

SOUNDSCAPE ANALYSIS: A CASE STUDY OF THE
SOUTH FAIRFIELD SOUNDSCAPE

by

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ABSTRACT

This thesis involves a field study of a residential soundscape. It adopts an approach which is distinctive from the traditional noise study, treating the acoustic environment as a set of informative elements rather than as a single measurable object.

Initially a monitoring procedure is used to provide a description of the physical presence of the soundscape. A questionnaire is distributed for the second stage of the research to obtain an understanding of the residents' perception of the study area soundscape.


The first stage, the objective analysis, revealed an environment rich with acoustical information and identified patterns in the occurrence of recorded sounds. The subjective analysis found the residents generally held a favourable impression of soundscape quality and the questionnaire responses indicated a greater awareness of ground sounds than figure sounds. The ground sounds were also the most frequently mentioned sources of information.

This study provides evidence of the diversity of information available in the acoustic environment and it stresses the importance of studying the physical presence of the soundscape together with an investigation of how it is perceived and understood.

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CHAPTER 1

INTRODUCTION

An interest in the study of soundscapes began in the late 1960s and the early 1970s when societies, particularly in North America, were becoming aware of the need to re-examine traditional attitudes towards the environment. Spurred by the public outcry characteristic of the 1960s, it was clear that environmental issues demanded a central position in future academic research. The challenge was met with a wave of research in an interdisciplinary area often termed "man-environment relations", "environment and behaviour", "environmental quality", or, in geography, "environmental perception". The response came from many disciplines, particularly the social sciences, but to date a substantial number of man-environment issues remain poorly examined. Soundscape study is one of these areas of research, being recognized at an early stage (Southworth, 1969), but still requiring much additional attention in the 1980s.

1.1 DEFINITION OF SOUNDSCAPE STUDY

Soundscape study is broadly defined as the investigation of the environment of sound as it is perceived and understood by the individual or by a society (Truax, 1978:128). This concept emanated from two sources. It has its principal roots in the work done at Simon Fraser University under the title of the World Soundscape Project (WSP). The individuals working on this project, both social scientists and musicians, offer a unique approach to the study of the sonic environment. The meshing of scientific and artistic perspectives was

a preliminary step in the process of developing soundscape study as an interdisciplinary subject, the aim of which is "to discover principles and develop techniques by which the social, psychological, and aesthetic quality of the acoustic environment or soundscape may be improved" (Truax, 1978:126).

Prior to the establishment of the WSP in 1971, Southworth (1969) was working toward a similar end from a slightly different perspective. As a planner specializing in the visual arts, city design, and environmental psychology, he became interested in aural sense impressions as one factor in the experience of urban environmental quality. While the WSP was working towards a theory of acoustic design, Southworth was dealing with the design of existing environments, but both were prompted by a growing dissatisfaction with the quality of the sonic environment. This shared research rationale, inadequately handled by traditional research themes, gave rise to soundscape study.

Interest in the sonic environment had not been entirely absent to this point but the tendency was for a problem-specific focus rather than a holistic treatment. Previous research had concentrated almost entirely upon one aspect of sound: the concept of noise. Interest in noise, or "unwanted sound", began in the late 1880s when it was first recognized as an occupational hazard (Barr, 1886), but the movement has gained momentum only in the last two decades. Currently there is a large and growing body of literature dealing with noise but there is little diversity of scope as emphasis is still exclusively directed to the negative aspects of sound.

Noise studies are fundamentally concerned with sound measurement and the development of statistical procedures capable of examining physical and psychological effects. The result has been a profusion of indices specifying intensities that are permissible or desirable in airport or freeway zones, in the industrial workspace, or in bedrooms, libraries, or residential areas. A great deal of money and energy has been expended on such research but the results usually go unheeded. This is often attributed to operational problems associated with the application of these research findings, as exemplified in the failure to enforce municipal noise by-laws (Jones, 1980).

Yet the negative aspects of sound, although central to the noise study, represent only one area of concern when analyzing soundscapes. The true soundscape study examines the entire continuum of sound, ranging from the negative to the positive qualities, thereby including both wanted and unwanted sounds. The sonic environment is not treated as an object which can be reduced to a single measurement or group of measurements. Instead, it is taken to comprise a vast array of stimuli, each representing a wealth of information capable of providing a variety of environmental experiences. The soundscape is considered a phenomenon with perceptual content; it is not wholly reducible to a series of physically measured parameters. This is the essential difference between the noise study and the soundscape study:

"They [noise studies] all isolate sound from the way human beings understand it. In any of these measuring systems, no matter how sophisticated, one sound is treated similar to any other sound. In other words,

any such device or system treats sound as a signal to be processed, instead of information to be understood."

(Truax, 1978:vi-vii)

Clearly, the soundscape study aims to re-introduce the human element. This goal may be realized through an understanding of the following items:

- 1) the physical presence of the soundscape;
- 2) the perceptual processing of the sound input; and,
- 3) the relationship between the two.

1.2 INTENTIONS AND RATIONALE

This thesis addresses the three objectives of soundscape analysis in a case study. The ultimate goal is a descriptive analysis of the South Fairfield soundscape and an examination of the nature of the residents' perception of this soundscape. Consistent with the framework of previous soundscape studies, this study is organized into three major sections: (1) an objective analysis of soundscape composition; (2) an examination of subjective interpretation of the soundscape; and, (3) an attempt to provide a link between the first two stages.

The techniques used for the preliminary data collection are sensitized listening and mechanical recording. In combination they permit systematic monitoring of the soundscape designed to facilitate descriptive analysis of soundscape character. They provide an understanding of the figure-ground relationship, identifying both the ambient frame and the acoustical signals or events.

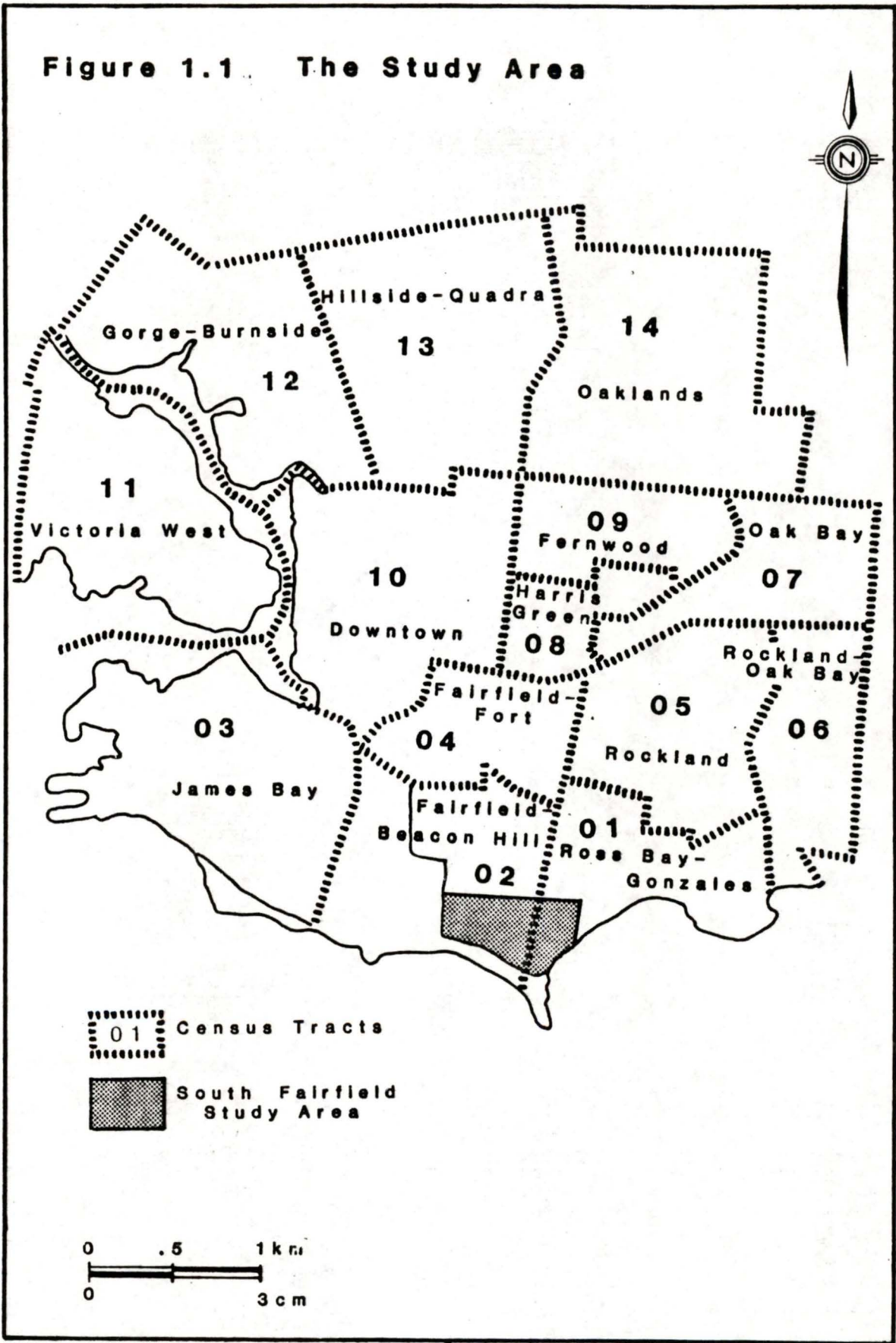
Extending from this first stage, the second section involves a questionnaire designed to elicit responses from study area residents regarding their perceptions of the soundscape and its components. The questions deal with sounds which respondents may equate with their environment and the meaning and content of this association.

The final section attempts to match the subjective with the objective components in an attempt to understand the relationships between the perceived and actual structures of the soundscape in the study area.

The soundscape chosen for study is the southwestern portion of the Fairfield census tract (South Fairfield), located in the City of Victoria, British Columbia (Figure 1.1). The major factor influencing the choice of this particular area was the researcher's familiarity with the location. A knowledge of the community and its soundscape was obtained during a five month residence in the area which coincided with the initial conception of the study. Experimentation with some of the field techniques suggested in the soundscape literature heightened the researcher's sensitivity to acoustic information. It was clear that the Fairfield study area offered a mixture of both unique and general soundscape characteristics which made it ideal for the proposed study.

Proximity to Beacon Hill Park, the parkway belt along Dallas Road, and the Juan de Fuca Strait provide valuable sources of unique sounds. As South Fairfield is a residential community located relatively close to the central business district of the City of Victoria, the area also contains sounds reflective of a more general urban soundscape.

Figure 1.1 The Study Area



The decision to concentrate on an urban residential area was motivated by several factors. The major influence was unquestionably the need for urban research as an increasing proportion of the population becomes concentrated in cities. This study addresses a specific urban problem in its concentration on the environmental quality of sound. It also complements existing research themes by offering a new scale of analysis. In the past, soundscape studies have focused on large urban areas (Schafer, 1978), or small rural villages (Schafer, 1977b); studies at the scale of the urban neighbourhood are conspicuous by their absence. Yet it is at this scale that the urbanite, outside working hours, is most exposed to the soundscape.

A final consideration in the choice of study area was that a neighbourhood-scale study would allow greater depth of analysis. This feature is particularly relevant given the extremely localized nature of most sounds, and because of the assumption that familiarity with them will be some function of exposure rate and proximity to sound source. This meant that the study area had to be a manageable size and an area easily identified by both the community and the researcher. These requirements were satisfied in the selected study area.

This thesis is significant in terms of both its theoretical and practical relevance. First, it hopes to contribute to aural perception research in providing a discussion of the link between the perceived and the actual structures of the soundscape. In addition, this study may be of practical value in that the methodology represents a pioneering attempt in the field of soundscape analysis and therefore complements existing research themes.

1.3 SUMMARY

This thesis is organized into four major sections. The first area of concern is a review of the major theoretical and conceptual issues surrounding soundscape study (Chapter 2). Noise research is dealt with extensively as it provides both a strong theoretical and conceptual basis to studies analyzing soundscapes and examining acoustic perceptions. The following chapter presents the research methodology for both the objective and subjective analysis. Chapter 4 examines the study area soundscape and discusses the results of the objective analysis. Chapter 5 presents the findings of the subjective analysis. The final section (Chapter 6) concludes the research with a summary and comparison of the subjective and objective soundscapes, suggestions of modifications to the research methodology and recommendations for future soundscape studies.

CHAPTER 2

THE FRAMEWORK FOR SOUNDSCAPE STUDY

To establish a framework for the proposed research, this chapter discusses the nature of soundscape studies in three sections. Initially, the focus will be on contextual issues. The second section provides an understanding of the field of soundscape analysis through a review of substantive literature and the final section presents methodological considerations.

2.1 CONTEXTUAL ISSUES

The review of contextual issues discusses research considerations pertaining to soundscape study. These include: environmentalism; geographic perspectives; urban design; and, public participation in planning.

2.1.1 Environmentalism

Environmentalism is the most fundamental of the aforementioned research considerations. It is usually considered to be rooted in the 1960s, nurtured by the period's public outcry over damaged ecosystems, depleted resources, and lack of community spirit. It is defined as "the set of ideas which emphasizes the interrelationships between humans and the ecosystem and the threats human activity poses to its continued viability" (Mitchell, 1980:219). The directive is a challenge to search for "the moral relationship between short term selfishness and enlightened longer term community interest" (O'Riordan, 1976:36).

Environmentalism takes many forms but it is usually argued that "the leading edge of environmental thinking and action is the notion that environmental and other important problems have their source in 'hard' technology systems and their solution in turning to 'soft' or synonymously 'appropriate' technology" (Morrison, 1980:275). The many actors in the movement represent a diverse array of groups from all levels of our society, but they can be broadly categorized in terms of whether they support reformist goals or propose revolutionary action. The largest proportion of environmentalists are reformists in pursuit of such objectives as, alternative or 'soft' technology, alternative agriculture, worker controlled industries, and regional and community self-sufficiency. Although the revolutionary environmentalists support many of these goals, they also tend to be higher profile groups (eg. anti-nuclear groups). From either perspective, environmentalism has had a multidisciplinary impact on research philosophies. New perspectives in geography, in part, reflect some of these changes in the traditional approach to environmental issues and the continuing concern over environmental quality.

2.1.2 Geographic Perspectives

The 1960s were a time of great change in geography. The traditional geographic emphasis on patterns persisted but the introduction of scientific methodologies was resulting in a shift to a quantitative and theoretical approach. Much effort was devoted to the advancement of geography as a science focusing on classificatory-theoretical issues (e.g. Bunge, 1962), but the revolution was not accepted without challenge.

The emphasis on patterns rather than the reasons for their existence, or in other words, processes, was the major source of dissatisfaction. Theories based on generalizations such as 'economic man', however, were soon considered incomplete. These were supplemented by approaches which were more conscious of the individual. Behavioral geography was one such approach. The move from the objective towards the subjective fused geography with other disciplines (Buttimer, 1969). The addition of an interdisciplinary perspective brought new methodologies into the field of geography. Quantification continued to be emphasized but the data base shifted with the use of new techniques such as psychological tests and the investigation of attitudes and perceptions.

As a result of these changes, geographic interests and perspectives became fragmented. Adding to this divisiveness was a growing movement to enhance the applicability of geographic research to real-world problem solving. A broader interdisciplinary perspective, a more holistic approach, and a wider range of research instruments and methodologies, all seemed to be working towards increasing the applied value of geographic research (Frazier, 1978).

One of the major practical fields infiltrated by geographers during this period was urban and regional planning. Geographers set a precedent among the social sciences, disrupting the near-monopoly of the design professions in the planning field (Forbes, 1974). Yet, despite the changes which were taking place in geography, its traditional image was unyielding and geography did little to re-orient planning from the physical to the more social or humanistic concerns (Harrison & Larsen, 1977). The major factor to constrain the

development of an understanding of the geography-planning relationship was the failure of both areas to come up with a widely accepted definition of their fields of study.

While geography was searching for a definition which would incorporate its proliferation of perspectives and research interests, and was seeking to re-define its applied interface with such fields as planning, it was faced with an additional philosophical and methodological re-orientation in the form of contemporary humanism. Usually attributed to the earlier works of Wright (1947), and Lowenthal (1961), this movement has gained momentum only since the early 1970s.

Humanistic geography emphasizes man's position as the central subject of geographic inquiry, calling for an anthropocentric view to study meanings, values, goals, and purposes. Investigation of some of these extremely subjective issues had been undertaken by perception (Saarinen, 1976) and behavioral (Gold, 1980) geographers, but the humanists challenged the scientific manner of this approach and the over-emphasis on techniques (Ley & Samuels, 1978). Humanistic geography does not rest on an established methodology. The use of phenomenology (Buttimer, 1976; Relph, 1970; Tuan, 1971, 1976), idealism (Chappell, 1976; Guelke, 1974), interactionism (Duncan, 1978), or the philosophies of Cassirer (Entrikin, 1977) or Merleau-Ponty (Seamon, 1979) are all concerned with increasing awareness and understanding to provide a perspective sensitive to the individual's or mankind's position. As a perspective it is considered a complementary and necessary component to other forms of analysis, prior to geographic synthesis (Ley, 1980).

The research framework of this thesis reflects many of the changes

which have recently been experienced within the geographic discipline. The traditional interest in spatial patterns is evident in the descriptive analysis of soundscape composition, but this study also reflects more current approaches in its examination of the processes related to the identified patterns. The nature of the research instruments and their focus illustrates the broader interdisciplinary nature of geographic inquiry. The portion of the research concerned with the subjective soundscape reflects the continuing interest in man's position relative to his environment, particularly in urban settings.

2.1.3 Urban Design

Proliferation of research perspectives has been accompanied by an expansion of research themes within geography. A growing interest in urban design is one focus which reflects the impact of changing techniques and philosophies.

The relevance of urban design has become firmly established by the need to deal with the rapid rates of urban growth particularly characteristic of North American societies. Projections suggest that within the next three decades Canadians will likely have to create more urban residences, more commercial and industrial facilities, more hospitals, more parks and recreation areas, more transportation facilities, and more power and other utilities than have been created in the entire history of the nation (MacNeil, 1974:39). The way in which this task is accomplished will ultimately determine the quality of the Canadian environment for the coming century. Clearly, this provides a strong rationale for the study of urban areas, and urban design.

