABLE 8 B).

5.4 ANNOYANCE

Annoyance is the most common outward symptoms of mental stress produced by aircraft noise. The fear of crashes at the neighbourhood is an important factor for generating annoyance with aircraft noise (Gunn et al., 1981; Gunn, 1987). Annoyance with aircraft noise has often been associated with fear and belief that the noise could be prevented if adequate measures were taken (Fields and Walker, 1982). There is a relationship between the fear of aircraft crashing and the extent of aircraft noise disturbance amongst the

residents at the experimental area. According to Penn (1979), residents around Hamburg and Munich airports suffer nervousness as a result of aircraft noise. Respondents living directly underneath a flight path are more annoyed than people living outside the path (Gjestland, 1988). Berglund et al. (1990) cite research conducted by Fields and Hall (1987) that aircraft noise may be more annoying than road traffic noise, which in turn may be more annoying than railway noise. This is so universal that noise specialists have used public annoyance as a basis for establishing land use guidelines and noise abatement measures (Schomer, 1983). The result of this study replicate the research done by Miedma (1987), which indicates that when road traffic noise and aircraft noise are compared, aircraft noise is perceived to be more annoying (TABLE 10A). At the control area in the present study traffic noise was more annoying than aircraft noise. The number of complaints received about aircraft noise is often used as an index of how much annoyance an airport's operations are producing.

Although noise level explains a significant proportion of the variances in annoyance, the other major factor, confirmed in many studies, is subjective sensitivity to noise. The sensitivity of residences on aircraft noise annoyance and disturbance at the experimental area is perceived to be high (68% and 66% respectively) (TABLE 11 A). People are more sensitive to noise at night when they are trying to sleep as stated by one "key person" at the experimental area. Noise is annoying when it seems to be an invasion of privacy or when it distracts us from something we are trying to concentrate on and can increase the number of errors made in work or by causing high level of nervous stimulation (Jones et al., 1972).

5.5 EMOTIONAL RESPONSES

The responses on emotional feeling depends on the meaningful interpretation that reflects the direct inward or outward feeling for each and every individual such as "how often does aircraft noise makes you feel irritated, annoyed, stressed, and depressed"? In the present study emotional reactions from the responses at the experimental area range from "very often" irritated (54%), depressed (50%), annoyed (49%) and stressed (37%). There

were no significant emotional feelings in relation to aircraft noise at the control area. The extent to which feelings occurred differed from person to person and irritation is consistent with the definition of annoyance, which involves mild fear and anger (Cohen and Weinstein, 1981).

5.6 COPING STRATEGY

Asking the respondents to endorse those behaviours in which he or she engages when the noise occurs, assessed coping strategy. The responses on coping strategy with the noise annoyance revealed that the respondents were using some strategies to cope with the noise. Three (5%) of respondents at the experimental area employed some strategies like smoking habits; 5 (15%), drinking in order to avoid aircraft noise intrusion; 35 (51%) stated that they ignored the noise and pretend that aircraft noise does not bother them and 10 (15%) of the respondents revealed that they are "use to" the noise. Fifteen (22%) of the respondents stated that they close their windows and doors to avoid the intruding noise of a passing aircraft. At the control area, 0% was recorded on these question options concerning coping strategy, probably because it does not bother them. This is consistent with the results of previous research by Fields (1992), which found that more annoyance is experienced when people are exposed to high levels of aircraft noise that makes the individual feel fearful.

This was similar to the study carried out by Lercher (1996) that revealed three basic coping styles: problem-focused / action-directed, denial / avoidance and palliative / comforting conditions. According to Van Kamp (1990), problem-focused / action-directed coping styles is negatively related and avoidance is positively related to the prevalence of health complaints. Furthermore, an evasive strategy is associated with a significantly higher degree of annoyance. However, additional work is needed on the noise adjustment mode and tolerance employed by the residents at the experimental area before final conclusion can be made on the coping strategy by those affected.

Certain people or households are more at risk from environmental hazards such as aircraft noise due to the fact that they are less able to avoid them, more affected by them, or less

able to cope with the effects they cause (Schomer and Neathammer, 1985). Such individuals or households are generally termed vulnerable or susceptible, physical and socio-economic disadvantaged group. Women are more vulnerable to noise and are susceptible to many environmental hazards when pregnant, since the reproductive system is particularly sensitive to adverse environmental conditions. Research by Van Kamp (1990) has shown that noise lowers birth weight, increase frequency of premature deliveries, and sometimes damages children while in the uterus. The most frightening thing about noise is that we have little or no defence against it. When we fall asleep our closed eyelids protect our eyes from being disturbed by light, but the ears have no such protection. They cannot close, and so continue to be sensitive to receive the sound of our environment even while we are asleep (Jones et al., 1972). It is worth to note that the airport authorities stand to benefit at the expense residents of the airport neighbourhood and this explain why those who cause the noise have little interest to minimise or desist it.

5.7 IMPACTS OF AIRCRAFT NOISE ON SCHOOL RESULTS

One area of long-standing concern for parents has been the effect of noise on their children's development and learning activities. It took a growing list of research findings (Bronzaft and McCarthy, 1975; Bronzaft, 1981; Green, et al., 1982; Evans, et al., 1995; Haines, et al., 1998) to convince the Federal Interagency Committee on Aviation Noise (FICAN) that noise is detrimental to children's development and learning. In its 2000 report, FICAN acknowledged that: "Research on the effects of aircraft noise on children's learning suggests that aircraft noise can interfere with learning in the following areas: reading, motivation, language and speech acquisition, and memory. The strongest findings to date are in the area of reading, where more than 20 studies have shown that children in noise impact zones are negatively affected by aircraft".

From (TABLE 12) the effect of aircraft noise, exposure at the experimental area did not so much reveal that schools located close to the airport would be negatively affected on their academic school results compared to schools far from the airport. In the present study, the school academic results were not affected significantly. The average academic results at the experimental area were not more than 91%. At the control area, most of the

average results were more than 91%. It was interesting to note that the average academic result of the three schools at the experimental area in 2001 was 90% while that of the control area was 95%. This difference on the school results necessitate further research on other issues rather than noise before one would draw a right conclusion about effects of aircraft noise on school results. According to Van Kamp (1990), noise can interrupt communication in the classroom, which has led him to nickname it "jet-pause" teaching. At the most simplistic terms, interference with speech is possible at schools in the experimental area and will clearly impact upon teaching efficiency for some lesson types.