Traditionally, urban planning and design has been concerned with the physical spaces of the built form. The reactions of users of the built environment were intuited and "thus the designed environment reflects the largely untested assumptions about human behavior held by the urban planner" (Porteous, 1977:315). This creates a planning process which essentially omits all but a cursory examination of the needs of the 'planned for'. Failure of designed environments to accommodate user needs (Sommer, 1974) has brought to the foreground the need to introduce links between politicians, planners, and citizens in the planning process. One of the most difficult gaps to bridge has been between the public and decision makers.

2.1.4 Public Participation

During the 1960s and the early 1970s it became clear that conventional indicators of public views were inadequate (Kasperson & Brietbart, 1974). This was most apparent in the failure of planners to identify public preferences correctly (Sewell, 1979). The response was the emergence of a public participation movement committed to developing the public's role in decisions relating to such issues as urban planning, resource development, and environmental protection (Sewell & O'Riordan, 1976).

The major reasons for increased citizen involvement are summarized by Connor (1972), as:

- 1) obtaining additional data for the planner's use;
- 2) obtaining the resident's technical expertise regarding a subject;
- 3) utilizing the creative capacity of non-professionals;

- 4) attaining the goals, preferences and priorities of non-professionals;
- 5) meeting the demands for public participation; and
- 6) altering behavior.

Examination of this list provides an appreciation of the benefits to be realized through increased citizen involvement, but it also forces recognition of the difficulties involved. Porteous (1977) outlines several problems with, and criticisms of, the participation process. These include, for example, the non-representative nature of public interest groups, and the lack of expertise, poor organization, indecisiveness, and myopic perspectives among citizens.

Public participation, however, is ethically desirable. It provides a medium through which the 'planned-for' can make their needs known. It also forces recognition of the value of public input into the decision making process. A variety of responses have been made to the public participation movement by different levels of administration (Sewell, 1979). These reactions have included an expansion of public information programs and the extension of existing means of public participation. Although there is still debate over the desired mode and degree of public involvement, recognition of the public's views and attempts to elicit their responses, have definitely increased. Soundscape analysis fits within this latter focus.

2.1.5 Soundscape Study

The ultimate goal of soundscape analysis is the development of an acceptable theory of acoustic design (Schafer, 1977a). Realization of

this goal depends on understanding the individual's or society's reaction to the nature and content of the soundscape. The principal reason for conducting a soundscape study is to expand knowledge of this largely neglected component of the urban environment. The soundscape study introduces a needed perspective as it recognizes that the sonic environment is more than a physically tangible aspect of urban areas. It offers a broader scope that accords value and meaning to the elements of the soundscape by considering them in terms of the public's views and reactions.

Clearly the aims of soundscape study cause it to touch upon, and draw from, many of the themes presented in the above review of contextual issues. The origin of soundscape study rests in the environmentalism movement. More specifically it is a branch of research in urban design, and such work reflects the current trend towards the increasing attention given to the 'planned for' and attempts to incorporate their views into the planning process. Finally, the theoretical, conceptual, and methodological changes recently experienced within geography, provide the framework which can easily accommodate the objectives of soundscape analysis.

2.2 SUBSTANTIVE LITERATURE

The literature providing background to this thesis can be divided into two main groups. The largest section is concerned with the examination of noise. Literature directly related to soundscape study, drawing upon issues presented by noise research, forms the second and much smaller unit.

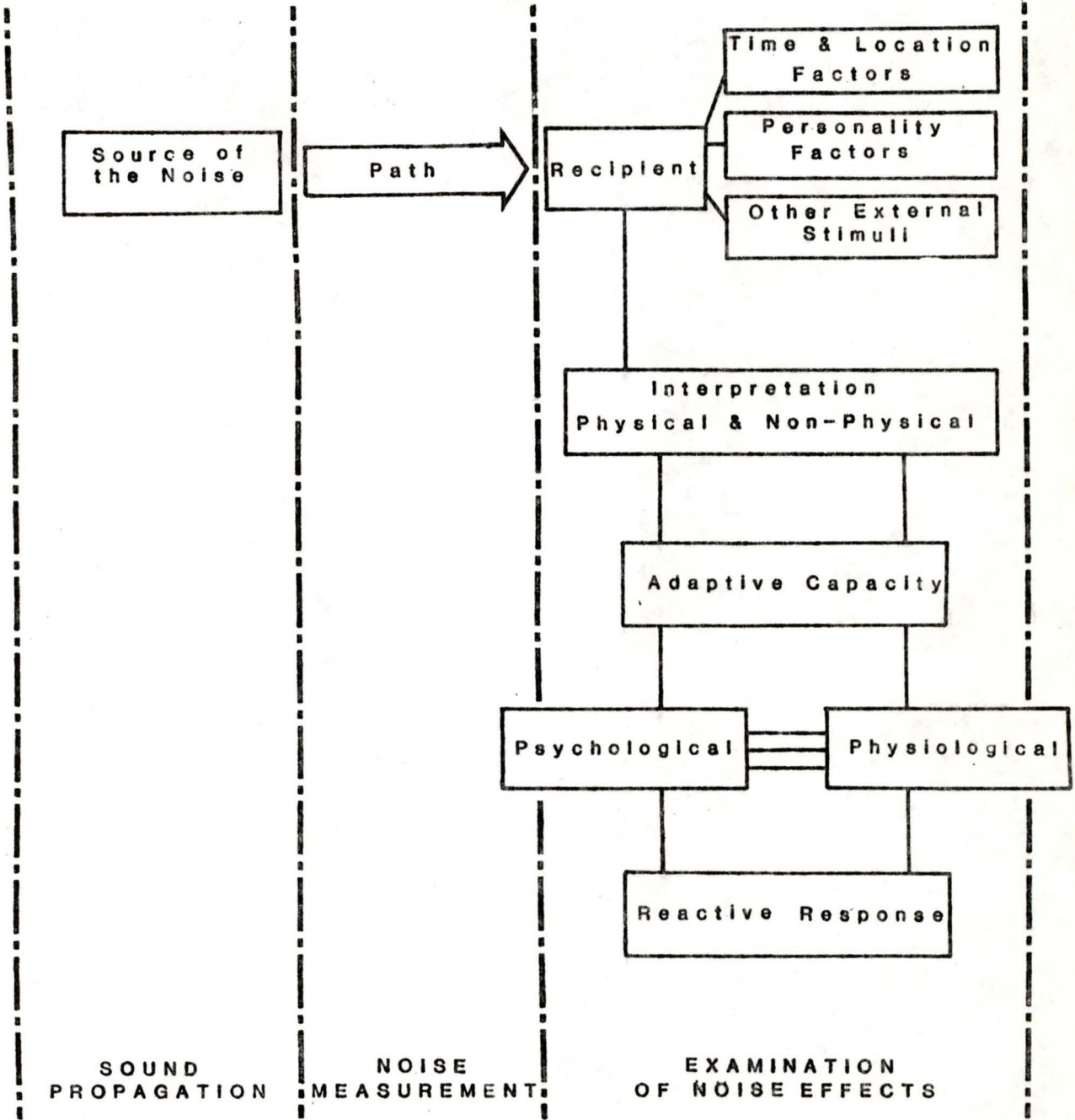
2.2.1 Noise Research

Noise has a variety of definitions (Truax, 1978), but the one most commonly accepted for general use is 'unwanted sound'. This establishes noise as a subjective term representing the negatively perceived components of the soundscape.

Figure 2.1 presents a simplified model for the analysis of the noise problem. The examination of noise at its source, or the study of sound propagation, concentrates primarily on physical properties. Analysis is strongly rooted in research done in physics and it forms the major objective component of the noise study. The next major focus is the measurement of noise. In isolating the point at which the physical characteristics of sound become noise, this stage links the objective and the subjective components of the noise problem. The final part of the noise problem model introduces the human element in the shape of the recipient. This stage involves the examination of a stimulus from the time it is received and filtered through interpretive and adaptive processes, both physical and non-physical, to effect physiological and psychological changes in the recipient.

The principal rationale for conducting noise studies is an attempt to understand the interactions of these elements. This is also the goal of the soundscape study although the latter examines the objective-subjective liaison in reference to both the positive and the negative elements of the sonic environment. To provide some understanding of this link it is necessary to review noise research, first in terms of research methods of noise analysis and secondly in terms of current knowledge of noise effects.

FIGURE 2.1. Model for the Analysis of Noise Problems



Source: After Hansen & Stussi (1972).

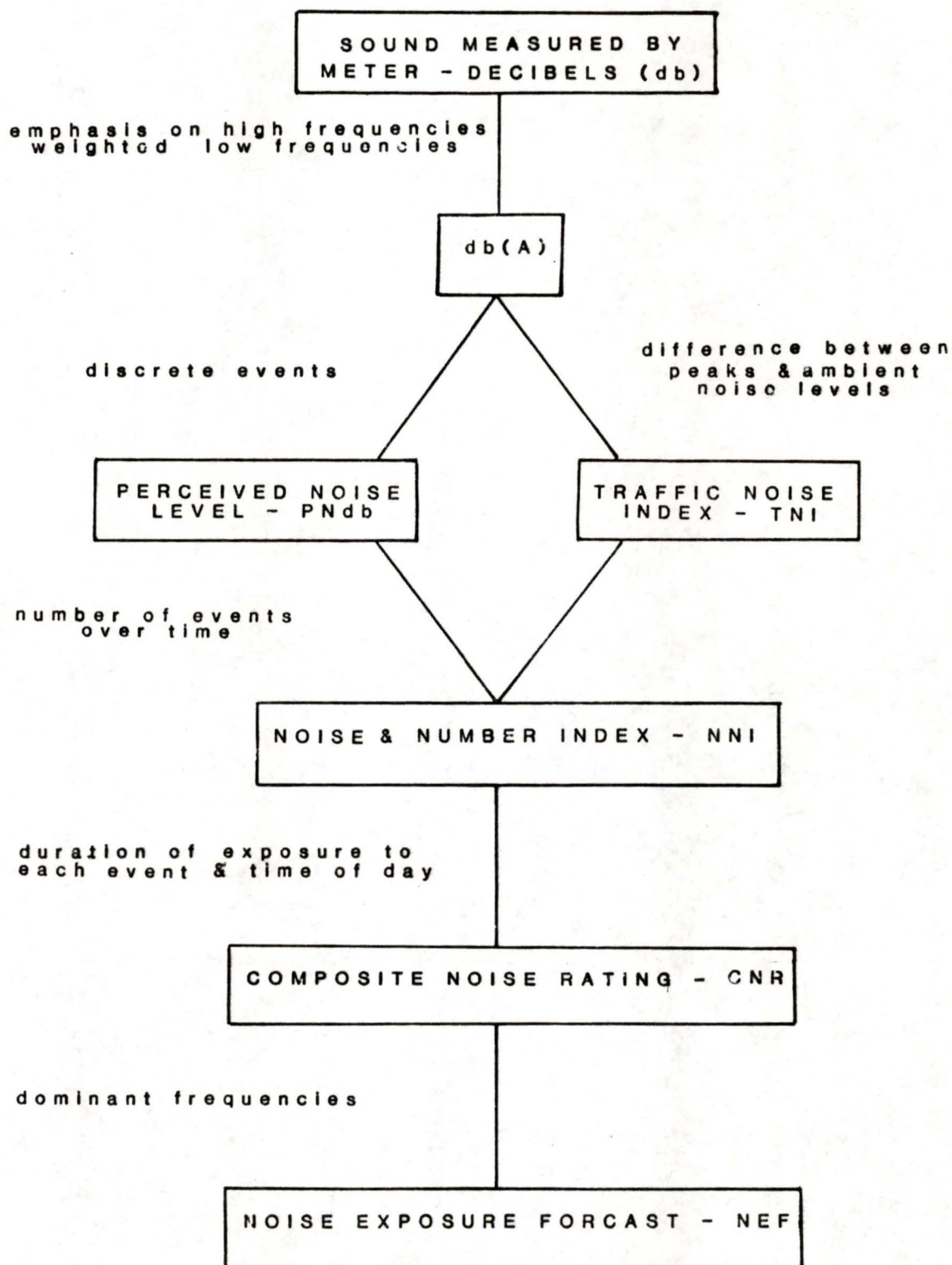
Noise Measurement

Measurements of noise usually take one of two forms. The first type consists of a group of scales concentrating on the physical properties of sound. They are defined by mathematical equations, consisting of elements that modify sound properties to reflect individual noise reactions. The second approach to noise measurement is the social survey. Research of this type emphasizes psychological and sociological considerations to determine relationships between acoustical measurements and human response. A brief review of both forms is necessary to present the major objective and subjective parameters considered relevant to noise measurement.

Noise measurements rely on sound measurements which attempt to reproduce the hearing process by a microphone, amplifier, and filtering network. The instrument transforms sound pressure into a voltage, and a voltmeter, with a logarithmic scale, indicates the sound pressure level. The filter is used to simulate human response. Past research has confirmed that the A filter, or A-weighted decibels (dBA), provides a good approximation of the human hearing response. It attenuates the low and high frequency contents of the sound, and is most sensitive in the range 1000-5000 Hz. The dBA scale is the basis for most scales measuring noise as illustrated in Figure 2.2.

Loudness is the subjective impression of the intensity of a sound (Truax, 1978). The loudness of a particular sound is related to the overall sensitivity of the human hearing system. Accordingly, equal loudness contours have been produced from experiments where subjects compare the apparent loudness of two sounds. The resulting curves

FIGURE 2.2. Noise Measurements Presenting Human Response Characteristics



indicated that loudness is not constant for a constant sound pressure level; it varies with frequency.

The equal loudness curves enable rating of the subjectively felt loudness of pure tones. For more complex sound, methods have been developed to calculate subjective loudness which are based on the equal loudness curve concept. The two main scales that have been developed to measure loudness use phons and sones. Both methods have seen only limited use as they are physically difficult both to measure and to calculate with accuracy, and they do not entirely achieve the desired approximation to hearing response.

An alternative concept, perceived noisiness, and associated equal noisiness contours, have been developed by Kryter (1960). Kryter found that equating sounds according to their loudness produced different results than equating sounds according to their noisiness. The equal noisiness contours that were developed were found to exhibit shapes similar to the loudness curves (Bradley, 1975). From the equal noisiness curves, Kryter developed a procedure for calculating the perceived noise level (PNdB) of sounds. Kryter originally constructed the scale to measure the perceived noisiness of aircraft on the ground by observers. The use of the scale as a predictor of human response was substantiated by a study conducted around London's Heathrow airport (Wilson, 1963), which found the annoyance rating of people interviewed varied almost linearly with the measured PNdB in aircraft flyovers. An extension of PNdB, also the product of the Wilson report, is the noise and number index (NNI). In addition to measuring the average peak noise level, the NNI also considers the number of events, such as flyovers, over a period of time, as a key annoyance factor.

The composite noise rating (CNR) provides further modifications to the NNI. In addition to the magnitude of the sound and number of occurrences, this scale also considers the duration of individual exposures and the time of day. In aircraft noise studies, the relative number of day to night flyovers provides the criterion upon which the final element is based. This analysis is carried one step further with the noise exposure forecast (NEF), which includes corrections for the presence of discrete frequencies in exposures. Calculation of NEF involves the use of a highly complex equation. It is usually applied to determine acceptable noise levels for various community zoning regions. For airports, the calculation of NEF requires information about the types of aircraft using the airport and the noise they generate, the number of take-offs and landings on each runway, and when these take-offs and landings occur. Since NEF is not easily measured, and the required data are difficult to obtain, it has not been widely used. Within Canada it has received some recognition by the National Research Council, resulting in Central Mortgage and Housing Corporation (CMHC) policy zones around airports where NEF contours are available (CMHC, 1972).

The noise descriptors discussed so far are generally source-specific and deal primarily with discrete noise events rather than continuous noise. Addressing this second condition, the equivalent energy level (L_{eq}), has been used to measure the average intensity over a given period of time. "As a result, the measurement (L_{eq}) is generally regarded as the best indicator of duration and loudness" (Truax, 1978:47).

Recently, the Leq has been gaining favour in Europe and North America as a recommended descriptor suitable for establishing noise standards (Kennedy & Faulkner, 1980). It is the measure adopted by the Ontario Model Noise By-Law (1976), and it is also the principal measurement tool proposed by the CMHC in their report on the effects of road and rail noise on housing (CMHC, 1977). As well, the NEF contours used in the older CMHC supplement on housing and airport noise can be approximately related to Leq values.

The scales discussed above have achieved some applied value in their capacity to calculate noise levels, but they contribute little to providing an understanding of how people perceive the sounds as noise. The wide diversity of individual responses to noise makes it almost impossible to deduce subjective reactions in the individual from the objective measurement of physical characteristics. For this reason, researchers have turned to social surveys to determine factors influencing noise reactions.

The emphasis of the social survey is on the reactions of groups to specific noises. This is usually approached through one of two methods:

- 1) with respect to the type of voluntary action taken by the individuals in a certain area (for example, complaints to authorities or company officials, legal action, or some measure of political activity); or,
- 2) in terms of responses made to questionnaires and interviews during a social survey of randomly chosen respondents in a certain area in which the sound levels are known. (Kennedy & Faulkner, 1980:3)

The first approach was used as early as the 1950s (Stevens, Rosenblith & Bolt, 1955) to relate aircraft noise intrusion to probable community reaction. The most obvious weakness inherent in this approach is that it reflects the views only of individuals who take the initiative to complain. The alternative approach, of systematic social surveys, elicits a broader range of society's reactions.

The social survey has tended to concentrate on annoyance reactions of individuals to specific noise situations. Annoyance due to noise is examined in terms of its impact on daily activities, such as sleep, speech or telephone communication, relaxation, and listening to radio or television. Consideration is also given to factors which may influence attitudes towards the noise source. These may include familiarity or relation of the noise source, individual listening habits and life style, perceived aversiveness of the noise, and previous noise exposure.

The major application of data collected in social surveys is the design of a set of subjective descriptors that can be correlated with the objective measures of noise levels. More often the result is the development of additional noise-level scales. The new scales still rely on the physical measures, but the elements modifying these values are factors relevant to noise perception that have become apparent during social surveys. The speech interference level (SIL) is an example of such a scale.

The SIL is based on average decibel readings for frequencies in the range in which human speech occurs. As such, it is a measure of the degree to which background noise interferes with or masks speech. It has been of greatest value in determining desired background noise

levels in occupational settings where verbal communication is required. Variations have now been proposed to account for effects on speech intelligibility in outdoor, as well as indoor environments. Some of the additional factors now incorporated into the scale are the effects of distance on voice attenuation, and the influence of intervening surface materials on reverberation and absorption rates.

The social survey and the SIL both determine annoyance reactions through an examination of noise interference, but from slightly different approaches. The SIL concentrates only on interference of the physical sound properties in relation to speech communication and listening ability. The social survey examines noise interference and annoyance reactions in terms of a broader range of activities that come closer to representing a daily living situation. The principal feature shared by the social survey and the physical measurement scales is that they are working towards the common goal of developing measurement procedures that are sensitive to the wide range of subjective factors influencing noise reactions.

The most extensive review of subjective response rating schemes was provided by Schultz (1972). Following a comparison of survey results Schultz concluded that there was a need to refine not only the physical measurement techniques but also the social response rating schemes if a stronger correlation was to be obtained between the two. These criticisms are still held to be quite valid despite further research advances (Kennedy & Faulkner, 1980).

Noise Effects

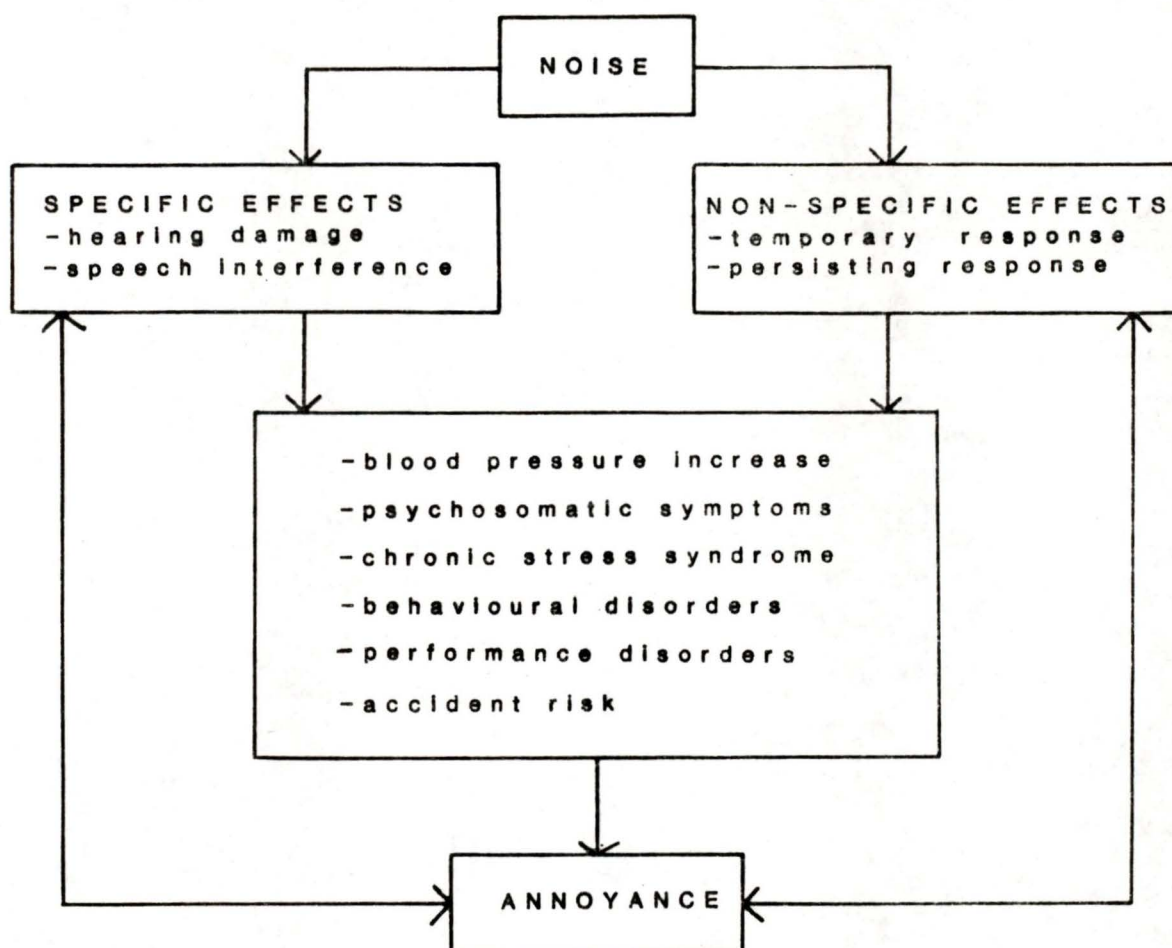
The limitations of the social survey and the psychophysical

experiment have hindered design of measurement techniques to examine noise conditions and noise response. This situation has perpetuated, and been perpetuated by, an incomplete knowledge of the noise response-effect relationships. In recognition of the need to address the many questions that remain largely unanswered, the study of noise effects has recently received a great deal of attention.

Traditionally the literature on noise effects has been divided in terms of whether it has adopted a physiological or a psychological approach to the noise problem. Despite the persistence of this trend, the dichotomy does not differentiate between two mutually exclusive research fields. Some of the relationships between these two dominant approaches (also referred to as auditory/non-auditory or specific/non-specific effects), are summarized in Figure 2.3.

Disorders which are specific to hearing can be divided into two main types; conductive deafness or hearing damage, and sensory-neural deafness or speech interference. Conductive hearing loss usually manifests itself in a fairly uniform decrease in hearing loss over most frequencies. It is a condition generally caused by a mechanical defect interrupting the transmission of the sound energy in the hearing mechanism. Damage of this type, caused by excessive noise, usually afflicts the eardrum. The second specific effect, sensory-neural deafness, is most severe at high frequencies. This causes the masking effect produced by background noise which makes speech intelligible. One of the main forms of this type of hearing loss is presbycusis. It is a shift in the threshold of hearing usually associated with deterioration of hearing acuity with age and/or high levels of noise exposure. This is the defect which has received the greatest attention

FIGURE 2.3. Noise Exposure Effects



Source: Ahrlin & Ohrstom (1978)

by researchers concerned with the loss of hearing due to continuous exposure to moderate or high noise levels. Its importance has been mentioned previously with reference to the use of speech interference as an effective subjective measurement scale.

There has been much debate over the establishment of levels for noise-induced hearing deterioration (Kryter, 1973), but intense noise exposure in excess of 160dB is usually considered to produce structural damage to the ear system. Regardless of how the noise level limits are defined, noise-induced hearing loss can be divided into two major categories, temporary hearing loss (TTS for temporary threshold shift) and, permanent hearing loss (PTS for permanent threshold shift or NIPTS for noise-induced permanent threshold shift).

Threshold shift is defined as the amount of hearing acuity lost above the threshold of hearing, measured in decibels. Exposure to high intensity noise, on a short term basis, causes the recipient to experience a temporary increase in the threshold of hearing. The level and duration of the shift are dependent on three main variables: sound pressure level of the stimulus; the dominant frequencies of the sound; and, the duration of exposure time. The phenomenon of threshold shift has been investigated quite extensively (Kryter, 1970; Ward, Glorig & Sklar, 1959; Ward, 1970; Ward, 1976), but conclusive evidence of the relationships between these variables has not yet been established. The proposed theories tend to be appropriate to a specific focus (eg. Kryter's energy equation predicts continued growth as time increases), and a synthesis of their perspectives has yet to be attained. Continued research has tended to introduce the value of additional

variables such as the nature of the impulses (Coles & Rice, 1971), and the way in which TTS is reached (Miller, 1974).

In general, studies of specific effects have achieved limited applied value. Damage-risk criteria have been established, but only in relation to very specific situations. The traditional emphasis on occupational settings has persisted, and only recently has there been an emergence of concern for the potential damage posed to hearing by the 'environmental' noise in the community.

The second major focus of research on noise effects considers those effects which do not have a direct impact on the auditory mechanism. Although these responses have been repeatedly acknowledged (Glass & Singer, 1972; Kryter, 1970), the extent to which they represent a health hazard is still openly debated (Rylander, 1978). Similar to the concept of TTS and PTS, the non-specific effects can also be divided in terms of momentary or persisting effects.

The main temporary response is that of the startle reaction, which is a reflex reaction comprised of several physiological components which put the body into a state of alert. The outward reaction may be an orienting response, as the receiver adverts attention and tries to locate the source of the noise. Inwardly, the overall reaction is to produce fluctuations in several bodily functions that are most likely to be within the range of what is considered normal variation (Ahrlin & Ohrstrom, 1978). The symptoms vary in intensity according to the character of the noise and the reaction pattern of the exposed individual. Usually, the duration is fairly short and the effects can disappear in a few minutes if the noise source is also fairly temporary. The persisting responses are similar to the temporary

responses but the extent of noise exposure is usually greater and there is a wider variety of medically identifiable effects.

The relationship between increased blood pressure and excessive noise exposure is one of the more extensively examined non-specific effects. In a recent review of some of the major studies Ahrlin & Ohrstrom (1978) conclude that, although definitive evidence of a relationship has not been established, research findings support the existence of a causal link between these two variables. Noise has also been repeatedly cited as one of the major environmental stressors linked with possible adverse health effects (Cohen et al., 1977; Glass & Singer, 1972; Kryter, 1970), but this position has not gone entirely unchallenged. The evidence is conflicting, with some research concluding that stress occurs at levels higher than those producing hearing defects (U.S. Environmental Protection Agency, 1973), while other studies provide evidence of stress under very low noise levels (Guski, 1978). A possible reason for these variations is that stressors may be additive, and noise is only one factor in an already stressful condition. If this is the case, assessing the contributions of noise as a stress factor in a community environment can be a very complex procedure.

There have been several attempts to link noise with health effects which would lend support to the theory of environmental noise as a stressor. One of the first studies providing such evidence was conducted by Abbey-Wikrama et al. (1969). The study examined the population around Heathrow airport, and found a higher admission rate to mental hospitals in an area exposed to high levels of aircraft noise, than an area not exposed to aircraft noise. Unfortunately, the

study's validity was restricted by failure to control for a large number of important variables such as socioeconomic factors.

An alternative approach was recently tested by Tarnopolsky (1978), using a questionnaire on general health. Although his results indicated a significant relationship between rated annoyance and high risk of mental breakdown, the results were again far from conclusive. Reviewing the relationship between noise exposure and the presence of psychosomatic response, Tarnopolsky and McLean (1976) conclude that the reaction pattern for psychosomatic disorders after noise exposure may require physical predisposition and a vulnerable personality. A physical predisposition was considered in association with a failure to adapt, while a vulnerable personality would have a heightened sensitivity to noise.

It would be hazardous to conclude that noise exposure can permanently alter behavior, but under certain situations noise has been identified as a contributing factor in the temporary modification of behaviour. For example, Zimbardo (1969) suggested that there are certain noise situations which cause a sensory overload so that people react to each other on a less personal basis. This is a continuation of the noise as stressor interpretation, and it has been supported by several additional studies on interpersonal distancing (e.g. Matthews, Cannon & Alexander, 1974). Aggression is also considered to be related to excessive noise exposure. The landmark study on this topic was conducted by Green & O'Neal (1969). Exposure to an aggressive film and administration of electric shocks were examined with different noise exposures, and aggression was found to be positively correlated with excessive noise. Experimentation has shown helping behaviour to

be a third aspect influenced by excessive noise exposure. Both laboratory (Cohen & Lezak, 1977), and field experiments (Mathews & Canon, 1975; Page, 1977) found helping behaviour to be affected by such factors as perceived control of the noise, volume of the noise, and stimulus characteristics of the noise.

Generally, these studies suggest that under conditions of high noise exposure, there is a reduction in the responsiveness to social cues. This would appear to be consistent with evidence provided for stress effects, in that excessive noise is associated with an environmental context in which certain activities are made difficult, perhaps even inhibited. This is not intended as a suggestion of environmentally deterministic effects of noise on behaviour, as clearly this view conflicts with the research on the evaluation of noise as a stressor which provides evidence of adaptation under even exceedingly high noise situations. Therefore, it is necessary to assume that additional variables, perhaps relating to the broader social environment, are working in combination to exert an influence on behaviour modification. Research dealing with the effects of noise on performance provides evidence of this type of relationship.

Although there is some debate as to whether or not noise influences performance it is clear that the relationship between these two factors is complicated, depending on many parameters of the noise, on the task, as well as on a large number of psychological elements. It is an area of interest which has been approached from many different research perspectives, acting to further reduce research comparability. Kryter (1973) concludes that there is no unequivocal evidence of performance decrements under excessive noise levels. But

there are two positions to consider. A reduction of general noise levels may increase auditory discrimination so that the worker can hear his machine better, and thus perform in an improved manner, but on the other hand, improved performance may also be associated with increased noise levels in that the masking effect may cancel distracting sounds.

Generally, the study of noise and performance is of most interest in industrial situations where an increase in performance may have economic value. Investigations have been conducted in additional environmental settings such as schools and offices (Miller, 1974) and it has become evident that there is some overlap between the probable explanations for performance variations and the factors influencing additional non-specific effects.

The research dealing with non-specific effects has confirmed relationships with environmental noise, but often the nature and extent of the correspondence is somewhat obscure. At one extreme is the strongly deterministic position identifying noise as the dominant factor capable of a direct impact on such effects as hearing threshold. The opposite pole is represented by a more individualistic perspective, which downplays direct noise effects, and places personal and social factors as the primary considerations. It is clear that the study of environmental noise effects is extremely complex, due to the multivariate nature of psychological and physiological reactions, and the social context of the noise.

Summary

Research dealing with noise measurement and noise effects has been characterized by a gradual shift in both research interests and

methodologies. The original interest in noise effects was an almost explicit concern with occupation hazards - mainly deafness. More recently, increases in both noise generation and the actual number of people exposed to hazardous or undesirable noise conditions have directed attention to psychological effects, and to physiological effects other than deafness. The focus has also expanded from the occupational setting to include other noise-impacted environments. The measurement and assessment of community noise clearly reflects this transition.

Studies of community noise have largely been concerned with noise measurement and the development of standards for noise control legislation. There are still major gaps in this research, primarily because emphasis on community noise issues has introduced new social situations for which the effects of noise have had to be evaluated. This has resulted in the investigation of issues which are tangential to the noise problem, such as its effect on behaviour patterns.

An additional factor, acting to further restrict advancement of noise research, has been imposed by the limitations of both the objective and the subjective measurement techniques. There is a well recognized need for the development of indices capable of incorporating a broader range of human and environmental factors relating to the noise problem. This need has been strongly emphasized by the proponents of the environmental quality index movement (Craik & Zube, 1976). The traditional reliance on objective indices in combination with emotional reactions is criticized as being a very narrow approach, limiting cognitive appraisals.

This review of noise research has presented a wide range of

unresolved issues and emphasized a number of areas where further research is required. It has indicated the importance attached to this aspect of our environment and it places in perspective the comparatively less developed field of soundscape study.

2.2.2 Soundscape Research

Research investigations of the soundscape represent a much more modest body of literature than the related studies of the noise problem. Although comparatively less developed, both theoretical and empirical contributions have been made.

Schafer (1977a) has provided the landmark study, presenting the theoretical framework for the examination of soundscapes. His text concentrates on three major issues. The first section is devoted to establishing a firm rationale for the study of soundscapes. In pursuit of the defined objectives, the next section concentrates on techniques of analysis. The concluding section emphasizes research applications, working towards a theory of acoustic design.

Schafer places a great deal of emphasis on the need to establish soundscape analysis as an interdisciplinary subject, "the middle ground between science, society, and arts" (Schafer, 1977a:4). Science is to contribute to the knowledge of acoustics and psychoacoustics. From society, the knowledge to be gained is an understanding of the relationships between sound and behaviour. Art, particularly music, provides the final element in the process of learning how to create the ideal soundscape. Schafer's interest in music accounts for his emphasis on the final element of acoustic design.

To supplement Schafer's text, Truax (1978), has compiled a

dictionary of terms central to soundscape analysis and the field of acoustic design. Truax tends to concentrate on scientific and social aspects of soundscape analysis and in this manner his work complements that of Schafer's. The handbook also makes clear the strength of the relationship between soundscape and noise research.

Despite a reasonably substantial theoretical background, empirical soundscape research has been very limited. To date, there are only two main studies: The Vancouver Soundscape (Schafer, 1978); and Five Village Soundscapes (Schafer, 1977b). The Vancouver study briefly summarizes the characteristics and information value of soundscape components, illustrating the threat rising noise levels pose to the continued existence of certain key elements. The village soundscape studies examine the soundscape in greater detail but since the study areas represent unique and isolated cases, the applicability of the results is somewhat reduced.

To date, soundscape studies lack an established methodology part IV suitable for developing an understanding of the relationship between man and the environment of sound. There has been a tendency to borrow research techniques that have received recognition in analyzing the noise problem, but they are of limited value because they focus on: (1) the sonic environment as an aggregate; and, (2) a general impression of community response. Noise studies provide a rationale for conducting soundscape analysis rather than a rigorous methodology.

The first requirement of the soundscape study is information on the actual elements of the soundscape. For a similar study of landscapes, a wide variety of techniques are available (e.g. photography and cartography), but an entirely new system of notation

would have to be developed to reproduce the soundscape (Schafer,1977a).

Lacking a method to give an exact impression of the entire soundscape, research has drawn upon a variety of techniques to isolate and examine the most significant features of the soundscape. Individuality, numerousness, or domination, are the criteria usually considered to give weight to the value of the sounds. The dynamic nature of the soundscape, coupled with the absence of techniques to reproduce an image of the soundscape, complicate analysis of these aspects.

One of the basic concerns of the soundscape study is acquiring an indication of the nature of soundscape change. Since sounds lack permanence, and only recently has there been any attempt to catalogue and preserve sounds¹, historical accounts, or earwitness accounts, have been used to provide descriptions of past soundscapes. Clearly, there are many limitations to this approach with respect to both reliability and representativeness.

To obtain a description of the key components of existing soundscapes, field techniques in addition to earwitness accounts are employed. The process is primarily one of cataloguing events, paying specific attention to the physical properties of the sounds; their time and frequency of occurrence, intensity, and duration. These are the same factors used to modify noise measurements, based on their confirmed relationship with perceptual reactions. For the same reason they are considered in soundscape studies, but the focus is on a specific sound source, or object, rather than a general sonic environment. This perspective is conducive to a more in-depth treatment of the soundscape components, permitting investigation of qualities of

¹The WSP is currently preparing a catalogue of world sounds.

individual sounds which give them particular value in terms of the reactions they generate.