These results replicate the earlier findings from the Schools Health and Environment Study (Bronzaft and McCarthy, 1975; Evans et al., 1995). Children are a high-risk group vulnerable to the effects of noise due to the fact that they are in the process of learning. Moch-Sibony (1984) performed a study in which the auditory discrimination ability of children attending a noisy school near the Paris Airport, and children in a sound attenuated school. The children in the sound attenuated school had better auditory discrimination scores and better school results than the children matched by social class who attended the nearby unatenuated school. It is interesting to note that some teachers in Kensington schools report mild aircraft noise.

5.8 ANNOYANCE AT SCHOOLS

Teachers from schools at the experimental area heard more aircraft noise and were more annoyed by it than teachers from schools in the control area. The respondents at the experimental area rated annoyance due to aircraft noise at 100% for the "very often" option (TABLE 13 A), while at the control area annoyance due to aircraft noise was rated at 0% for the "never" option (TABLE 13 B). This indicates that aircraft noise might have different sensitivities on people and may account for the differences in noise annoyance. It is not clear whether high levels of aircraft noise annoyance in children have longer-term health implications, but certainly, there seem to be an indication of short-term disturbance of quality of life and on lessons in class.

Other studies on the effects of aircraft noise on teacher's teaching suggest that aircraft noise interfere with listening by the students during lectures, reading, motivation, language and speech acquisition and memory (Stansfeld et al., 2000). According to the U.S. Federal Interagency Committee on Aviation Noise (2000) the strongest findings are in the area of reading, where more than 20 studies have shown that children in noise impact zones are negatively affected by aircraft noise. Amongst children, there are specific vulnerable groups like children with lower aptitudes, children with hearing problems or children learning in a non-native language (Haines et al., 2000).

5.9 LIMITATIONS

It is important to note that there were some limitations. It was very difficult to precisely define the boundaries of the airport noise impacted areas and further no document was found stating the current aircraft noise levels within the study areas. The study areas were base on approximation and predictions.

CONCLUSION AND RECOMMENDATIONS

6.1 CONCLUSION

The study was focused on the effects of aircraft noise on residents and schools of Bishop Lavis, particularly on the areas lying under and adjacent to the probable arrival and departure route, since it is in these regions that the aircrafts are too close to the ground and therefore have the greatest noise impact.

Comparisons of the data of the experimental and the control area suggest that the respondents (residents and school teachers) close to the airport, and exposed to higher noise level suffers most and this contribute to annoyance. The over conclusion prompted by this study is that aircraft noise is a significant environmental problem which has negative psychological effects threatening human health and which requires effective controls through more consideration in future city planning.

Changes in aircraft type operated by the airlines and changes in the frequency and time of the day of operations will influence the noise impact on the airport neighbourhood residents and schools. Furthermore the sensitivity of people to aircraft noise varies depending on the time of the day, type of residence, age of residents, background noise levels etc. However, the more dominant the aircraft noise level (i.e. the closer the land use to airport), generally the greater the perceived annoyance.

The aircraft noise problem is a complex one, consisting of many factors, which must be carefully considered, in order for successful residential encroachment to the airport. Noise solutions are airport-specific. No two airports are alike in their noise and land use environments. The best solutions for a particular airport may not be effective or desirable in another location (U.S. Department of Transportation, 1999). Noise exposure problem at the Cape Town airport can be minimized by adopting diverse measures. One of the

measures is the reduction of the noise at source, which can be accomplished by modifying some operational procedures and enforcing internationally approved environmental regulations. Also by introducing a "control area" to monitor noise around airport neighbourhood, banning of chapter 1 and 2 aircraft, limiting ground operations, introducing noise charges on airlines, and restricting night flight operations. Operating restrictions of this kind can have significant economic implications for the airlines concerned, both those based in the states taking action and those based in other states that operate to and from the affected airports.

Other mitigation measures include proper land use planning while preventive measures can be adopted to minimize noise impact on people's health and to decrease the level of annoyance including other psychological effects. Noise-sensitive land uses such as residential areas, schools and hospitals can be relocated to areas with more acceptable noise levels and old buildings recycled for a more compatible use. Surely, answers are worth seeking vigorously in order to prevent these known ills of aircraft noise disturbance, annoyance and other associated problems coupled with community dissatisfaction.

Regardless of any viewpoint on the aircraft noise dilemma, it is essential to achieve a reduction of noise in an exposed area without changing the average rate of the air travel industry growth, which is beneficial to the entire nation. Therefore, it is important for local government to consult airport owners regarding land use zoning close to the airport. An action plan should be drafted that suits the airport and adopt the appropriate remedial actions contained in the South African National Policy of Aircraft Noise Emission. An environmental impact assessment could be utilised on land use and residents around the airport. Land acquisition and relocation be instituted, and noise insulation programs implemented. Taylor and Williams (1982) considered participation of the residents of the region in the land use planning process to be essential, but mentions that specific programs and projects must be relevant, including protection from aircraft noise. The U.S. Department of Transportation (1999) maintains that community involvement is a critical part of airport noise compatibility planning. The noise-impacted communities

need an advocate to speak for them to counter balance the far more influential aviation companies because they are always excluded in the decision-making forum of airport development planning (Taylor and Williams, 1982).

The noise effect at schools confirms previous findings of Evans et al. (1995), that noise exposure is associated with poorer reading performance but that the effects are mild. These results add to the growing research evidence around international airports that high levels of noise exposure affect teacher's performance and lead to raised annoyance. It further reveals that teachers in Bishop Lavis are exposed to high levels of aircraft noise at schools. Teaching in a disadvantaged learning environment might have negative consequences for cognitive development of children and their well-being.