Even with these methodological restrictions, the research results support the existence of a relationship between individuals and their soundscape. The survey of the five European villages (Schafer, 1977b) revealed soundscapes that were experiencing a period of change as they accommodated an increasing number of technological sounds. These sounds tended to be "flatline" sounds, or sounds that produce uniform patterns of little interest. The changes identified with the introduction and/or increase of technological sounds, were "...a degeneracy in the variety and complexity of community sounds and a break-down in the balancing forces that once organized the community" (Schafer, 1977b:79-80). In the latter part of this statement Schafer seems to be making a rather deterministic inference that a decrease in the quality of the soundscape was a major causal factor in the breakdown of the traditional social organization of the communities. The evidence supporting this statement is rather weak, but even without accepting this conclusion, the study does present relationships between individuals and their soundscape.

The most important feature associated with the rise in the proportion of technological sounds was a loss in the acoustical complexity of the soundscape. The residents identified this loss in terms of an absence of certain sounds they had previously used to gain information about their environment.

This evidence supports the view that the soundscape is a definite part of the individual's experience of the environment. It also suggests a need to conduct further investigations into the nature of

soundscapes in terms of the information they generate and the perceptual processing of this information. In particular there is a need to study soundscapes in a broader, more representative range of environments (e.g. in an urban setting as opposed to a rural village). In addition, soundscape studies require the development of more rigorous methodologies capable of providing data reproducible for a broader range of samples.

2.3 METHODOLOGICAL CONSIDERATIONS

2.3.1 Objective Soundscape Analysis

Many of the problems which must be faced in attempting to objectively analyze the soundscape are similar to the obstacles encountered in noise research. These problems stem from the fact that the dBA scale, which is the main descriptor of the sonic environment, provides an incomplete representation of the perception of acoustic phenomena. Attempts to modify the scale have failed to adequately reproduce human response to noise or sound. The focus of the soundscape study on discrete components, rather than aggregate conditions, tends to magnify these problems.

The first obstacle encountered by the soundscape study is the lack of descriptors, or methods of cataloguing sound events, which deal with them as aural phenomena in their true form. Sounds are invariably drawn back to their source for identification and reference, a process which automatically shifts emphasis to a visual dimension. In terms of methodology construction, there are both strengths and weaknesses to this tradition.

The main benefit is that it acts to reduce some of the potential

sound variations, based on the assumption that sounds will have certain similarities owing to common origins. This makes a classification of sounds more feasibly operational.

The major disadvantage relates to the amount of detail which may be sacrificed as a result of the grouping. It takes little effort to 'hear' that similar sources do not always produce similar sounds. It is, therefore, a matter of deciding whether or not a loss of detail is compensated for by the ease of identification which can be gained. Since the research aim is to understand soundscape composition, the use of sound origin to represent sound type would not appear to be the logical choice. Unfortunately, the use of sound origin is already predetermined by the lack of available acoustical terminology specifically related to sound presence.

Equating sound types with their origins gives them a spatial basis and reduces some of the potential variation in the soundscape, but this must be supplemented with additional information relating to the physical presence of the sound. The complexity of the exterior environment limits the number of physical parameters which can be investigated. Frequency of occurrence, intensity, and duration are the three properties most frequently used to present the objective elements of the soundscape.

2.3.2 Subjective Soundscape Analysis

The subjective focus of the soundscape study deals primarily with individual's or society's perceptions of the soundscape. Acoustic perceptions are impressions individuals receive of the sound or sounds. It is a process activated by a stimulus and involving the hearing

mechanism and the ability to tie in past experiences and present feelings (Saarinen, 1976). These are difficult constructs to measure and the problem is further complicated by the unique character of the individual's perceptions.

Perceptions depend on all of the senses, notably capacities for sight, smell, hearing, and touch (Porteous, 1977). Although perception involves the processing of information simultaneously through all of the senses, research has tended to focus on the visual dimension. This has been justified on the basis of the human tendency to be "predominately a visual animal" (Tuan, 1974).

There is abundant evidence to support the dominant role of visual perception, but it is not sufficient to negate the input of additional senses. Lynch (1976) is one of the few authors who has adamantly stressed this position. Lynch's review of the sensory qualities of regions is a valuable pioneering study, and it has served to reveal many of the gaps in existing research on environmental perception. In particular, he criticizes the laboratory analysis of visual perception and the inability of these results to deal with "the confused, sequential, sensation rich and socially contaminated perception of the everyday world" (Lynch, 1976;166).

The value of the 'subordinate' senses has not been completely unrecognized, but they have only been the focus of a very limited amount of research. Relative to the other modes of sensory perception, hearing has received slightly more attention. It has been accorded greater significance because of the strong interaction of sight and sound. Sound functions to enrich visual perception, making it more contrastful, more attention-demanding, and more informative.

Similarly, auditory perception is far different without simultaneous sight (Southworth, 1969).

The almost exclusive focus on the visual stimulus-response system may be open to question, but this perspective has provided some valuable insights into the nature of the perception process. Some of these have found application in understanding other modes of sensory perception. The figure-ground relationship, for example, is a borrowed concept that has proven useful as a framework for organizing sounds, because it reflects the structuring of acoustic experiences by classifying sounds into three groups; keynote sounds, signals, and sound-marks.

Keynote is a musical term, used in reference to the fundamental key around which a composition modulates. Its importance may be obscure, in that it does not have to be consciously listened to, but it is the reference point which gives meaning to the remainder of the composition. In a similar manner, the keynote sound tends to be ubiquitous, although it may not always be consciously heard. The keynote is what the psychologist of visual perception would refer to as the ground.

The figure is the other part of this relationship, existing as the focus of interest while the ground is the setting or context. In the soundscape study the signal is analogous to the figure, representing those sounds which are listened to consciously. Any sound can be listened to consciously so the WSP has found it necessary to define signals as those sounds which must be consciously listened to because they constitute acoustic warning devices such as whistles, horns and sirens.

The third theme used for categorizing sounds is the soundmark. Its visual counterpart is the landmark which is a visually dominant or unique component of a scene. The soundmark also stands out because of qualities which make it especially prominent.

The physical characteristics of the sound do not establish it as a keynote, sound signal or soundmark (Schafer, 1977a). Whether a sound is figure or ground is determined by factors which influence individual perceptions.

Although the figure-ground relationship is useful for organizing acoustical experiences, the concept is also a product of one set of perceptual and cultural habits. As such, it may have limited value in cross-cultural studies of the relationship of societies to their environment of sound. Despite these restrictions, it has proven its value in the Vancouver soundscape study (Schafer, 1978).

The techniques and methods chosen for the subjective analysis of soundscape composition should provide an indication of the individual's acoustic perceptions in terms of the figure-ground organization of the sounds. Unfortunately, this presents methodological difficulties in that it is difficult to gain reliable information about such concepts. These problems arise because residents habituated to an environment find it hard to communicate their reactions to sound (Schafer, 1977a). This situation has been repeatedly identified in noise studies which have found that avoidance and desensitization are the common psychological means that people use to deal with noise. The techniques, therefore, must be carefully applied so they will elicit responses on these concepts that are so conceptually difficult to grasp.

2.3.3 Research Techniques

By far the most important research method for the study of soundscapes is listening. As a research technique, it shares many features with its visual counterpart, which is observation. In the strict sense, observation implies the use of the eyes, "a watching and noting of phenomena as they occur in nature with regard to cause and effect or mutual relations" (Oxford English Dictionary). It is the "classic method of scientific enquiry" (Moser & Kalton, 1977). More recently, observational methods have also found use in the social sciences. This wider application has simultaneously extended the definition of observation.

The extended meaning of observation defines a technique which gathers information directly rather than through the reports of others. This enables the collection of data that may otherwise be difficult to obtain. As a research technique, it has certain limitations. Observation can only deal with immediate events. In addition, it is difficult to draw a representative sample using observation methods. To plan to observe all members of a group does not ensure that the resultant group is representative and not all phenomena are directly observable (e.g. attitudes).

Listening is the parallel research method used in the soundscape study. Recently, it has also been assigned a broader definition. Listening is not only considered to involve the hearing mechanism in the process of becoming aware of a stimulus, but also it involves the perceiver's past experiences and present feelings, as they modify impressions (Ihde, 1973:1976).

Research techniques for examining the soundscape can essentially

be dichotomized in terms of whether the receptor is human or mechanical. The mechanical method utilizes a tape recorder to collect sounds on a magnetic tape. It gives sounds permanence, storing them for future analysis. The tape recorder is a fairly objective data collection method. The reasons sounds are excluded from the tape are generally factors related to the physical properties of the sounds rather than subjective reactions. The tape recorder, for example, would record both the pleasant and unpleasant simultaneously occurring sounds, given the absence of masking effects.

A major disadvantage associated with its use is that recording efficiency is significantly reduced in the exterior environment of the soundscape. Wind, for example, influences the propagation of sound waves and it can also influence the quality of the recording by increasing low frequency 'noise'. Wind screens can be used to help reduce wind 'noise', but this produces a directional bias which sacrifices detail.

In comparison to the second type of receiver, which is the human listener, the tape recorder benefits from having a wider hearing range, finer sensitivity, and no listening preferences. These are all valuable attributes, but at the same time they also restrict its use as a research tool. Essentially the tape recorder can only function as a storage mechanism. The information it contains must ultimately be qualitatively examined by the human receptor. The subjective nature of the soundscape, therefore, determines that the process of hearing, or listening, is the dominant research technique. Additional instruments, such as the tape recorder and the sound level meter, serve secondary or supplemental roles. They provide information on the general sonic

environment while the listener identifies the discrete events.

A carefully structured research design using these three techniques (listening, recording, and sound level monitoring), can be used to provide a descriptive analysis of the soundscape. To obtain an understanding of the subjective soundscape, it is necessary to draw upon social survey techniques.

Questionnaires are the most widely used technique for gaining information from large groups of people. They provide the most economical form of social survey and they benefit from a standardized format which is easy to administer. Questionnaires have received limited application in soundscape studies as a large scale survey has yet to be conducted.

2.4 SUMMARY

Recently it has become more widely accepted that noise has a detrimental effect on the quality of life in urban areas (Jones, 1980). In recognition of this role, a large and growing body of noise research has evolved. The principal focus has been on noise measurement with some attention being given to the effects of noise on behaviour and health. The most striking feature of this research in relation to this thesis, is that it treats the acoustic environment as a single object rather than as a system of unique sounds. To fill this gap, soundscape research has been proposed to investigate the nature of the acoustic environment and the individual's or society's reactions to its components.

CHAPTER 3
METHODOLOGY

As noted earlier, the methodology comprises two complementary sections, the objective analysis and the subjective analysis. This chapter outlines the research techniques for both of the stages.

3.1 OBJECTIVE ANALYSIS

The objective analysis involved the systematic monitoring of the soundscape to provide data for a descriptive analysis of its composition. The research instruments used to examine the temporal and spatial variations in the soundscape were listening, taping and sound pressure level (SPL) monitoring.

Traditionally, researchers have turned to previously conducted studies to isolate a rationale for structuring a sampling framework. Unfortunately, the scarcity of soundscape research provides little scope for comparative analysis to justify the choice of a sample design. The experimental nature of existing soundscape studies has also meant that there is a definite lack of data to statistically confirm representativeness of sample characteristics. This weakens the theoretical and empirical foundation for this study's sampling and research design and emphasizes the pioneering nature of this research field.

3.1.1 The Monitoring Procedure

The taping was conducted on a portable Uher 2000 stereo recorder.

A major factor in equipment use was the accurate positioning of the microphones with respect to their height, orientation, and proximity to obstacles affecting sound wave transmission. The importance of these factors has been frequently illustrated in noise studies, particularly in measuring annoyance reactions. Jones (1980), for example, presents evidence of a correlation between annoyance response and microphone height. In an attempt to control for some of these monitoring sensitivities, the equipment was arranged for transport so that the microphone height and orientation were constant. As well, the recording unit was always stationed in the same position at the specific monitor locations to provide greater taping consistency across time.

The second instrument, the SPL meter, was used to take SPL readings when new tapes were required. These values provided a reference point for interpreting the graphics produced by processing the tapes through a frequency analyzer. The frequency analyzer gave a visual display of the information recorded on the tapes. Sound pressure level variations could then be determined for other points along the graph which provided a record of SPL at each monitor location.

In addition to the mechanical monitoring the process of sensitized listening was also conducted. This procedure directly involved the researcher as it required the identification and recording of acoustical information onto the soundwalk sheets developed by the WSP (Appendix A).// While the mechanical recordings were being made, the researcher concentrated on listening to the soundscape and transcribing relevant information onto the soundwalk sheets. The particular features of the soundscape to which attention was directed were sound origin and frequency of occurrence. Brief notes were also made

regarding qualitative impressions of the environmental factors known to influence the nature of the soundscape and the monitoring of its composition.

The researcher's ability to act as a sensitized listener was established upon completion of the pilot study. At this time, the information collected on the tapes and soundwalk sheets was examined by experienced soundscape researchers (Barry Truax and Ron Franklin) from the Communications Studies Department, Simon Fraser University. Their role was to extract information from the tapes and to compare this with the data collected on the soundwalk sheets. As well, their confirmation of the technical quality of the taping and SPL measurements verified that the mechanical monitoring had been conducted with an acceptable level of expertise.

The goal of the mechanical monitoring was to produce a permanent record of the soundscape while the sensitized listening was to provide a subjective catalogue of immediate events. Although the two techniques differ in their approach they are essentially providing similar data. An additional characteristic shared by these two instruments is their sensitivity to the wide range of external environmental conditions which influence the efficiency of their monitoring capabilities. The temporal and spatial sampling frameworks attempt to control for some of these effects.

3.1.2 The Spatial and Temporal Sampling Frameworks

The greatest amount of detail on the actual composition of the soundscape can be collected from points that will allow even the softest sounds to be heard. The aim, therefore, was to obtain a

distribution of monitor positions from which a representative sample of sounds could be collected.

A concept which provided a useful approach to this goal is the 'earshot' distance (Truax, 1978; Westerkamp, 1974). 'Earshot' distance is used to refer to the distance usually maintained between members on a soundwalk. The distance is maximized when it is difficult to hear normal conversation voices of other members on the soundwalk. The articulation index is based on similar considerations as it measures the point at which it is no longer easy to communicate to determine the threshold of a dangerous noise condition.

To establish an 'earshot' coverage of the study area it was necessary to conduct preliminary field investigations, paying particular attention to the following factors:

- 1) the spatial representation of an 'earshot' distance; and
- 2) a manageable monitoring time frame.

An approximation of an 'earshot' distance was gained during soundwalks conducted in both the pilot and the actual study areas. The information gathered during the soundwalks was consistent with the results of previous research as it indicated that under normal conditions voices can be heard at distances up to approximately 50 feet (May, 1978). Beyond this distance, attenuation rates and background ambience interfere with communication, often making speech unintelligible.

The soundwalks were also beneficial in that they provided an indication of the length of time that would be required to monitor the soundscape. This information was desirable because it was clear that a 50 foot radius would produce more monitor locations than could be

adequately handled. The temporal framework helped to refine the spatial design.

The selection of a time period to monitor soundscape composition was largely determined by the second phase of the research design. Questionnaire distribution was to be conducted during the weekday evening hours when chances of finding the household head or spouse at home were considerably higher. This was compatible with the requirements for the objective analysis since exterior environmental factors which influence the quality of the monitoring (e.g. the temperature and wind changes which often occur at nightfall), were minimized during this time period. The most suitable times for both monitoring and questionnaire distribution were, therefore, summer weekday evenings between 5:00 and 9:00 p.m.

A second temporal factor influencing the structure of the spatial sampling framework was the length of time each position was to be monitored. The goal was to select the shortest interval which would provide a reasonable representation of the diversity of sound type. The selected time frame would obviously determine the number of positions which could be effectively monitored during the four hour period.

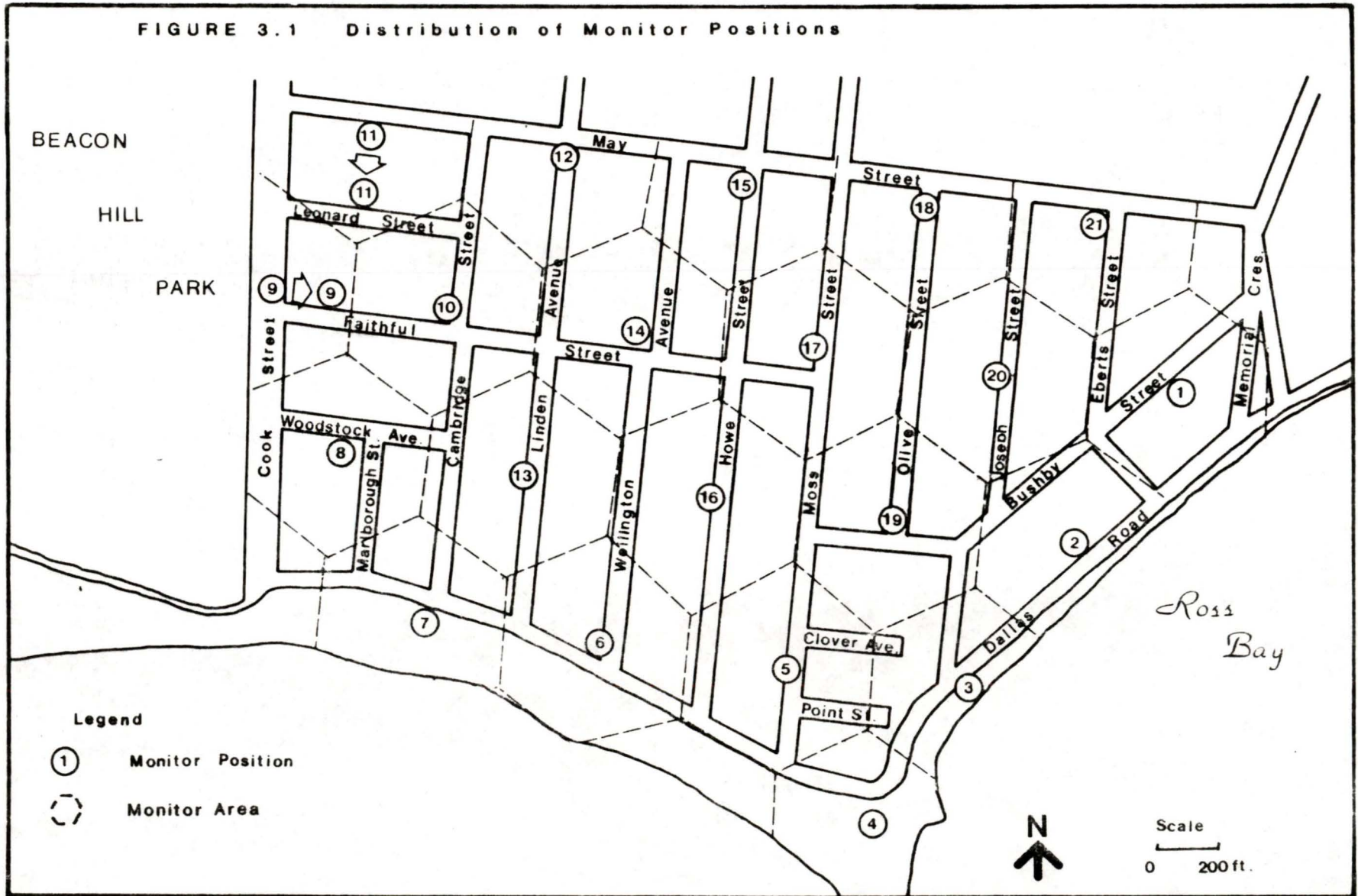
Hexagons were used to delineate the areas covered by the individual monitor positions. They proved suitable because the resulting spatial grid maximized coverage of the study area. Careful attention was given to the orientation of the hexagons because they were being used to provide an areal approach to sample phenomena that exhibit extremely varied spatial distributions. The wide array of sounds being examined all had an impact over different sized areas

which meant that the factors affecting their range (primarily physical sound properties and environmental conditions) had to be considered in designing the sampling procedure.