In many instances, it is people from disadvantaged communities who are most affected, and it is these people who will continue to bear the brunt of the noise problem in future. Noise as an environmental pollutant can logically be considered a public health hazard whenever it produces harmful physiological effects, interferes with normal activities such as sleep, speech, watching or listening to television, learning, performance of task which need concentration, radio broadcasts, relaxation, telephone communication, teaching, listening to music, or causes annoyance and general mental distress. Additional studies is required to account for these factors and clarify the relationship between aircraft-related noise and learning effect, particularly due to the confounding factors of background noise, school quality and socio-economic status. Future research is required to assess how noise may affect teachers' behaviour and annoyance, and how this may potentially or indirectly, contribute to the noise effects on children.

6.2 RECOMMENDATIONS

The results indicated that exposure to aircraft noise will affect the community living around the airport in terms of annoyance, sleep disturbance and activities disturbance. The study did not reveal any significant effects or difference in the school results at the experimental area and the control area. However, some hearing problems were reported

at schools in the experimental area of which no medical test was conducted to confirm the cause. Therefore, further research is recommended for auditory test on the general hearing level of community residing and children learning within the vicinity of Cape Town International Airport. Also, an obvious and necessary further study would be required to measure the noise levels within the Cape Town airport neighbourhood since no data are currently available or could be found. The next step for future research should be to examine the dose response relationship between aircraft noise exposure and child annoyance since this was not part of this study. An intervention study could also be made to focus on school children instead of on the teachers; this will help to clarify the relationship between aircraft noise annoyance / disturbance and school results.

An authority with jurisdictional powers seems to be always confused by their role because enabling legislation does not exist. When land use control powers do exist, the authorities often fail to exercise these powers effectively. A clear understanding of the implementation of regulations by the authorities is therefore essential. At Cape Town International Airport where more than one municipal authority is affected by noise, co-ordination of planning and implementation can be difficult, and a regional agency is necessary to assume authority. Municipal planners must be sensitive to the impact of noise and resist political pressure to continue constructing low social groups houses around the noise impacted airport zone as is the case with Cape Town Airport neighbourhood.

However, the appropriateness of any of these measures depends on the physical lay out of the airport and its surroundings but in all cases, the procedure must give priority to safety consideration, health and well-being of people. The feasibility or cost effectiveness of actions, whether remedial or preventative, must be taken into account. For example, it is usually more feasible to avoid the creation of new incompatible land uses than it is to reduce existing noise impacts through land use changes. Moreover, while the benefits or effectiveness may be the same in each case, the cost of eliminating or mitigating existing land use incompatibilities is usually far greater than avoiding it in the first place.

The researcher is of the opinion that, even though insulation and relocation as remedial actions are not particularly suited to the areas neighbouring Cape Town International Airport, they should be included in the South Africa National Policy on Airports and Airspace Management of 1998. Relocation as remedial measures is very costly and not as practical for communities in existing incompatible, formal residential areas. However, for communities living in the informal shacks, relocation to more suitable areas is advisable. Informal housing areas as land use type are more sensitive to noise due to the structure of the housing. Consequently, they should be given a greater priority than formal residential areas. It is also important to keep in mind and apply the views of SABS regulations on noise, the Environment Conservation Act 73 of 1989, Section 24 in the Bill of Right Act No 108 in the Constitution of South Africa 1996, the Environmental Management Act 107 of 1998 and the vision for integrating airports into the environment as expressed in the White Paper on Airports and Airspace Management National Policy. It states, "Accessible airports integrated into and operating in their natural and built environments, while performing their function in the economy and the transport system, and serving and benefiting their affected communities, with minimized negative impacts on both the built and natural African environment" (Department of Transport 1998a). Quite clearly the above regulations were made to carter for the welfare of our environment and in this case, it seems not to be applied to the aircraft airport noise at Cape Town International Airport.

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APPENDIX 1A: Households from where samples were drawn (Source: City of Cape Town)

LIST OF HOUSEHOLDS IN THE EXPERIMENTAL AREA (BISHOP LAVIS)

NO.	HOUSE & STREET NO.	NO. CHOSEN		NO.	HOUSE & STREET NO.	NO. CHOSEN		NO.	HOUSE & STREET NO.	NO. CHOSEN
1	60			49	214			97	26	
2	30			50	58A			98	24	
3	98			51	129A			99	22	
4	100			52	58B			100	20	
5	102			53	129A			101	18	
6	104			54	127			102	16	
7	4			55	125			103	14	
8	6			56	125			104	12	
9	8			57	123A			105	10	
10	10			58	121			106	8	
11	12			59	12			107	6	
12	14			60	35			108	4	
13	16			61	37			109	15	
14	18			62	39			110	13	
15	1			63	41			111	11	
16	3			64	38			112	9	
17	5			65	26			113	3	
18	7			66	24			114	5	
19	17			67	22			115	7	
20	15			68	20			116	9	
21	13			69	18			117	11	
22	11			70	16			118	13	
23	9			71	14			119	15	
24	7			72	1			120	17	
25	5			73	4			121	19	
26	3			74	7			122	21	
27	12			75	5			123	23	
28	16			76	3			124	25	
29	16			77	1			125	27	
30	78			78	9			126	29	
31	80			79	17			127	31	
32	82			80	19			128	33	
33	84			81	21			129	1	
34	86			82	23			130	7	
35	88			83	25			131	5	
36	90			84	27			132	7	
37	96			85	29			133	18	
38	4			86	31			134	16	
39	7			87	43			135	14	
40	9			88	45			136	12	
41	11			89	47			137	10	
42	13			90	49			138	8	
43	15			91	38			139	6	
44	10			92	36			140	4	
45	60			93	34			141	2	
46	62			94	32			142	22	
47	64			95	30			143	20	
48	66			96	28			144	18	

145	16			201	12			257	6	
146	14			202	8			258	9	
147	12			203	10			259	37	
148	10			204	12			260	39	
149	8			205	14			261	41	
150	6			206	16			262	3	
151	4			207	26			263	5	
152	23			208	28			264	7	
153	21			209	30			265	38	
154	19			210	32			266	36	
155	17			211	33			267	34	
156	3			212	31			268	32	
157	5			213	29			269	30	
158	7			214	27			270	28	
159	9			215	17			271	26	
160	11			216	15			272	24	
161	13			217	13			273	22	
162	15			218	11			274	20	
163	17			219	9			275	18	
164	19			220	2			276	16	
165	21			221	4			277	10	
166	23			222	5			278	8	
167	25			223	7			279	6	
168	27			224	9			280	4	
169	29			225	11			281	8	
170	31			226	13			282	6	
171	33			227	15			283	4	
172	3			228	17			284	2	
173	5			229	19			285	101	
174	7			230	21			286	103	
175	9			231	23			287	122	
176	11			232	25			288	124	
177	13			233	27			289	126	
178	15			234	29			290	128	
179	17			235	31			291	130	
180	19			236	33			292	132	
181	21			237	35			293	134	
182	23			238	46			294	136	
183	25			239	44			295	138	
184	27			240	42			296	140	
185	29			241	40			297	142	
186	4			242	38			298	144	
187	2			243	36			299	28	
188	38			244	34			300	34	
189	36			245	33			301	30	
190	34			246	30			302	28	
191	32			247	28			303	18	
192	30			248	26			304	3	
193	28			249	24			305	5	
194	26			250	22			306	7	
195	24			251	20			307	11	
196	22			252	18			308	13	
197	20			253	16			309	15	
198	18			254	14			310	25	
199	16			255	12			311	27	
200	14			256	8			312	22	

313	20			370	73			427	58	
314	18			371	59			428	8	
315	16			372	57			429	6	
316	14			373	55			430	4	
317	12			374	53			431	2	
318	10			375	51			432	80	
319	8			376	49			433	82	
320	7			377	47			434	96	
321	9			378	45			435	98	
322	11			379	43			436	100	
323	13			380	47			437	102	
324	15			381	39			438	104	
325	17			382	37			439	106	
326	19			383	8			440	108	
327	21			384	6			441	58	
328	19			385	4			442	56	
329	20			386	45			443	54	
330	16			387	47			444	52	
331	14			388	49			445	50	
332	12			389	80			446	48	
333	10			390	78			447	46	
334	8			391	76			448	44	
335	6			392	74			449	42	
336	4			393	72			450	40	
337	1			394	70			451	38	
338	6			395	68			452	36	
339	5			396	66			453	34	
340	7			397	64			454	32	
341	7			398	62			455	30	
342	9			399	60			456	28	
343	11			400	58			457	43	
344	13			401	56			458	45	
345	15			402	54			459	47	
346	17			403	52			460	49	
347	19			404	3			461	51	
348	3			405	9			462	53	
349	58			406	11			463	55	
350	56			407	13			464	57	
351	54			408	15			465	59	
352	52			409	17			466	61	
353	50			410	19			467	63	
354	48			411	21			468	65	
355	46			412	23			479	67	
356	44			413	25			470	69	
357	42			414	27			471	71	
358	40			415	29			472	73	
359	38			416	31			473	75	
360	36			417	33			474	77	
361	75			418	35			475	10	
362	71			419	86			476	8	
363	79			420	84			477	6	
364	81			421	82			478	4	
365	83			422	80			479	56	
366	85			423	78			480	54	
367	87			424	76			481	52	
368	89			425	74			482	50	
369	91			426	80			483	48	

	46			544	35			604	2	
	44			545	33			605	95	
	42			546	31			606	95A	
	40			547	29			607	97	
	38			548	37			608	1	
	36			549	35			609	1A	
)	32			550	23			610	3	
1	30			551	21			611	5	
2	20			552	26			612	88	
93	18			553	24			613	86	
94	16			554	24A			614	86A	
95	14			555	23A			615	84	
496	12			556	23			616	28	
497	10			557	21			617	28A	
498	8			558	22			618	77	
499	6			559	20			619	39	
500	28			560	20			620	39A	
501	26			561	19A			621	41	
502	24			562	19			622	43	
503	3			563	17			623	43A	
504	5			564	29A			624	18	
505	7			565	30			625	16	
506	9			566	28			626	16A	
507	11			567	28A			627	14	
508	13			568	26			628	12	
509	15			569	24			629	12A	
510	17			570	24A			630	62	
511	19			571	23			631	60	
512	29			572	25			632	80A	
513	21			573	25A			633	79	
514	33			574	27			634	81	
515	16			575	1			635	81A	
516	14			576	105			636	94A	
517	35			577	107A			637	12	
518	37			578	109			638	70	
519	39			579	11			639	70A	
520	41			580	111			640	68	
521	43			581	111A			641	66	
522	45			582	113			642	66A	
523	47			583	115			643	62A	
524	49			584	115A			644	86	
525	51			585	114			645	86A	
526	53			586	116			646	88	
527	57			587	116A			647	98	
528	59			588	118			648	39	
529	15			589	120			649	26	
530	13			590	120A			650	24	
531	11			591	14			651	24A	
532	9			592	12			652	22	
533	7			593	124			653	6	
534	5			594	110			654	6A	
535	3			595	98			655	4	
536	1			596	98A			656	2	
537	49			597	96			657	2A	
538	47			598	94			658	41A	
539	45			599	94A			659	41	
540	43			600	5A			660	28	
541	41			601	6			661	26	
542	39			602	4			662	26A	
543	37			603	4A			663	24	

664	22			724	4			784	8	
665	22A			725	6			785	8A	
666	21			726	8A			786	3	
667	23			727	8			787	5	
668	23A			728	10			788	5A	
669	25			729	12			789	5	
670	27			730	10			790	3	
671	27A			731	10A			791	3A	
672	71A			732	8			792	8	
673	3			733	6			793	6	
674	32			734	6A			794	6A	
675	71			735	12			795	4	
676	69			736	15			796	2	
677	32A			737	15A			797	2A	
678	30			738	7			798	14	
679	67A			739	4			799	16	
680	67			740	6			800	16A	
681	28			741	6A					
682	28A			742	7					
683	65			743	5					
684	63A			744	5A					
685	24			745	1					
686	22			746	3					
687	63			747	3A					
688	61			748	5					
689	22A			749	7					
690	20			750	18					
691	18			751	20					
692	14			752	20A					
693	14A			753	22					
694	12			754	24					
695	10			755	24A					
696	10A			756	25					
697	51			757	23					
698	53			758	23A					
699	53A			759	21					
700	55			760	19					
701	57A			761	19A					
702	76			762	34					
703	3			763	36					
704	3A			764	36A					
705	5			765	8					
706	7			766	6					
707	7A			767	6A					
708	52			768	4					
709	50			769	2					
710	7A			770	24					
711	52			771	37					
712	50			772	35					
713	50A			773	35A					
714	72			774	112					
715	74			775	112					
716	7A			776	110					
717	58A			777	108					
718	58			778	106					
719	56			779	1					
720	54A			780	92					
721	54			781	94					
722	52			782	94A					
723	4A			783	6					