One characteristic which significantly influenced the nature of soundscape composition was the grid subdivision of lots. Together with the linear arrangement of streets this results in an alignment of houses which subsequently funnelled sounds along streets rather than across them. The tendency for sound to move in this fashion was partially accounted for when the straight edges of the hexagons were positioned parallel to the north-south orientation of the streets. The merits of this alignment were realized while experimenting with the actual size and number of hexagons for the sampling network. The final sample design consisted of a pattern of 21 hexagons each of which could be monitored for five minutes within the four hour period. The resulting spatial distribution of monitor positions is presented in Figure 3.1.

This design placed most of the centre points at suitable monitor locations, but a floating grid was established to allow some leeway in the selection of an actual field position. The selected radius was the 50 foot 'earshot' distance. The final positions used for the monitoring are indicated in Figure 3.1. There were two exceptions where it was necessary to relocate the mid-points over greater distances. Monitor position nine was moved to Faithful Street to place it further inside the study area. This move was based on the need to monitor the overspill of park sounds rather than the peripheral dominance of the Cook Street traffic. Similar considerations motivated the relocation of position eleven which served to reduce the number of

FIGURE 3.1 Distribution of Monitor Positions



monitor positions on May Street.

The monitor sequence was structured to gain an impression of temporal variation in the soundscape at specific locations. Each position, therefore, was monitored at a different time each day. The relevance of this condition has been favourably supported in noise research. Even in the earliest noise studies conducted in the 1950s (Stevens, Rosenblith, & Bolt, 1955), time of day was isolated as one of the key variables to be examined when measuring community reaction to noise and it was introduced as a correction factor to increase sensitivity of subjective noise measures. In recognition of the importance of time of day as a variable influencing the quality of soundscapes, the monitor sequence was varied for each day so that no position would be monitored at the same time more than once. The temporal sampling framework is summarized in Table 3.1.

3.1.3 The Pilot Study

The pilot study was conducted to test the suitability of the research instruments and the adequacy of the spatial and temporal sampling frameworks. The main factors considered in the selection of a pilot study area were:

- 1) lot size and housing type;
- 2) traffic volume; and,
- 3) the nature of adjacent noise generating areas.

The aim was to choose an area similar to the study area in terms of these characteristics.

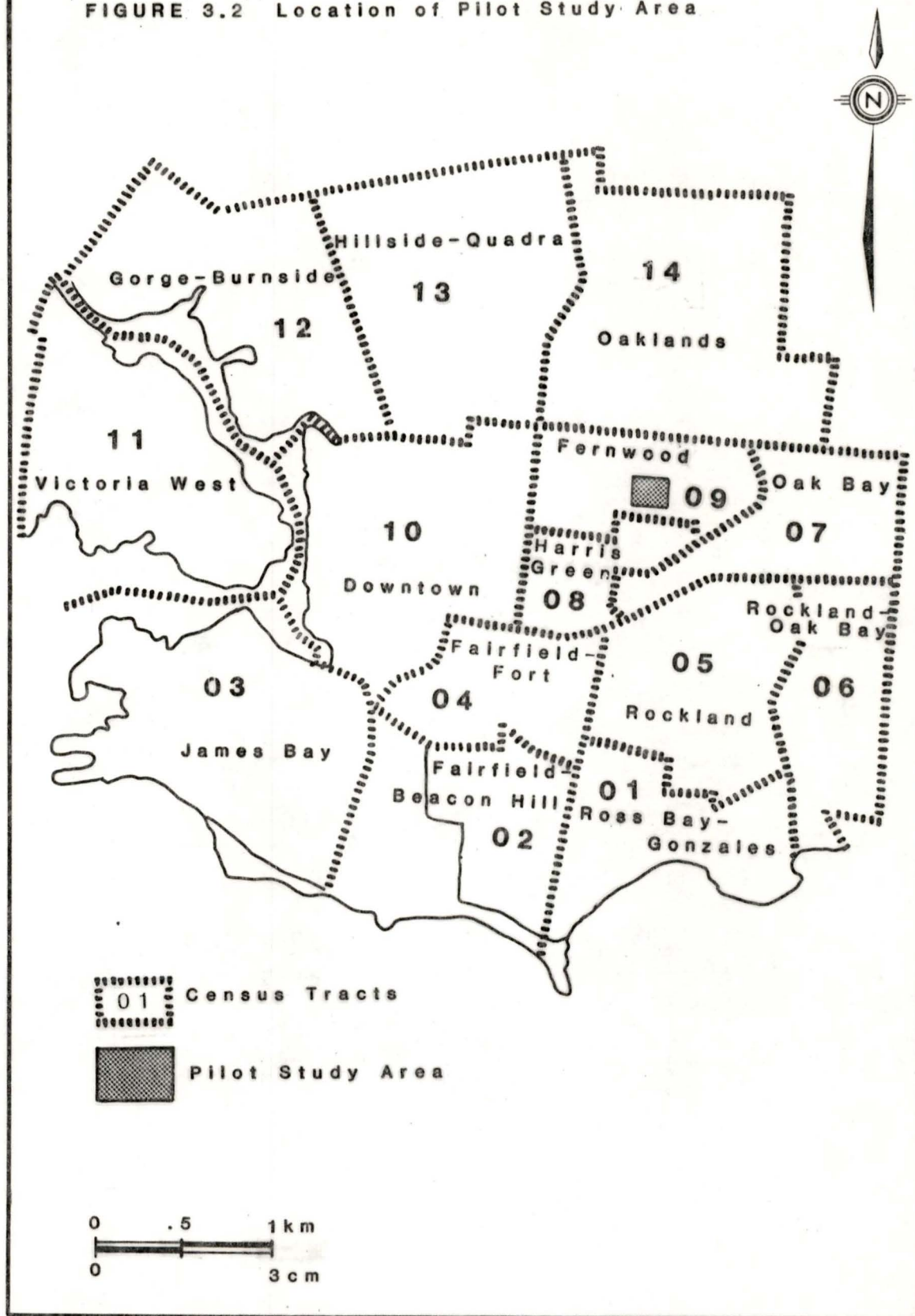
The pilot study area, also located in Victoria (Figure 3.2), is similar to the actual study area in that the houses are predominantly

single family dwellings. In both areas the housing design is varied but the lots are quite uniformly rectangular.

Table 3.1 Monitoring Schedule

MONITOR TIMES-P.M.	MONITOR DAY				
	WED	THURS	FRI	MON	TUES
5:08 - 5:13	1	5	9	13	17
5:19 - 5:24	2	6	10	14	18
5:30 - 5:35	3	7	11	15	19
5:41 - 5:46	4	8	12	16	20
5:52 - 5:57	5	9	13	17	21
6:03 - 6:08	6	10	14	18	1
6:14 - 6:19	7	11	15	19	2
6:25 - 6:30	8	12	16	20	3
6:36 - 6:41	9	13	17	21	4
6:47 - 6:52	10	14	18	1	5
6:58 - 7:03	11	15	19	2	6
7:09 - 7:14	12	16	20	3	7
7:20 - 7:25	13	17	21	4	8
7:31 - 7:36	14	18	1	5	9
7:42 - 7:47	15	19	2	6	10
7:53 - 7:58	16	20	3	7	11
8:04 - 8:09	17	21	4	8	12
8:15 - 8:20	18	1	5	9	13
8:26 - 8:31	19	2	6	10	14
8:37 - 8:42	20	3	7	11	15
8:48 - 8:53	21	4	8	12	16

FIGURE 3.2 Location of Pilot Study Area



It was also necessary to study traffic flow because of the dominant role this feature plays in shaping the urban soundscape. Peripheral traffic volume was higher around the pilot study area but within both areas it was quite similar (City of Victoria, Traffic & Engineering Dept., 1980). Distant urban traffic, therefore, contributes more to the background ambience in the pilot study area but the number of traffic events reported at the monitor stations can be expected to be quite similar.

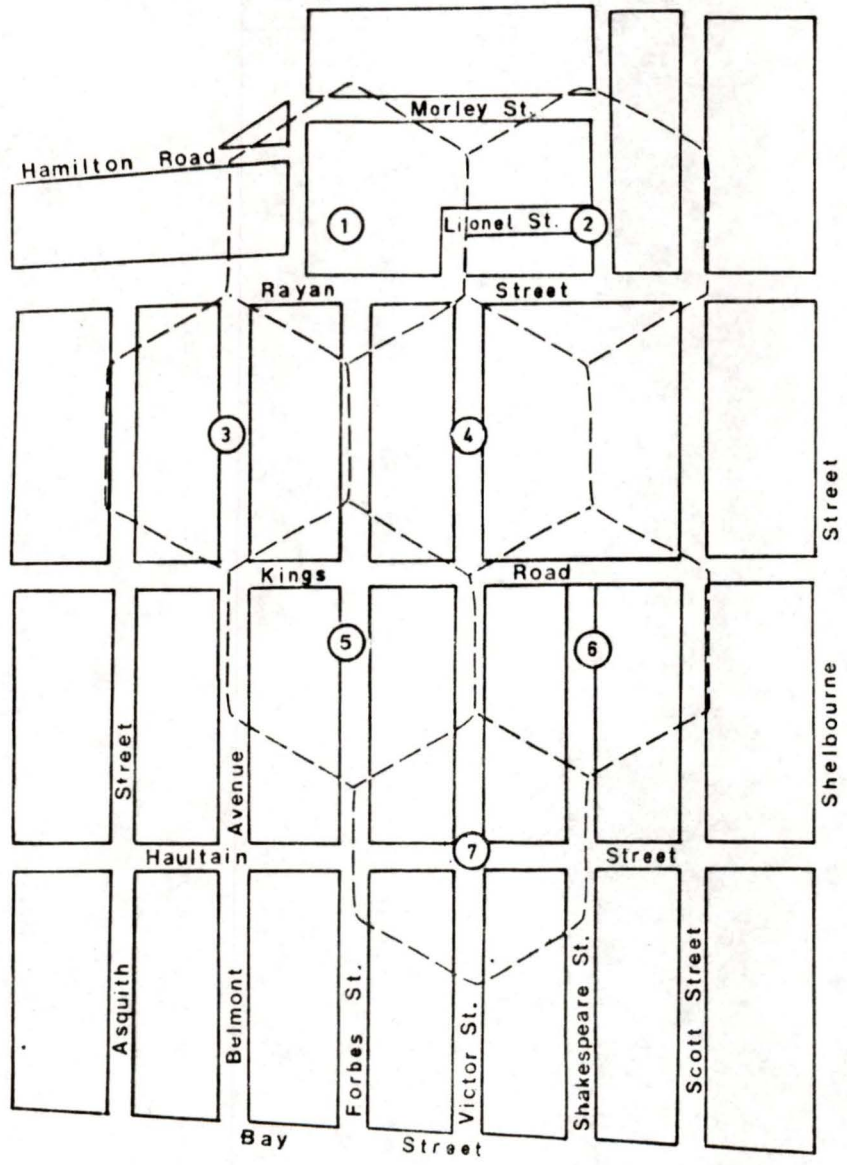
In terms of the larger urban soundscape there is a high degree of correspondence in the acoustical frame shared by both areas. This condition exists because both the actual and the pilot study areas are relatively similar in distance from Victoria's inner core, which equalizes their potential exposure to the overspill of urban sounds.

Figure 3.3 outlines the portion of Fernwood used for the pilot study and indicates the individual monitor stations within the hexagons. The same radius was used for both the pilot and the actual study area grids. Similarly, final monitor positions were located within the 50 foot radius of hexagon mid-points.

The pilot study was conducted in late July 1980 on two summer evenings. The first day allowed the researcher to become familiar with the location of the monitor points and the taping, SPL recording, and listening procedures. The second day was devoted to pre-testing the data collection methods.

The tapes and soundwalk sheets were examined by experienced soundscape researchers. The most valuable outcome of the pre-test emerged from the comparison of the information collected on the soundwalk sheets with the information gathered on the tapes.

FIGURE 3.3 Monitor Locations in Pilot Study Area



Legend

- ① Monitor Position
- ⋯ Monitor Area



0 200 ft.

The major difference between the two data collection methods existed in the range of sound types they identified. The researcher's soundwalk sheet was far more detailed than the tapes. Closer inspection revealed that the sounds not present on the tapes tended to be characteristically softer. These findings confirmed the advantages of the human ear as a device capable of discriminating between sounds over greater distances. Although the process of sensitized listening appeared to be more efficient, this did not serve to negate the value of taping. On the contrary, these observations tended to re-affirm the importance of mechanical monitoring as a complementary listening device. Taping preserved a record of the louder often ubiquitous sounds which freed the researcher to listen for the softer sounds. Completion of the soundwalk sheets, therefore, became a two-stage process. Data were initially collected in the actual soundscape and additions to the sheets were subsequently made in the laboratory from the information stored on the tapes. In adopting this procedure the methodology benefited from the attributes specific to the two listening devices and at the same time it allowed for some recognition of the concurrent nature of sounds.

3.1.4 The Sample

The successful collection of data in the pilot study and the subsequent analysis of these results by the qualified soundscape researchers, supported use of the methodology as outlined to objectively analyze soundscape composition. The five day sampling period commenced August 6, 1980 and it was completed August 12, 1980 (omitting Saturday and Sunday evenings).

The weather proved to be ideal for the monitoring. The only environmental factor found to influence the quality of the taping was the presence of wind at monitor positions along Dallas Road. On several evenings, particularly when these positions were monitored later in the sampling period, the wind speed was sufficient to influence the quality of the taping and the SPL readings. The greater wind velocity at these locations was due to the prevailing onshore breezes. To compensate for the interference the wind caused to the mechanical monitoring, greater attention was paid to the sounds which otherwise would not have been captured on the tapes.

3.2 SUBJECTIVE ANALYSIS

The second stage of the research aimed to develop an understanding of residents' perceptions of the soundscape through an investigation of sound recognition, sound evaluation, and the information that was obtained from the sounds that were heard. A self-administered questionnaire was the research technique used to obtain responses on these topics.

3.2.1 The Questionnaire

The major themes of the subjective analysis are evident in the organization of the questionnaire (Appendix B). The first series of questions is directed towards obtaining a qualitative assessment of the study area and its soundscape. This is followed by a community sound list which is designed to provide an indication of both the range of recognized sounds and the respondents' evaluation of these sounds. Questions are also included to identify sounds that respondents found

to be particularly informative. The final section contains general household profile questions.

These topics were initially covered in an interview questionnaire but this form was subsequently modified to a self-report style. The benefits of the second format became apparent during preliminary testing in the pilot study area. The major weakness of the interview was its inability to capture responses from individuals who seemed interested in the topic but were unwilling to make the immediate time commitment necessary for a structured interview. The self-report questionnaire provided an acceptable alternative as it gave the respondent greater flexibility in terms of completion time and it was anticipated that this would increase response rates. A second benefit was that the respondent would also be given more time to consider potential answers. This feature was considered to be particularly relevant to this study given the problems associated with expression (Schafer, 1977), and conceptualization (Ihde, 1973; 1976) of acoustic experiences.

The majority of the questions were included as open-ended questions. This style was chosen to allow the respondent freedom to decide "the aspect, form, detail, and length of his answer" (Moser & Kalton, 1977:341). The preference for open-ended questions was determined by the absence of results from related studies which could be used to formulate pre-coded questions.

A major portion of the questionnaire was occupied by the community sound list. The elements included in this list were the 55 sound sources identified during the objective analysis. Eleven additional sounds were those prominent either during the researcher's residence in

the study area or in the WSP sound catalogue. The final set of 66 sounds was arranged thematically, similar to the organization of the soundwalk sheets. In recognition of the pioneering nature of soundscape research, the list was open-ended, allowing space for the respondents to include additional sounds.

An attitude scale was positioned opposite each sound and respondents were asked to rate the sounds they reported hearing around their homes. The ends of the six-point scales were represented by two bipolar adjectival phrases. Rating positions were to be selected relative to these phrases as respondents indicated the strength of their like or dislike of the sounds they heard. Although there is some debate as to the number of points that should be included on a scale, it is agreed that the number should not be too large (Osgood *et al.*, 1957). The six-point scale provides a reasonable number of categories and, as an even scale, it assists the promotion of emotional responses while discouraging tendencies to select 'neutral' or 'no opinion' categories.

3.2.2 The Sample

The hexagonal grid designed for the objective analysis provided the framework for the selection of potential respondents. The households within the areas defined by the hexagons were listed and six households were then randomly selected from each list. Hexagon 4 was omitted from the sample because it contained a disproportionately small number of households.

The final 120 households represented an approximately 15 per cent sample of the study area. The questionnaires were distributed to the

household head or spouse on weekday evenings between February 9, 1981 and February 13, 1981. The purpose of the questionnaire was explained to the respondent and it was left at the household with a postage pre-paid envelope for convenient return. One occupant did not wish to take part in the study which made it necessary to return to the list to randomly select another household within the respective hexagon. Often repeated visits were required to the selected households to establish contact but by the end of the week only 17 households had not received questionnaires. Since the questionnaire included an explanatory introduction the remaining questionnaires were left at the selected households where contact was not established.