APPENDIX 1B: Households from where samples were drawn (Source: City of Cape Town)

LIST OF HOUSEHOLDS IN THE CONTROL AREA (KENSINGTON)

NO.	HOUSE & STREET NO.	NO. CHOSEN		NO.	HOUSE & STREET NO.	NO. CHOSEN		NO.	HOUSE & STREET NO.	NO. CHOSEN
1	1			49	214			97	6	
2	2			50	58A			98	8	
3	5			51	129A			99	10	
4	7			52	58B			100	12	
5	9			53	129A			101	184	
6	11			54	127			102	55	
7	13			55	125			103	53	
8	224			56	125			104	51	
9	222			57	123A			105	49	
10	220			58	121			106	47	
11	78			59	121			107	45	
12	76			60	48			108	43	
13	74			61	46			109	41C	
14	75			62	117			110	41B	
15	184			63	115			111	41A	
16	185			64	42			112	41	
17	183			65	44			113	39C	
18	181			66	113			114	39B	
19	179			67	111			115	39A	
20	178			68	40			116	39	
21	182			69	38			117	37	
22	164			70	104			118	35	
23	162			71	107			119	33	
24	160			72	34			120	27	
25	158			73	36			121	23	
26	161			74	105			122	21	
27	159			75	103			123	19	
28	157			76	32			124	17	
29	155			77	30			125	15	
30	156			78	28			126	13	
31	182			79	26			127	11	
32	154			80	97			128	9	
33	3			81	95			129	84B	
34	5			82	93			130	73	
35	7			83	91			131	78	
36	9			84	18			132	80	
37	145			85	20			133	82	
38	143			86	22			134	7	
39	141			87	24			135	5	
40	139			88	16			136	3	
41	152			89	89			137	71	
42	4			90	14			138	84A	
43	6			91	81			139	84	
44	8			92	79			140	88	
45	148			93	77			141	88A	
46	150			94	75			142	84	
47	146			95	69			143	90	
48	12			96	4			144	92	

145	94			201	29			257	9	
146	96			202	29A			258	11	
147	104			203	87a			259	13	
148	106			204	87			260	15	
149	108			205	29c			261	17	
150	110			206	83a			262	19	
151	112			207	85			263	21	
152	114			208	83			264	23	
153	116			209	94			265	29	
154	1118			210	12			266	31	
155	120			211	14			267	33	
156	122			212	16			268	136	
157	128			213	18			269	120	
158	126			214	20			270	122	
159	132			215	22			271	128	
160	130			216	24			272	142	
161	124			217	26			273	148	
162	133A			218	30			274	131	
163	133			219	34			275	123	
164	131B			220	36			276	129	
165	131A			221	39			277	121A	
166	131			222	38			278	119	
167	129			223	40			279	117	
168	113			224	81			280	113	
169	111			225	94			281	111	
170	4			226	92			282	109	
171	6			227	90			283	107	
172	5			228	88			284	99	
173	3			229	84			285	97	
174	109			230	80			286	95	
175	7			231	78			287	2	
176	9			232	76			288	4	
177	11			233	74			289	6	
178	13			234	72			290	8	
179	15			235	70			291	10	
180	17			236	68A			292	12	
181	19			237	68			293	14	
182	21			238	66			294	16	
183	107			239	64			295	18	
184	105			240	87			296	20	
185	103			241	85			297	22	
186	101A			242	83			298	26	
187	101			243	91			299	28	
188	99			244	79			300	30	
189	97			245	77			301	32	
190	95			246	75			302	94	
191	93			247	1525A			303	92	
192	23			248	120			304	90	
193	25			249	118			305	88	
194	27			250	116			306	37	
195	29			251	168			307	39	
196	91			252	170			308	41	
197	89			253	1			309	43	
198	23			254	3			310	81	
199	25			255	5			311	79	
200	27			256	7			312	77	

313	75			370	10			427	201	
314	130			371	6			428	188	
315	128			372	4			429	190	
316	126			373	114			430	192	
317	124			374	12			431	194	
318	122			375	14			432	196	
319	120			376	16			433	198	
320	118			377	18			434	200	
321	116			378	20			435	202	
322	114			379	22			436	204	
323	112			380				437	206	
324	110			381	108			438	32	
325	108			382	110a			439	149	
326	106			383	110			440	147	
327	104			384	12a			441	145	
328	100			385	66			442	143	
329	98			386	68			443	141	
333	94			387	70			444	139	
331	92			388	72			445	137	
332	90			389	74			446	135	
333	106			390	31			447	133	
334	104			391	29			448	197	
335	102			392	27			449	60	
336	100			393	25			450	62	
337	98			394	23			451	62A	
338	3			395	21			452	64	
339	118			396	19			453	66	
340	119			397	17			454	68	
341	21			398	15			455	70	
342	115			399	211			456	72	
343	113			400	209			457	74	
344	111			401	82			458	76	
345	109			402	84			459	30	
346	107			403	86			460	77	
347	105			404	88			461	75	
348	103			405	90			462	73	
349	101			406	92			463	71	
350	99			407	94			464	69	
351	4			408	115			465	67	
352	6			409	113			466	65	
353	8			410	111			467	63	
354	10			411	109			468	61	
355	104			412	107			469	88	
356	106			413	105			470	84	
357	31			414	103			471	80	
358	29			415	207			472	78	
359	27			416	205			473	76	
360	25			417	203			474	74	
361	23a			418	201			475	72	
362	23			419	199			476	70	
363	21a			420	197			477	68	
364	21			421	195			478	26	
365	19			422	193			479	22	
366	17			423	191			480	24	
367	15			424	189			481	20	
368	13			425	205			482	18	
369	11			426	203			483	16	

484	14			544				604	129		
485	12			545				605	135		
486	10			546				606	139		
487	8			547				607	147		
488	4			548				608	7		
489	2			549				609	5		
490	2a			550				610	3		
491	157			551				611	34		
492	165			552				612	32		
493	159			553				613	30		
494	167			554				614	28		
495	133c			555				615	26		
496	135			556				616	24		
497	137			557				617	22		
498	141			558				618	20		
499	143			559				619	18		
500	145			560				660	16		
501	147			561				621	14		
502	149			562				622	12		
503	151			563				623	10		
504	24			564				624	8		
505	12			565				625	6		
506	166			566				626	4		
507	164a			567				627	133		
508	16a			568				628	135		
509	162a			569				629	137		
510	162			570				630	139		
511	160			571				631	141		
512	158			572				632	143		
513	156			573				633	145		
514	154			574				634	147		
515	152			575				635	149		
516	150			576				636	151		
517	148			577				637	153		
518	146			578				638	155		
519	144			579				639	157		
520	140			580				640	159		
521	134			581				641	161		
522	3			582				642	154		
523	5			583				643	152		
524	9			584				644	150		
525	11			585				645	148		
526	13a			586				646	146		
527	13			587				647	144		
528	84			588				648	142		
529	86			589				649	140		
530	88			590				650	138		
531	90			591				651	19		
532	92			592				652	136a		
533	94			593				653	130		
534	96			594				654	128		
535	26			595				655	128		
536	128			596				656	128		
537	126			597				657	126		
538	124			598				658	124		
539	120			599				659	120		
540	118a			600				660	118a		
541	79			601				661	79		
542	83			602				662	83		
543	89			603				663	91		

484	14			544				604	129	
485	12			545				605	135	
486	10			546				606	139	
487	8			547				607	147	
488	4			548				608	7	
489	2			549				609	5	
490	2a			550				610	3	
491	157			551				611	34	
492	165			552				612	32	
493	159			553				613	30	
494	167			554				614	28	
495	133c			555				615	26	
496	135			556				616	24	
497	137			557				617	22	
498	141			558				618	20	
499	143			559				619	18	
500	145			560				660	16	
501	147			561				621	14	
502	149			562				622	12	
503	151			563				623	10	
504	24			564				624	8	
505	12			565				625	6	
506	166			566				626	4	
507	164a			567				627	133	
508	16a			568				628	135	
509	162a			569				629	137	
510	162			570				630	139	
511	160			571				631	141	
512	158			572				632	143	
513	156			573				633	145	
514	154			574				634	147	
515	152			575				635	149	
516	150			576				636	151	
517	148			577				637	153	
518	146			578				638	155	
519	144			579				639	157	
520	140			580				640	159	
521	134			581				641	161	
522	3			582				642	154	
523	5			583				643	152	
524	9			584				644	150	
525	11			585				645	148	
526	13a			586				646	146	
527	13			587				647	144	
528	84			588				648	142	
529	86			589				649	140	
530	88			590				650	138	
531	90			591				651	19	
532	92			592				652	136a	
533	94			593				653	130	
534	96			594				654	128	
535	26			595				655	128	
536	128			596				656	128	
537	126			597				657	126	
538	124			598				658	124	
539	120			599				659	120	
540	118a			600				660	118a	
541	79			601				661	79	
542	83			602				662	83	
543	89			603				663	91	

664	107			724	5			784	11a	
665	127			725	3			785	13	
666	129			726	1			786	13a	
667	5			727	139			787	15	
668	3			728	141			788	16	
669	23			729	143			789	64	
670	25			730	147			790	66	
671	27			731	1			791	68	
672	29			732	2			792	70	
673	31			733	3			793	72	
674	35			734	4			794	74	
675	37			735	5			795	163	
676	41			736	180			796	107	
677	43			737	178			797	105	
678	2			738	176			798	103	
679	168			739	174			799	101	
680	166			740	8			800	99	
681	164			741	10			801	97	
682	162			742	12			802	95	
683	160			743	14			803	93	
684	158			744	16			804	160	
685	156			745	18			805	162	
686	154			746	178			806	164	
687	152			747	38			807	164a	
688	150			748	40			808	166	
689	153			749	42			809	168	
690	155			750	44			810	76	
691	157			751	46			811	78	
692	159			752	48			812	80	
693	17			753	193			813	235	
694	15			754	176			814	233	
695	159			755	174			815	231	
696	161			756	172			816	229	
697	13			757	170			817	227	
698	11			758	168			818	225	
699	165			759	3			819	232	
700	167			760	5			820	234	
701	169			761	187			821	223	
702	5			762	52			822	223a	
703	171			763	54			823	219	
704	3			764	2			824	217	
705	173			765	176			825	215	
706	6			766	174			826	49	
707	8			767	13			827	212	
708	4			768	10			828	212a	
709	6			769	8			829	214	
710	8			770	6			830	216	
711	10			771	4			831	218	
712	12			772	58			832	220	
713	14			773	60			833	222	
714	16			774	167			834	224	
715	18			775	165			835	226	
716	20			776	163			836	228	
717	140			777	161			837	230	
718	138			778	159			838	232	
719	136			779	9					
720	134			780	7					
721	9			781	5					
722	8			782	3					
723	7			783	11					

APPENDIX 2: Random numbers table used to draw the samples.