The response rate was slightly over 50 per cent as 62 completed questionnaires were returned. Seven additional questionnaires were returned, but these were either poorly completed (ie. only one or two questions had been answered) or they were returned blank and were therefore omitted from the analysis.

The spatial distribution of the respondents was fairly uniform with at least two questionnaires being returned in all of the hexagons except for the area monitored by position 3 (Table 3.2).

Table 3.2 Distribution of Questionnaires by Hexagon

<u>Position Number</u>	<u>Number of Questionnaires</u>	<u>Position Number</u>	<u>Number of Questionnaires</u>
1	4	11	4
2	3	12	5
3	0	13	4
5	3	14	2
6	4	15	3
7	3	16	3
8	3	17	2
9	4	18	3
10	3	19	4
11	4	20	3
		21	<u>2</u>
		TOTAL	<u>62</u>

3.3 SUMMARY

The pioneering nature of soundscape studies was made quite apparent during the development of the methodology, particularly for the objective analysis. The almost complete lack of previous studies meant that there were few examples of techniques suitable for collecting field data on soundscape composition. The questionnaire represented a seasoned research technique, but it was receiving a relatively new application in the soundscape study. This has meant that for both research stages, the data base suitable for comparing research results to determine data reliability, is either very limited or non-existent.

Despite these obstacles the methodology designed for this study proved to be very operational. The data collected during the two research stages is discussed in the following chapters.

CHAPTER 4

OBJECTIVE ANALYSIS

Initially this chapter introduces the South Fairfield study area. This involves a discussion of population and housing characteristics, physical setting and prominent soundscape features. Presentation of these points also provides a suitable framework for a descriptive examination of the representativeness of the research data. The second major section of this chapter examines the results of the objective analysis, while the concluding section summarizes these results.

4.1 THE STUDY AREA

The main reason for selecting the South Fairfield study unit was to provide information on soundscapes at a scale of analysis that had yet to be examined. To date, soundscape studies have concentrated on small isolated areas (traditional European villages) and large complex regions (urban centres). Although abundant evidence can be found to favour studying these areas (Schafer, 1977a; Schafer, 1977b; Schafer, 1978), it is still necessary to examine the numerous areas of intermediate sizes. The residential area is representative of one such area which still requires further investigation. This study aims, therefore, to add to existing knowledge on soundscapes by examining the residential soundscape that figures so prominently in the lives of most urbanites.

South Fairfield was built at the turn of the century in a district that attracted a predominantly working class population. The housing values still reflect this past when compared to the higher

prices found in the surrounding regions (Figure 1.1) such as Rockland and Oak Bay (Porteous, 1979). South Fairfield is zoned for single family dwellings (R-1-B) except for small parcels of land between Dallas Road and Bushby Street which are zoned for low density attached (R-J) and multiple dwellings (R-3-2). The R-1-B area is currently experiencing a gradual process of change with the renovation of many of the 'character' homes. This gentrification process has been recognized as the invasion of middle class professionals seeking to upgrade single family dwellings (Porteous, 1979). It has also involved the conversion of single family houses into multiple family units and the construction of new apartments and condominiums. The residents of South Fairfield appeared to be aware that gentrification was occurring as several of the questionnaire respondents identified various aspects of this process as being responsible for changes in neighbourhood sound quality (see Chapter 5). A more specific understanding of population and housing characteristics in South Fairfield can be obtained from the 1976 census data (Table 4.1).

It is difficult to gain a preliminary understanding of the character of the study area from the census data because it lies astride two rather different census tracts. Table 4.1 is a summary of selected population and housing data for these two areas. Although the largest part of the study area is within the Fairfield census tract it would appear to bear a closer resemblance to the Ross Bay Gonzales tract. The variations between the Ross Bay - Gonzales and Fairfield tracts stem primarily from the large number of rental dwellings and

Table 4.1 Selected Population & Housing Percentages For Census Tracts Covering South Fairfield

		<u>Ross Bay - Gonzales</u>	<u>Fairfield</u>
Tenure	% Owned	72	43
	% Rented	28	57
<hr/>			
Dwelling Type	% Single Family	75	38
	% Multiple Family	25	62
<hr/>			
Population	% Male	45.7	43
	% Female	54.3	57
<hr/>			
Age	0 - 14	15.8	11.1
	15 - 24	15.3	13.8
	25 - 44	22.5	20.5
	45 - 64	26.6	21.9
	64 +	19.8	32.7

(Source: City of Victoria, Department of Community Development. Social and Economic Data, Victoria 1980. May 1980.)

apartments north of Beacon Hill Park and the study area. The two portions of the census tracts which lie within the study area are quite similar. This is apparent from field observations of the study area and it is further supported when the census data for Ross Bay - Gonzales is related to the data from the questionnaire sample (Table 4.2).

The variety of housing design is an attractive feature of this area but the abundance of surrounding park land has been equally as valuable in contributing to the unique character of the area. South Fairfield benefits from being in close proximity to Beacon Hill Park, Clover Point Park and the Clover Point to Finlayson Point Beach. In total this represents over 86 ha. of nearby parkland which leaves the northern boundary along May Street as the only edge of the study area not directly adjacent to parkland. These large expanses of parkland act as a buffer zone between South Fairfield and the remainder of the City of Victoria, limiting the overspill of urban sounds. South Fairfield is located fairly close to the central business district, but not along the main access routes into the city. This has served to keep traffic volumes on the streets bordering South Fairfield somewhat lower than they are in other parts of the city (Appendix C).

In general, South Fairfield was found to be surrounded by sound sources that served to enrich the character of the soundscape. The system used to classify components of the Vancouver soundscape provides a suitable framework to present some of these key features of the soundscape.

Schafer (1978) identified vehicular traffic as the main keynote sound in Vancouver. Cars occur with the greatest frequency and are

Table 4.2 Population & Housing Percentages From South Fairfield
Community Sound Questionnaire

		<u>South Fairfield</u>
Tenure	% Owned	77.4
	% Rented	22.6
<hr/>		
Dwelling Type	% Single Family	88.7
	% Multiple Family	11.3
<hr/>		
Population	% Male	46.8
	% Female	53.2
<hr/>		
Age	18 - 30	22.6
	31 - 44	40.3
	45 - 64	24.2
	65 +	12.9
<hr/>		

the most ubiquitous source of vehicular traffic sound, but additional generators include buses, motorcycles, trucks, trains, planes, jets, and helicopters. Sounds emanating from types of air and rail transportation tend to be rarer and they serve a less significant role in the shaping of the keynote sound.

Schafer has conducted surveys of the perception of these sounds to justify why they are classified as part of the environment which is not always listened to. Schafer's support for labelling air traffic as a part of the keynote sound is taken from a survey of residents in Sentinel Hill, Vancouver. In 1969, and again in 1973, residents were asked to estimate the number of aircraft flying over their homes per day. The average number estimated in 1969 was 8 and in 1973 this was up to 16. The actual volume of aircraft flyovers in 1969 was 65 with 106 in 1973. Other variables could account for this large discrepancy, but these results tend to suggest that these sounds are not generally part of conscious aural perception. Schafer also classifies the sounds made by moving trains (excluding whistles), as part of the keynote sound but these are not of great importance to this study because South Fairfield lacks nearby rail networks. The Esquimalt-Nanaimo line is the closest rail network and, since it is approximately two air miles from South Fairfield, it produces sounds that are very faint in the study area.

In general, the nature of the South Fairfield keynote sound can be expected to be quite different from Vancouver's as Victoria is a smaller centre with fewer activities contributing to the keynote sound. The high volume of road traffic characteristic of most North American cities, for example, is considerably lower in Victoria. A network of

heavily travelled roads and highways and an industrial base to generate traffic for this system, are not prominent features of Victoria's landscape.

South Fairfield's proximity to the flight path for sea planes landing in Victoria's Inner Harbour is one of the few factors contributing to keynote sound that is shared by both Victoria and Vancouver. For Victoria, however, the effect is slightly reduced due to a lower volume of air traffic. Similarly, coast guard helicopters, trucks, and buses make a much smaller impact because of the reduced scale of activity.

Soundmarks have a permanent character which contrasts sharply with the variability of keynote sound. As with landmarks, their prominence and preservation may be due to a number of factors ranging from their ability to perform some functional role to their aesthetic value in a particular setting. South Fairfield claims several soundmarks which serve to enrich the character of the soundscape. Fog horns, for example, are a reminder of South Fairfield's proximity to the ocean and they also serve a vital role in the navigation system.

The carillon tower, located in Victoria's Inner Harbour, can also be classified as a soundmark. Similarly, church bells represent an additional soundmark which is an important part of the South Fairfield soundscape. The aesthetic qualities of both the church and carillon bells rests in their musical attributes and they also serve functional roles by transmitting acoustical information. The carillon bells, sounded daily at regular intervals, provide a gentle reminder of the time. This is also true of the church bells although they are not rung daily. The church bells dominating the South Fairfield soundscape are

housed in one of Victoria's oldest churches and they have been rung in the same sequence since their construction. These bells, therefore, are extremely valuable as historical soundmarks.

An additional soundmark is produced by several varieties of birds (particularly peacocks) that are kept in a compound in Beacon Hill Park. The unusual sounds produced by these birds remind residents of the adjacent park area and the uniqueness of South Fairfield's location. Sound events lack the permanence of soundmarks but they are ascribed equal value as they also add to the character of the soundscape. In South Fairfield, many of the activities taking place in Beacon Hill Park produce sound events that figure prominently in the soundscape. Regular sports events, weekly pipe band practice, as well as the summer jazz series are examples of sound events experienced in the study area. Sound events perform a role similar to soundmarks by being symbolic qualities of South Fairfield.

The final group of sounds identified by the WSP are the sound signals. Similar to sound events and soundmarks these sounds are classified as figure rather than ground as they tend to be consciously listened to because they transmit important information. Although any number of sounds could potentially fit into this category, the WSP defines sound signals as warning devices such as horns, sirens or whistles. This definition does create a dual classification for sounds such as foghorns which exist simultaneously as prominent stationary sound sources and as off-shore acoustic warning devices. For the most part sound signals are mobile and not location specific. Examples are the sirens signifying the presence of police vehicles, fire trucks, or ambulances which tend to be ubiquitous and generally characteristic of

most urban areas. Boat whistles are heard less frequently and their presence in the study area is an additional reminder of South Fairfield's adjacent marine environment. The sources of these whistles are the passenger vessels travelling between Victoria, British Columbia and Seattle, Washington and Victoria, British Columbia and Port Angeles, Washington. Their whistles, sounded upon entering and leaving the harbour, figure prominently in Victoria's soundscape.

The WSP classification of soundscape features is also a useful method for presenting relationships of some of the key elements of the South Fairfield soundscape. The only prerequisite for this discussion of these sounds was a preliminary knowledge of the character of the study area and the immediate environment in terms of the major types of land use and the activities taking place within these settings. The objective analysis adds more depth to this understanding by examining the actual occurrence of these sounds in the study area.

4.2 OBJECTIVE SOUNDSCAPE OF SOUTH FAIRFIELD

4.2.1 Soundscape Components

One of the first features of the soundscape revealed by the objective analysis was that the individual monitor positions tended to have relatively simple sound profiles (Table 4.3). Given the potential range of sound type presented on the soundwalk sheets it was surprising to find that 16 represented the maximum number of different types of sound heard for any monitor period. It is also clear that a similar number of sounds was heard at each of the monitor positions.

Additional aspects of sound types are presented in Table 4.3

Table 4.3 Temporal Variations in Number of
Sound Types at the Monitor Positions

Time P.M.	Number of Sound Types									Total
	4-5	6	7	8	9	10	11	12	13-16	
5-6	0	2	3	4	6	2	5	1	2	25
6-7	2	2	4	2	6	4	3	3	4	30
7-8	3	5	4	4	0	2	3	3	1	25
8-9	2	5	9	4	3	1	0	1	0	25
Total	7	14	20	14	15	9	11	8	7	105

Table 4.4 Daily Variations in Number of
Sound Types at Monitor Positions

Day	Number of Sound Types									Total
	4-5	6	7	8	9	10	11	12	13-16	
Wed.	1	1	3	3	4	2	2	2	3	21
Thurs.	1	3	3	4	2	1	1	3	3	21
Fri.	1	3	5	2	1	2	6	0	1	21
Mon.	2	4	3	2	7	3	0	0	0	21
Tues.	2	3	6	3	1	1	2	3	0	21
Total	7	14	20	14	15	9	11	8	7	105

which also provides a breakdown with monitor time and Table 4.4 which crosstabulates sound type by monitor day. In the production of these tables the distribution of sound type has been condensed but statistical analysis of the tables is still limited as they have a high proportion of valid cells below expected cell frequency. Fortunately, the tables are still useful for identifying trends in the relationships between the variables. A significant feature of Table 4.3 is that the number of sound types tends to decrease with time. For example, between eight and nine o'clock only two monitor positions report more than nine sound types. Generally, Table 4.3 indicates that the distributions for sound types tend to be quite similar for all time periods.

The distribution of cases in Table 4.4 indicates an almost total daily representation of at least one monitor position in each of the nine categories of sound type. Monday is the exception to this trend as it lacks cases with greater variety of sound type. Friday and Tuesday also lack cases in these upper categories but they still retain a high percentage of cases with a variety of sound type. In sum, it would appear that the range of sound type was constant on all of the monitored days.

The fairly limited monitor schedule means that the results should be interpreted with caution. Even with these limitations, it still appears as if variations in sound type were not strongly influenced by either the time of day or day of the week. In addition, there is a very strong tendency for all of the monitor locations to have fairly simple sound profiles. This is supported by the fact that the average number of sounds (8.6), represents only 7.6 per cent of the possible

range of sounds summarized on the soundwalk sheets.

To give some identity to the sound types reported at the monitor positions, it is necessary to turn to Table 4.5 which summarizes frequency of occurrence for the individual sounds. One of the most distinctive features of this table is the magnitude of the range in values. The upper limit is maintained by the sounds of car traffic. These sounds can also claim being heard at the greatest number of positions. This feature isolates car sounds as the only sound which comes close to being ubiquitous within the study area. Most of the sounds included in the sound list were rarely heard during the monitoring (75 per cent of the sounds were heard at less than 25 per cent of the monitor positions). The remaining sounds form a somewhat smaller group but this group includes sounds that were recorded at a larger number of monitor positions. Since these sounds were heard more frequently and at a greater variety of locations, it would appear as if they reflect the general characteristics of the South Fairfield soundscape.

The limited range of sound type heard at the monitor positions and the distribution for frequency of occurrence suggests that there will be little similarity in the combination of sounds identified at the monitor positions during the objective analysis. The great variety of sound type heard at the individual monitor positions complicated attempts to provide a description of the general features of the soundscape. In order to generalize about the character of the South Fairfield soundscape, it was necessary, therefore, to develop a classification system which would reduce the range of sound type to a more manageable and yet meaningful size.

Table 4.5 Sound Frequency

<u>SOUND</u>	<u>NO. OF TIMES REPORTED</u>	<u>% OF POSITIONS REPORTING</u>	<u>SOUND</u>	<u>NO. OF TIMES REPORTED</u>	<u>% OF POSITIONS REPORTING</u>
Water	1	1.0	Footsteps	88	53.3
Wind in Trees	31	29.5	Vehicle Horns	7	5.8
Breezes, Storms	34	32.4	Vehicle Doors	43	30.6
Thunder & Lightning	-	-	Vehicle Brakes	-	-
Horses	-	-	Construction Equipment	3	2.9
Dogs, Cats or Other Pets	40	37.2	Mechanical Tools	6	5.7
Small Song Birds	56	53.3	Air Conditioners	-	-
Peacocks	10	19.5	Park Sports Events	6	5.7
Roosters	3	2.9	Playground Activity	5	4.5
Crows	27	25.7	Jazz Concert	9	8.6
Seagulls	18	17.1	Pipe Band Practise	5	4.8
Pigeons	2	1.9	Parades	-	-
Insects	2	1.9	Films	-	-
Male Voice	7	5.8	Church Bells	1	1.0
Female Voice	10	8.6	Carillon Bells	4	3.8
Children's Voices	44	32.6	Boat Whistle	18	17.1
Mixed Voices	39	35.3	Train Whistle	2	1.9
Non-Verbal (Laughing, Coughing, Etc.)	2	1.9	Police Sirens	8	7.6
City Buses	16	15.2	Ambulance Sirens	3	1.9
Charter Tour Buses	10	7.6	Fire Sirens	-	-
Cars	757	97.1	Baby Crying	2	2.0
Motorcycles, Etc.	16	11.4	Conversation	-	-
Trucks	25	12.0	Shouting	-	-
Trains	2	1.9	Using Pool	-	-
Sea Planes & Other Small Planes	41	33.3	Radio, T.V. or Stereo	6	5.7
Jets	33	26.7	Telephone	7	6.7
Helicopters	5	4.8	Plates Clattering at Meal Time	3	2.9
Ships	-	-	Children Playing	1	1.0
Ferries	5	2.9	Gardening	33	31.4
Bicycles	51	30.5	Doors & Windows-Opening & Closing	8	7.6
Roller Skaters	8	3.9	Wind Chimes	6	5.7
Hang Gliders	1	1.0	Distant Urban Traffic	92	87.6
Strollers, Buggies, Etc.	2	1.9	Household Construction	11	10.5

4.2.2 The Classification of Soundscape Components

The principal goal of any classification system is to draw together information to discover similarities, contrasts, and patterns. Inherent in this objective is the fundamental problem that classification systems must provide evidence favouring the strength of a relationship between phenomena that are essentially juxtaposed. The unifying characteristics commonly used to classify sounds can be summarized as: their physical characteristics (acoustics); the way in which they are perceived (psychoacoustics); their function and meaning (semiotics and semantics); or their emotional or affective qualities (aesthetics) (Schafer, 1977b). Problems arise with the classification of sounds because

"...a soundscape cannot be understood merely by a catalogue of such parameters, even if that were possible, but only through the representations formed mentally that function as a basis for memory, comparison, grouping, variation and intelligibility" (Truax, 1978:vi).

These comments suggest that construction of an ideal method of classification will remain elusive as it requires further experimentation with various ways of disaggregating component parameters of sounds.

In an attempt to fill this gap the WSP designed a classification system for their catalogue of world sounds. Organization is based primarily on referential aspects of sound taken from descriptions of sound in literary, anthropological, and historical documents. The system has evolved in response to the WSP's desire to gather information on people's past experiences with their soundscapes. Thus

it has an empirical structure and cannot be considered as entirely definitive. An additional problem that plagues this approach is that the specific sounds lack objective meaning so that each individual's perception of the sound will reflect personal attitudes, values and beliefs. As a catalogue it should be flexible enough to accommodate the findings of additional research; thus it cannot contain a finite number of categories. The design must also allow cross classification between groupings because of the subjective nature of sounds.

Sound groups taken from the catalogue relevant to urban community soundscapes can be identified in the community soundwalk sheets used for the objective analysis. This itemization of the sounds into various themes is the final product of much experimentation conducted by the WSP to develop a systematic approach for collecting and cataloguing information on sounds. Similar to the larger catalogue of world sounds, the list is neither intended to be descriptive of the entire urban soundscape nor are the groupings to be handled as discrete compartments. Based on past success the WSP has had with the soundwalk sheets and their success in the data collection for this study, the use of this classification appeared valid.

Classification of the sounds reduced the community sound list to six categories: natural sounds; human sounds; motor sounds; activity sounds; indicator sounds; and neighbour sounds. The conceptual basis for these groups can be best understood if they are discussed individually.

The unifying theme for the group of natural sounds is that they are not generated by humans or human activity. The only exceptions are for domestic pets and the captive birds confined within Beacon Hill

Park, as one could argue that their presence is the result of human actions. Human sounds are the least diverse of the sound groups, primarily combining incidents of voice communication. The largest and most varied group draws together sources that have a transportation and motor focus. The three subgroups within this category are: motor transportation; non-motor transportation; and motor equipment. The fourth group of sounds, activity sounds, identifies the collage of sounds generated at any one of the several parks or open space areas in the Fairfield study area. Activity sounds generally relate to sound events while the next group, which has been termed indicator sounds, includes the main sound signals (e.g. sirens, carillon bells). The major criterion organizing the final group is that the sounds should in some way be the result of the activities of neighbours.

The obvious overlap between these groups re-emphasizes the complexity of the soundscape and the futility of attempts to fully compartmentalize its components. A classification of environmental sounds based on single properties would be of limited value in terms of generalizing about soundscape characteristics but a system of unmanageable proportions would result with the incorporation of all possible perspectives (e.g. acoustics, psychoacoustics, or semantics). The presence of these obstacles and the previously successful applications of the WSP classification influenced the decision to re-examine the basis for organizing the sounds into the six groups. The frequency counts for sound type provided the data base for investigating the empirical validity of the conceptually formed groups.

The statistical test used for this purpose was the SPSS sub-program Reliability which evaluates multiple-item additive scales

through the computation of widely recognized coefficients of reliability (Hull & Nie, 1979:110). The variables, summed across the five days, were the frequencies of the sounds. The 105 sample positions were reduced to the 21 cases identifying monitor locations. Analysis of reliability was conducted on six scale items representing the sound groups but only sounds heard during the monitoring were included as variables in the scales. The reliability test included options for several methods of analysis. The alpha model, used for this study, is the most frequently used reliability coefficient. The program also generates a correlation matrix and item total statistics with alpha values to indicate the overall effect of deleting individual variables. Table 4.6, summarizing the results of the test, clearly indicates that statistically significant results were not obtained.

Table 4.6 Reliability Coefficients for Scale Construction of Sound Classification Groups

<u>Scale</u>	<u>Alpha</u>
Natural Sounds	-0.28477
Human Sounds	0.08371
Motor Sounds	0.17684
Activity Sounds	0.55016
Indicator Sounds	0.51607
Neighbour Sounds	0.38029

It would appear necessary, therefore, to conclude that the sound groups do not form statistically reliable constructs. This was further supported when the deletion of individual variables from the scale items did not strengthen the measures of reliability. An additional interpretation is that frequency of occurrence is not a sufficiently good measure of sound properties to verify identified patterns and interrelationships among soundscape parameters. This conclusion is probably quite valid since there is no firm evidence that sound (or even noise) frequency is related to the physical or psychological properties identifying similar groups of sounds. Although the reliability test did not provide empirical support for the WSP classification several factors seem to justify its present use for examining soundscape composition until an alternative method can be developed. These include: the problems associated with the use of frequency data which may have influenced the results of the reliability test; the successful use of these groups in previous studies (Kawano, 1981; Schafer, 1977b); and, the successful use of these groups in the field work conducted for this study.

4.2.3 Soundscape Composition

Sound pressure level was obtained by examining the graphic display produced from the frequency analysis. A SPL value was selected from a point at the start of the taping where the frequency spectrum was not obviously dominated by a single sound source. The five SPL's for each position, one for each day of monitoring, were then averaged to provide the values summarized in Table 4.7. Although a geometric average does not take into account the logarithmic progression of SPL, there was

enough similarity in the five values to justify its use. Leq, an integrated average that is taken over an appropriate time period would have been more representative of overall conditions but it was not used because of lack of available time and equipment. This may also explain why the SPL's for the monitor positions tended to be higher than the 35 - 45 dBA level recommended for residential areas (Ontario Ministry of the Environment, 1976).

Table 4.7 SPL For Monitor Positions

<u>Position Number</u>	<u>dBA</u>	<u>Position Number</u>	<u>dBA</u>
1	54	12	60
2	66	13	49
3	67	14	52
4	65	15	52
5	50	16	48
6	57	17	52
7	57	18	48
8	47	19	53
9	51	20	52
10	50	21	54
11	52		

Scattergrams were first plotted for SPL by the sound groups (reproduced in Appendix D), and the correlation coefficients summarizing these distributions are presented in Table 4.8. The highest correlation coefficient indicated a strong positive association between SPL and frequency of motor sounds. The visual display of this distribution presented in this particular scattergram revealed the presence of two extreme scores characterizing positions with very high motor content and SPL. Although these cases may have strengthened the correlation, the roughly linear distribution of the remaining cases in the scattergram suggested that there is a definite association between SPL and motor sound which is increasing in a positive direction.

The only remaining sound groups with reasonably high correlation coefficients at reliable levels of significance were natural and neighbour sounds. Their negative values indicated a tendency for the frequency of both sound types to decrease with rising SPL. A similar pattern is evident for the three remaining groups, but the strength of association is not as high and the calculated levels of significance imply a need for cautious interpretation. Inspection of the scattergrams for both activity and indicator sounds suggested that the strength of association was being influenced by a number of cases which did not have any sound in a particular group.

The strong positive association between SPL and motor sounds is a relationship which has been repeatedly confirmed in studies measuring traffic volume and dBA levels, but what these studies have failed to examine is the effect on additional sounds. The absence of a strong relationship between SPL and sound frequency in the sound groups other than motor sounds served to suggest the need to examine relationships

Table 4.8 Correlation Coefficients for SPL & Motor Sound with Sound Groups

			<u>Correlation Coefficient</u>	<u>Significance Level</u>
Motor Sound	by	SPL	.79507	.00001
Natural Sound	by	SPL	-.59910	.00205
		Motor Sound	-.43839	.02341
Human Sound	by	SPL	-.44846	.02072
		Motor Sounds	-.49931	.01060
Activity Sound	by	SPL	-.28014	.10935
		Motor Sound	-.24629	.14092
Indicator Sound	by	SPL	-.23659	.15091
		Motor Sound	-.25919	.12925
Neighbour Sound	by	SPL	-.64169	.00086
		Motor Sound	-.51789	.00809

between the sound groups themselves (scattergrams reproduced in Appendix E).

The first relationship to be examined was between motor sound and the the five additional groups. The correlation coefficients measuring the association between these variables are also presented in Table 4.8. The measures are very similar to the values calculated for SPL with only natural and neighbour sound exhibiting any sizeable variation. This consistency re-emphasizes the link between SPL and motor sound frequency and their apparent effect on decreasing the variety of sounds heard within the study area but they do not provide evidence of a direct relationship between motor sounds and the five additional groups.

In an attempt to discover relationships between the sound groups, scattergrams and correlation coefficients were produced for all possible combinations of the sound groups. The results of these tests are summarized in Table 4.9. Strong linear patterns were not identified in the scattergrams and the absence of relationships was confirmed by a lack of significant correlation coefficients. These results suggest that although there may be a tendency for sound frequency in the groups to decrease with rising SPL and number of motor sounds, there are no associated patterns between the sound groups in the way they increase or decrease.

Following attempts to find patterns in the frequency measurements for sound groups, investigation of soundscape composition shifted to a study of the spatial distribution of the various parameters. The importance of the spatial dimension is readily apparent when features such as SPL are referenced to the actual monitor locations. It is

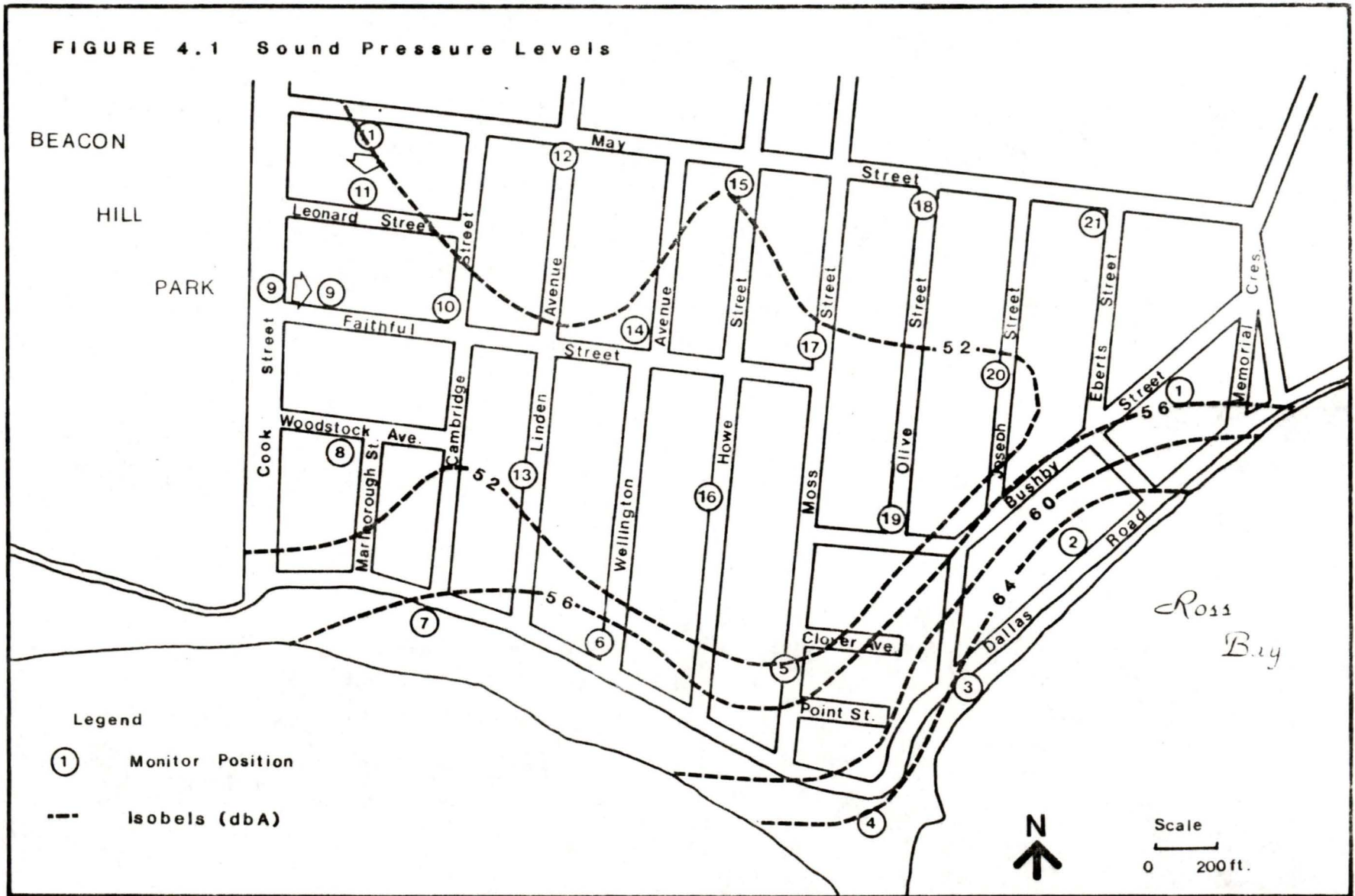
Table 4.9 Correlation Coefficients for All Sound Groups

			<u>Correlation Coefficient</u>	<u>Significance Level</u>
Natural	by	Human Sound	.53405	.00632
		Activity Sound	.12111	.30051
		Indicator Sound	.29318	.09856
		Neighbour Sound	.22670	.16152
Human Sound	by	Activity Sound	-.07703	.36999
		Indicator Sound	.39380	.03867
		Neighbour Sound	.15771	.24738
Activity Sound	by	Indicator Sound	.21218	.17791
		Neighbour Sound	.60130	.00197
Indicator Sound	by	Neighbour Sound	-.06883	.38673

evident from the spatial pattern of isobels (Figure 4.1) that the highest SPL recordings were taken along Dallas Road from Clover Point into Ross Bay. These positions represent the extreme scores identified in the association between SPL and motor sound. The greater frequency of motor sounds and the higher SPL recordings appear to be the result of the Dallas Road traffic but as the isobel contour is not continuous along Dallas Road, this provides only a partial explanation for these conditions.

The first factor influencing these variations in SPL is that the monitor positions between Cook and Moss Streets are slightly farther from Dallas Road. Although the distance is not great it is significant in relation to the attenuation rates of sound. This is evidenced by the lower SPL readings and a decrease in the ability to discriminate between sound events. The physical environment has acted as an additional factor contributing to the variations in SPL. The portion of Dallas Road contained within the study area can be divided into two distinct areas. The first section slopes from Clover Point to Ross Bay where it is only slightly above the ocean. As it descends, the narrow zone of grass parkland is gradually eliminated and in its place a concrete wall separates the sidewalk and street from the lower beach area. This wall was designed to deflect the high waves produced in the Juan de Fuca Strait during stormy weather. It performs a similar function within the soundscape as it restricts outward propagation of sound waves generated at the street level. This serves to increase SPL and often the ability to distinguish between sound events, although the higher SPL may also be associated with an increased masking effect.

FIGURE 4.1 Sound Pressure Levels



In general, the isobel contours identify positions with high SPL along the periphery while the lower levels are found within the interior of the study area. This pattern emphasizes the role of motor sounds and it also gives support to the idea that there are definite spatial variations in the composition of the soundscape.

In search of possible patterns in soundscape composition, the monitor positions were subsequently examined using a multivariate test operating on the frequency data for the 6 sound groups. The technique selected was cluster analysis using a programme included in the SAS package. Sound frequencies for the 5 days were combined to produce the 21 cases representing the individual monitor locations. The 6 sound groups were the variables for the test. Cluster analysis examined the monitor locations in terms of the sound groups by measuring distance between variables.

The major weaknesses of the test are that it does not provide statistics to indicate the strength of the clusters and it does not suggest an optimum number of clusters. It is necessary, therefore, to repeat the test several times varying specifications as to the required number of clusters. These results can then be subjectively examined to determine the set which best reflects patterns thought to occur within the sample data. Fortunately, this feature did not prove to be a major obstacle to this study as the number of potential clusters was kept to a minimum by the small sample of monitor positions. It was decided, therefore, to cluster the data into three, four, and five groups.

The organization of the monitor positions into three clusters did not provide much additional information relating to soundscape composition. The three positions with high traffic and little variety

of sound type were sufficiently different that they formed two of the three clusters. The main feature separating these two clusters was their relative number of motor sounds. The third cluster, containing the 18 remaining cases, was the only group to change when the command for the number of clusters was varied. Therefore, any substantial increases in the number of required clusters may produce artificial divisions in this large cluster. To partially account for this effect, clustering was limited to four groups.

The four resulting clusters are summarized in Table 4.10. The test calculations of distances within and between clusters firmly established the dominance of the motor sound category in determining the grouping of the positions. Differences between the clusters in terms of the remaining sound groups are less dramatic but they are still useful in generalizing about characteristics of the positions forming clusters.

The features shared by the third and fourth clusters are their high traffic content, lack of neighbour sound, and their relatively few indicator, human, activity and natural sounds. The first two clusters present quite a contrast to this profile as they have a much lower motor sound content, but a higher representation of sounds in the five remaining groups. The differences between clusters one and two exist mainly in terms of sound frequency within a particular group. Cluster two tends to be characterized by slightly higher mean values in the sound groups, although these values are generally quite similar for both clusters. The motor sound group and to a lesser extent, neighbour sound, are the only categories which exhibit any sizeable variation.