	A	B	C	E	F	G	H	I	J	K
1	08939	53632	41345	65379	20165	32576	13967	90616	17995	92422
2	92578	23668	08801	39792	59341	99117	58830	60923	36068	68101
3	83994	91054	90377	22776	23263	34593	98191	77811	83144	98563
4	43080	71414	40760	01831	44145	48387	93018	22618	98547	87716
5	39372	46789	26381	37186	85684	79426	05395	17538	56671	82181
6	83046	58644	04452	98912	53406	30224	00687	32099	86414	29590
7	99808	32539	96961	88917	60847	64826	41332	64557	15354	11111
8	28478	70870	68912	75644	33648	21097	23745	52593	01849	37760
9	09916	19651	28659	95093	12626	19919	05879	56003	83100	94572
10	19537	66067	20569	28808	8722	67059	12851	73573	25776	92500
11	23013	05574	26320	07754	09642	88068	41626	57139	68199	94938
12	55838	80585	80967	60540	34528	62310	63106	17843	39104	74036
13	92279	87344	93556	75233	09394	79265	9147	32891	77925	71530
14	27850	23332	89336	26026	52130	78544	02090	05645	15060	39550
15	01760	54605	11794	79312	69728	04554	99775	57659	47981	68954
16	81889	70751	87501	88247	41966	57574	67745	88304	20118	25964
17	74722	14654	15425	60665	25162	04987	03467	75915	24282	62456
18	56196	75068	44643	92240	51651	79743	13598	63901	61020	91003
19	96842	62021	00543	45073	65545	87612	35765	26079	34589	72821
20	25619	98328	59393	71401	93871	20611	78830	87477	15390	05044
21	91746	05084	04781	82933	54564	80986	94843	40178	87483	63288
22	92384	84706	76778	98313	98875	08427	60687	88272	83448	06237
23	86390	62208	95735	14535	25591	22730	06059	31786	36181	31016
24	60458	83606	57510	92609	38061	94881	26736	06489	98303	31419
25	03783	39922	05486	73630	92379	91602	18193	84741	44704	05558
26	31011	36035	37113	98362	59149	51634	04468	62096	32361	35301
27	20555	05621	48728	41776	12101	96615	70781	55151	93876	66892
28	56466	36766	12400	43510	49456	05140	85736	68155	37306	10438
29	25875	67304	61950	65962	38220	35676	70043	99173	64677	95457
30	90648	84770	92791	93814	27760	22232	83545	01183	55188	20482
31	26197	72840	01264	52019	00739	36259	10905	39097	36437	66743
32	72522	34445	53975	13840	97262	59007	78685	41044	38103	59216
33	12370	41270	36290	46307	51230	90614	82613	80148	37371	02895
34	81028	60112	31415	47478	02131	85480	93699	92876	13958	47867
35	61573	38634	77650	18189	10283	97999	95442	90657	84963	93863
36	98511	46300	91199	30492	62159	98525	31710	03540	35844	83200
37	76606	10834	75548	55779	54744	26450	66001	57949	53685	00567
38	20237	16311	15733	47599	43998	35594	17577	85113	52487	48900
39	21022	86025	26951	87480	82317	06580	98627	32536	07573	52612
40	47512	11564	41777	46581	03492	01722	78900	57901	37307	02727
41	80598	59041	28861	41793	91007	69907	00376	73086	35132	53014
42	01892	34225	88327	21926	36607	22307	04376	25491	13563	51955
43	89657	70349	15176	57919	10911	44218	67108	04678	24097	02476
44	97983	65616	11841	80504	76452	34176	16386	94328	13091	29592
45	59727	92033	14654	59622	25844	18460	78162	02832	13528	55683
46	12340	72894	26303	01771	73895	27432	99596	50328	06141	83886
47	48049	3318	67463	04914	22316	89663	37132	15825	60759	22131
48	85953	16537	25639	05004	99269	50577	10036	05022	39800	93605
49	03426	78111	37828	23967	03350	04397	96227	37787	60680	23993
50	97837	71085	45973	36073	02680	91425	24425	23725	22521	21601

SOURCE: Fleiss J.L. 1981: Statistical Methods for Rates and Proportions John Wiley and Sons, New York.

APPENDIX 3: Letter to the population chosen for the study.

Dear Sir/Madam,

I am a student at Cape Technikon and I'm conducting this research as part of my Master studies in the Department of Health Sciences of the Faculty of Applied Sciences. I am carrying out research into how noise in the environment affects people's health and well being.

Your household has been chosen at random from the rent office register; even if you are not the specifically named person on the envelope, I would be grateful if you would assist in the research questionnaire. It appears quite lengthy, but because for most questions I am looking for an instant response as opposed to a carefully considered one, the whole booklet may only take about 15 to 20 minutes. You will be free not to answer any question and you may terminate the interview at anytime you wish. I would be grateful if you give me your contact number.

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Please take the time to help me evaluate this important aspect of well being in our community your response is valuable. All Information collected is strictly confidential and will not be connected with you personally.

Many thanks,

APPENDIX 4A: Questionnaire for schools in Bishop Lavis / Kensington.

Study No (1)	
Date of interview:	
Name of Interviewee:	
Household number:	
Respondent's position:	

1. How long have you been in this school.....years.

2. What is the total number of students in the school?
   a) < 1000 students
   b) 1000 – 1500 students
   c) 1500 – 2000 students
   d) 2000 – 2500 students
   e) 2500 – 3000 students
   f) > 3000 students

3. What percentage pass rate was obtained in the following years?
   a) 1999
   b) 2000
   c) 2001
   d) 2002
   e) 2003

4. Does the aircraft noise have any influence on the school results?
   a) Yes
   b) No
   c) Don't know

5. Comment on the student's behaviour during class proceeding when the aircraft is landing or taking off.

6. Are there any cases of hearing problem in your school?

   Yes

   No

   Don't know

   If yes, what is the number of known cases? (.....student(s))

7 Do you think there is any structural damage to the school building due to the aircraft noise?

   a. Yes b) No c) Don't Know

8. Does aircraft noise vibration have any impact on your teaching performance?

   a. Yes b) No

9. Does aircraft noise interfere with the normal teaching activities?

   a. Yes b) No

   Give reasons for your answer.

10. Coping strategy

If you are annoyed by the aircraft noise, how do you cope?

Please circle the appropriate option

a) I pretend that the noise does not bother me.

b) I complain to the Aircraft Authorities.

c) I close windows and doors to reduce the noise exposure.

d) I try to make myself feel better by exercising or using relaxation techniques.

e) Does not annoy me.

11. How often do you feel annoyed when you are exposed to the following noise?

Please circle the appropriate option

Noise in general	Never, Rarely, Occasional, Often, Very often
Aircraft noise	Never, Rarely, Occasional, Often, Very often
Traffic noise	Never, Rarely, Occasional, Often, Very often
Noise from train	Never, Rarely, Occasional, Often, Very often
Noise from neighbours	Never, Rarely, Occasional, Often, Very often

12. When you are exposed to the following types of noise how loud is it?

Please circle the appropriate options

Noise in general	Very quiet, Quiet, Loud, Very Loud, Leaves a ring in your ears
Noise from train	Very quiet, Quiet, Loud, Very Loud, Leaves a ring in your ears
Noise from traffic	Very quiet, Quiet, Loud, Very Loud, Leaves a ring in your ears
Noise from neighbours	Very quiet, Quiet, Loud, Very Loud, Leaves a ring in your ears
Aircraft noise	Very quiet, Quiet, Loud, Very Loud, Leaves a ring in your ears

15. Other comments by respondents / participants regarding how aircraft noise affects them.

APPENDIX 4B: Questionnaire for residents at Bishop Lavis / Kensington.

Study No (1)	
Date of interview:	
Name of Interviewee:	
Household number:	
Respondent's position:	

1. How long have you lived in this house?
    a) < – 4 years
    b) 4 – 5 years
    c) 6 – 8 years
    d) 8 – 10 years
    e) >10 years

2. How many persons live in the house?
    a) 1 person
    b) 2 persons
    c) 3 persons
    d) 4 persons
    e) > 5 persons

3. How many children younger than seven years live in the house?
    a) 1
    b) 2
    c) 3
    d) 4
    e) >5

4. Does anyone in the house complain of hearing problems?
    a) Yes
    b) No

5. If yes, is the hearing problem due to:
    a) Old age?
    b) Workplace noise exposure?
    c) Noise of aircraft flying over?
    d) Deaf since birth?
    e) Don't know

6. Do you experience sleeping disorders?
    a) Yes
    b) No
    c) Used to

7. Do you think that aircraft noise interfere while you communicate with other people in this area?
    a) Yes
    b) No

8. Do you think your domestic animals are disturbed in any way by the aircraft noise?
    a) Yes
    b) No
    c) Don't notice

    If yes, what are the symptoms of the disturbance of your animals?

9. Is there structural damage to your house that you would say is due to

a) Aircraft noise?

b) Poor construction?

c) Dilapidated house?

d) Don't notice

10. Activities disturbance or interference.

How often are you disturbed by the intruding aircraft noise on the following activities?

Please circle the appropriate option.

Listening to TV, Radio, Music	Never, Sometimes, Often, Very Often
Having a conversation (including on the phone)	Never, Sometimes, Often, Very Often
Reading, Writing or other quiet activities	Never, Sometimes, Often, Very Often
Sleeping / Resting	Never, Sometimes, Often, Very Often
Having Meals	Never, Sometimes, Often, Very Often

10 B: Next is a 1 – 10 scale of aircraft noise disturbance. If you are not disturbed by noise choose one, unbearably disturbed choose 10 etc. Thinking about the last 12 months what number between 1 – 10 best shows how much you are bothered or disturbed by aircraft noise

1 = Not at all disturbed					10 =unbearably disturbed				
1	2	3	4	5	6	7	8	9	10

11. Emotional responses (Noise and Mode)

How often does the aircraft noise make you feel…?

Please circle the appropriate option.

Irritated	Never, Sometimes, Often, Very Often
Annoyed	Never, Sometimes, Often, Very Often
Stressed	Never, Sometimes, Often, Very Often
Depressed	Never, Sometimes, Often, Very Often

12. When you are exposed to the following types of noises in the evening, or when you are trying to sleep, how do experience noise in terms of loudness?

Please circle the appropriate option.

Noise in general	Very quiet, Quiet, Loud, Very Loud, Leaves a ring in your ears
Aircraft noise	Very quite, Quiet, Loud, Very Loud, Leaves a ring in your ears
Traffic noise	Very quiet, Quiet, Loud, Very Loud, Leaves a ring in your ears
Train noise	Very quiet, Quiet, Loud, Very Loud, Leaves a ring in your ears
Neighbourhood noise	Very quiet, Quiet, Loud, Very Loud, Leaves a ring in your ears

13. Bearing in mind the noise problem, would you leave the area?

1. Yes 2. No

14. Annoyance at home

Next is a 1 – 10 scale of Aircraft Noise annoyance. If you are not annoyed by noise choose one, extremely annoyed choose 10 etc. Thinking about the last 12 months what number between 1 – 10 best shows how much you are bothered or annoyed by aircraft noise

1 = Not at all annoyed					10 = Extremely annoyed				
1	2	3	4	5	6	7	8	9	10

15. Coping strategy

If you are annoyed by the aircraft noise, how do you cope?

Circle the appropriate number

a) I pretend that the noise does not bother me/ ignore it
b) I complain to the Aircraft Authorities.
c) I think about the possibility of moving.
d) I close windows and doors to reduce the noise exposure.
e) I try to escape the effects of the noise using cigarettes / alcohol / sleeping tablets.
f) I try to make myself feel better by exercising or using relaxation techniques.
g) I am used to the noise.

16. How often do you feel annoyed when you are exposed to the following noise?

Please circle the appropriate option

Noise in general	Never, Rarely, Occasional, Often, Very often
Aircraft noise	Never, Rarely, Occasional, Often, Very often
Traffic noise	Never, Rarely, Occasional, Often, Very often
Noise from train	Never, Rarely, Occasional, Often, Very often
Noise from neighbours	Never, Rarely, Occasional, Often, Very often

17. When you are exposed to the following types of noise how loud is it?

Please circle the appropriate option

Noise in general	Very quiet, Quiet, Loud, Very Loud, Leaves a ring in your ears
Noise from train	Very quiet, Quiet, Loud, Very Loud, Leaves a ring in your ears
Noise from traffic	Very quiet, Quiet, Loud, Very Loud, Leaves a ring in your ears
Noise from neighbours	Very quiet, Quiet, Loud, Very Loud, Leaves a ring in your ears
Aircraft noise	Very quiet, Quiet, Loud, Very Loud, Leaves a ring in your ears

18. Other comments by respondents / participants regarding how aircraft noise affects them.