Table 4.10 Cluster Analysis Producing Four Clusters

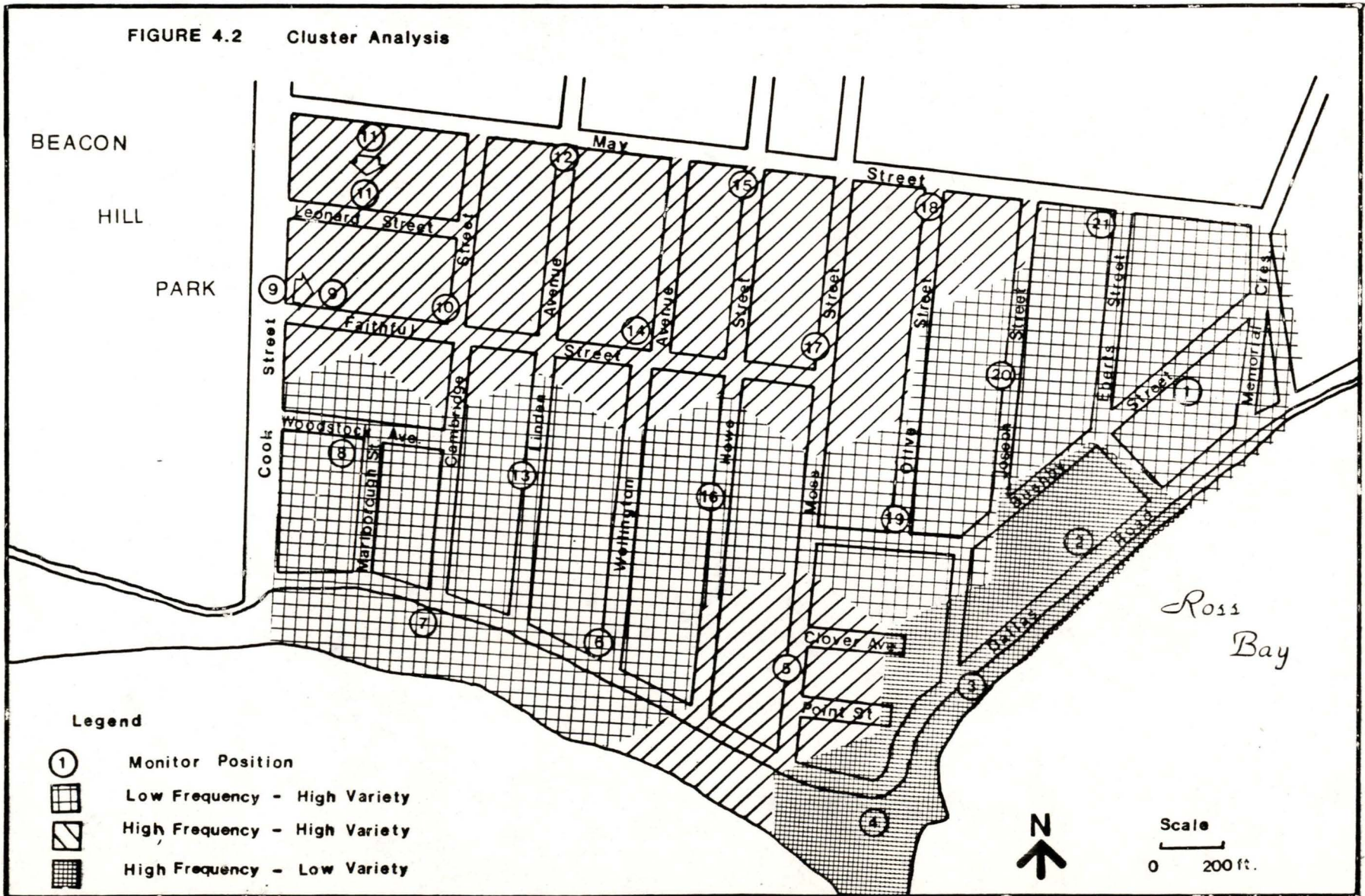
Cluster Sound Type	Position Number	Frequency of Sounds in Sound Groups				Indicator Sounds	Neighbourhood Sounds	
		Natural Sounds	Human Sounds	Motor Sounds	Activity Sounds			
Low Frequency High Variety	1.	1	11.0	10.0	24.0	0.0	3.0	2.0
		6	12.0	6.0	25.0	0.0	1.0	0.0
		21	9.0	5.0	27.0	2.0	1.0	1.0
		13	14.0	4.0	29.0	0.0	0.0	3.0
		16	13.0	9.0	31.0	0.0	0.0	4.0
		7	6.0	1.0	30.0	0.0	0.0	3.0
		8	10.0	2.0	23.0	2.0	0.0	5.0
		18	9.0	6.0	20.0	1.0	1.0	6.0
		20	8.0	8.0	18.0	1.0	0.0	5.0
		Mean	10.2	5.7	25.2	0.7	0.7	3.2
High Frequency High Variety	2.	5	12.0	7.0	41.0	0.0	2.0	5.0
		14	12.0	6.0	44.0	2.0	2.0	5.0
		9	11.0	4.0	38.0	5.0	3.0	5.0
		10	12.0	6.0	39.0	3.0	2.0	7.0
		11	11.0	5.0	33.0	4.0	0.0	7.0
		12	8.0	3.0	59.0	2.0	0.0	7.0
		15	10.0	3.0	59.0	1.0	0.0	4.0
		17	12.0	7.0	54.0	1.0	1.0	3.0
		19	10.0	3.0	49.0	1.0	0.0	5.0
		Mean	10.9	4.9	46.2	2.1	1.1	5.3
High Frequency Low Variety	3.	4	9.0	4.0	90.0	1.0	0.0	0.0
	4.	2	9.0	1.0	235.0	0.0	0.0	0.0
		3	5.0	2.0	232.0	0.0	1.0	0.0
		Mean	7.0	1.5	233.5	0.0	0.5	0.0

Although the differences between the two clusters are minimal, the second cluster does have a slightly greater frequency of both motor and non-motor sounds. This produces a soundscape which is quite different from the soundscape identified by the distribution of the frequencies in the sound groups for the third and fourth clusters. Overall, these positions have a greater frequency of sound events but the concentration in the motor sound group appears to have had a detrimental influence on sounds occurring in other sound groups. Two possible explanations can be proposed to account for the presence of these different soundscapes within this relatively homogeneous residential area. Since increasing SPL was identified in association with a higher frequency of motor sounds, it is possible that a condition is being created that results in the masking of numerous sounds. The reduction in the diversity of sound type may also be explained as the product of a situation generating a large number of motor sound activities that are incompatible with non-motor sound producing activities. Observations made during the field work suggest that the characteristics of clusters three and four are due to both masking effects and the existence of relatively fewer sound sources.

One final aspect of soundscape composition was observed by producing a map of clusters. The clusters were distributed in the definite spatial pattern identified in Figure 4.2. The third and fourth clusters were combined to form the area with the highest frequency of sound events but the lowest variety of sound type. These positions also coincide with the section of Dallas Road with the highest values of SPL.

The second cluster forms a block in the northwest portion of the

FIGURE 4.2 Cluster Analysis



study area. A combination of high motor content and high frequency and variety of sound type are the principal features of monitor positions included in this group. Monitor position 5 also shares these characteristics although it is not actually adjacent to the main group. The remainder of the study area between these two sections contains the monitor positions identified with the first cluster. The means for the sound groups and the frequencies within the two clusters exist mainly in the level of activity taking place within each area.

4.3 SUMMARY

The objective analysis identified a wide range of sound types which included many of the sounds identified as key features of the South Fairfield soundscape. Despite this potential for variety, the number of sounds recorded at the monitor positions was fairly consistent. The number of sounds changed very little across the individual monitor locations, times, or days, but the sound content of the 21 locations was not equally as stable. Cars were the only sound source which could be considered ubiquitous within the study area. The next most common sounds were other traffic and motor-related sounds as well as sounds classified as human or natural. The rarer sounds tended to belong to the indicator, activity, or neighbour groups. This organization of frequencies supports Schafer's assertions that motor sounds, particularly those produced by cars, are the major component shaping the keynote sound of urban areas. Although the dominance of motor sounds is unquestionable, natural and human sounds also serve a valuable role in shaping the character of the study area soundscape.

The ability of the objective analysis to identify some of these sources as regular features of the soundscape also confirmed that South

Fairfield is not typical of what Schafer identified as the overwhelmingly complex urban soundscape. These observations provided further support for the use of South Fairfield as an appropriate area in the examination of soundscape perceptions.

The data collected during the objective analysis was not as successful in drawing support for the structure of the WSP classification of sounds. Due to the wide range of the frequency values and the presence of numerous rarely reported sounds, statistical confirmation of the conceptually formed groups was not obtained. Even with these limitations the groups of sounds did prove useful in identifying spatial variations in the composition of the soundscape within the study area. The differentiation between monitor positions was primarily in terms of the more frequently reported sounds and therefore reflected variations in general soundscape character rather than the uniqueness of specific locations. In sum, the objective analysis identified features of the soundscape which were both unique and general in nature. The more general features, the WSP's keynote sound, were sufficiently varied that spatial differences in the organization of the sounds were also identifiable. These differences were not extreme, but they suggest the sensitivity of the soundscape to changes in the level of sound-generating activities. Although unique features were also identified, they were rarer sounds that were not often present during the objective analysis.

CHAPTER 5

SUBJECTIVE ANALYSIS

This chapter focuses on the questionnaire data collected during the second stage of the research. The first section examines the questionnaire respondents' general impressions of soundscape quality in South Fairfield. The next section takes a more specific look at perceptions of individual soundscape components. The third section examines the nature of information associated with the perceived sounds. The final section summarizes the subjective analysis.

5.1 SOUNDSCAPE QUALITY

The initial concern of the questionnaire (Appendix B) was to gain an understanding of the respondents' general impressions of the study area soundscape. The difficulties associated with both conceptualizing (Ihde, 1973; 1976) and expressing (Schafer, 1977b) acoustic experiences made it necessary to obtain this information through a series of questions that were both formatted and open-ended.

Introducing the open-ended questions was a single rating scale ranking general neighbourhood sound quality. The responses to this question (Table 5.1) provide an initial qualitative assessment of neighbourhood sound. The distribution of data in this table indicates a generally favourable rating of neighbourhood sound quality. Slightly over 66 per cent of the respondents felt South Fairfield was either a quiet or a very quiet area. In comparison, only 6.5 per cent felt that the area was noisy and there were no responses indicating that the

Table 5.1 Impression of Neighbourhood Sound Quality

Question 10. Accounting for all sounds, this neighbourhood is...

Question 1. On the whole this neighbourhood is.....	Freq.	An Ideal	A Good	A Fair	An Unsatis-	An Extremely	Total
	Row Pct	Place	Place	Place	factory	Unsatisfactory	
	Col Pct				Place	Place	
Very Quiet	6	3	0	0	0	0	9
	66.7	22.2	0.0	0.0	0.0	0.0	14.5%
	46.2	5.0	0.0	0.0	0.0	0.0	
Quiet	7	24	1	0	0	0	32
	21.9	75	3.1	0.0	0.0	0.0	51.6%
	53.9	60	12.5	0.0	0.0	0.0	
About Average	0	13	4	0	0	0	17
	0.0	76.5	23.5	0.0	0.0	0.0	27.4%
	0.0	32.5	50.0	0.0	0.0	0.0	
Noisy	0	1	3	0	0	0	4
	0.0	25.0	75.0	0.0	0.0	0.0	6.5%
	0.0	2.5	37.5	0.0	0.0	0.0	
Very Noisy	0	0	0	0	0	0	0
	0.0	0.0	0.0	0.0	0.0	0.0	
	0.0	0.0	0.0	0.0	0.0	0.0	
Total	13	41	8	0	0	0	62
	21%	66.1%	12.9%				

study area was very noisy. The next series of questions provide an understanding of this positive assessment.

Questions 2, 3, and 4 looked at experienced changes in neighbourhood sound quality as well as wanted and unwanted change (Table 5.2 and Table 5.3). Almost half (45.2%) of the respondents indicated that they had not experienced any change in neighbourhood sound quality during their residence in the study area. When change was identified it was usually restricted to a single source. Only 19.4 per cent of the respondents identified two sources of change while as few as 4 respondents mentioned 3 sources of change. Increased traffic noise was the most frequently mentioned cause of change in neighbourhood sound quality. This was followed by responses mentioning the shift towards a greater number of young households, particularly young families with children. These have been grouped as changes in the population structure (Table 5.2). Household construction and an increase in the number of pets were considered important sources of change when more than one source was identified. These sound sources reflect various aspects of the process of gentrification, suggesting that neighbourhood sound quality is sensitive to changes which are likely to produce a general increase in the scale of activity in the study area.

More respondents identified sources of unwanted change (71.0%) than wanted change (45.2%). Again, traffic received by far the highest ranking, followed by changes in population structure and land use. These comments seem to be implying that even though respondents positively evaluated the quality of the South Fairfield soundscape,

Table 5.2 Identified and Unwanted Change in Neighbourhood Sound Quality

	Identified Change (Question 2)			Unwanted Change (Question 4)		
Change	53.2%			71.0%		
No Change	45.2%			21.0%		
No Response	1.6%			8.0%		

<u>Source</u>	<u>1st Source</u>	<u>2nd Source</u>	<u>3rd Source</u>	<u>1st Source</u>	<u>2nd Source</u>	<u>3rd Source</u>
Traffic	20			25	1	
Population Structure	8	2		8	4	
Land Use				8	5	
Pets	1	4		1	1	1
Parties	2	5	2	1	1	
Household Construction	1	1	1			
City Maintenance	1					
Aircraft				1	2	
Sirens			1			
Total	33 53.2%	12 19.4%	4 6.5%	44 71.0%	14 22.6%	1 1.6%

Table 5.3 Preference for Change in Neighbourhood Sound Quality

	<u>Preferred Change (Question 4)</u>
Change	29 %
No Change	64.5%
No Response	6.5%

<u>Source</u>	<u>1st Source</u>	<u>2nd Source</u>
No Rental Zoning	6	
Reroute City Buses	5	
Fewer Pets	2	
Better Enforcement of Noise By-Law	2	
Repave City Streets	2	
Fewer Helicopters	2	
Control of Sirens	<u>1</u>	<u>1</u>
Total	21%	1.6%

they were aware that the area was undergoing a process of change that was adversely affecting the quality of the sonic environment.

The respondents were less definite about the types of change they wanted to hear. Fewer than one third of the respondents (29.0%) indicated that there were changes they would like to experience, but of these, only 21 per cent actually listed sources of change. The responses to question 3 usually included comments proposing changes that might lower the incidence of sounds produced by certain activities. An interesting feature of these responses is the almost complete lack of reference to traffic sound, specifically sounds generated by cars. As we have seen, traffic was identified as the major source of actual change, as well as the principal component of unwanted change, yet respondents did not stress the need to implement methods to reduce or limit the incidence of traffic sound. The only sources of preferred change related to traffic sound were repaving streets and rerouting buses. The remaining sources suggested methods to lower the incidence of some of the unwanted sounds that were presented in question 4. For example, adopting a zoning policy to limit rental is one of the measures which can be used to stabilize population densities. Even though traffic sound was regarded as the major source of change, the respondents were not able to recommend methods for controlling this sound source

5.2 SOUNDSCAPE COMPONENTS

The community sound list (question 5) provided data relating to the respondents' recognition of the sounds associated with the area in and around their homes. The responses to this list are summarized in

Table 5.4 which ranks the sounds in terms of the percentage of respondents who reported hearing them. The sounds heard by the highest percentage of respondents are mainly the keynote sounds identified during the objective analysis. These included both natural and motor sounds. There were also a few figure sounds exhibiting reasonably high rates of recognition. The most significant group included electro-acoustical warning devices, such as ambulance, fire, and police sirens. Sound events were heard less frequently although at least 70 per cent of the respondents indicated that they heard jazz concerts, pipe band practices or peacocks. The lower percentages in Table 5.4 are frequently associated with South Fairfield's soundmarks: church bells 65 per cent; carillon bells 48 per cent; and fog horns 24 per cent. The additional group of figure sounds sharing these low percentage rates was made up of sounds associated with the activities of neighbours. The pattern of these results is significant as it indicates that respondents were more aware of the components of the ground of the soundscape than of the figure sounds. In other words, aside from the sound signals, the sounds meant to be consciously listened to were less often perceived by the respondents.

The community sound list also provided an indication of the number of sounds heard by individual respondents. The average number of sounds heard was 36.9. The range of this distribution was quite high with a lower limit of 11 and an upper limit of 63 but most of the scores tended to cluster around the mean, thereby indicating that respondents generally recognized about the same number of sounds.

To check for patterns between respondents in terms of frequency of mentioned sounds, several statistical tests were conducted to match

Table 5.4 Analysis of Community Sound List*

Sound	Frequency Heard (%)	Mean From Rating Scale	Standard Deviation of Rating	Sound	Frequency Heard (%)	Mean From Rating Scale	Standard Deviation of Rating
Ferries	26	2.063	2.100	Radios, T.V. or Stereo	66	3.878	1.661
Jets	26	4.375	1.408	Pigeons	67	3.714	1.597
Plates Clattering	27	3.235	.664	Vehicle Brakes	68	5.452	.832
Fog Horns	29	1.609	1.150	Children Playing	69	2.419	1.277
Construction Equipment	31	5.105	.875	Footsteps	69	2.628	.900
Water	31	1.579	.961	Vehicle Horns	71	5.045	.914
Playground Activity	33	2.476	1.078	Male Voice	71	2.955	1.238
Ships	34	2.048	1.004	Female Voice	71	2.727	1.246
Roller Skaters	35	2.727	1.316	Jazz Concert	71	2.295	1.636
Household Construction	37	3.609	1.530	Peacocks	73	1.867	1.079
Wind Chimes	39	2.458	1.693	Gardening	74	2.130	.957
Insects	43	3.556	1.761	Pipe Band Practise	74	2.087	1.380
Doors and Windows Opening and Closing	45	3.464	1.036	Helicopters	76	3.957	1.367
Trucks	47	5.207	.774	Mixed Voices	79	2.766	.985
Baby Crying	48	3.567	1.675	Sea Planes & Other Small Planes	81	3.540	1.328
Carillon Bells	48	1.567	.817	Vehicle Doors	81	4.340	.982
Park Sport Events	48	2.400	1.221	Crows	81	4.315	1.503
Non Verbal (Laughing, Coughing, Etc.)	50	3.419	1.025	Motorcycles, Etc.	84	5.077	1.045
Telephone	52	3.750	1.545	Breezes, Storms	85	2.356	1.297
Distant Urban Traffic	53	4.121	1.474	Wind in Trees	86	1.811	1.833
Shouting	55	4.824	1.314	Childrens Voices	87	2.389	.988
Bicycles	56	2.257	.780	Ambulance Sirens	92	4.912	1.074
Conversation	58	3.083	1.556	Fire Sirens	93	4.828	1.272
Strollers, Buggies, Etc.	58	2.389	1.128	Police Sirens	93	4.948	1.146
Boat Whistle	60	2.027	.866	Seagulls	93	3.207	1.673
Mechanical Tools	60	4.595	1.142	Small Song Birds	93	1.172	.464
Thunder & Lightning	63	3.000	1.556	Dogs, Cats & Other Pets	98	4.016	1.500
Church Bells	64	1.625	.838	Cars	98	4.18	1.258
City Buses	65	4.100	1.277				

*This list does not include those sounds heard by fewer than 25 percent of the respondents.

sound frequency with the household profile questions.¹ Pearson's correlation coefficients were calculated for the questions producing continuous data (Table 5.5). The results were not statistically significant but they did suggest the presence of some relationships between the variables. The negative coefficients for both years of residence in South Fairfield and years of residence in Victoria suggested that the respondents who had lived in the area for longer periods were aware of fewer sounds. These findings conflict with the assumptions of previous soundscape studies which sought the long-term residents to act as experts to provide earwitness accounts of various aspects of the soundscape and soundscape change. A crosstabulation of sound frequency by years of residence (Table 5.6) confirmed a tendency for the more recent residents to report hearing the most sounds. An examination of Table 5.7 partially explains this pattern. Several of the respondents, although new residents in South Fairfield, had moved there from within Victoria so they may have had previous exposure to some of the soundscape components.

Table 5.5 Pearson Correlation Coefficients for Sound Frequency Data

	Correlation Coefficient	Level of Significance
Household Size	.1830	.077
Years of Occupancy	-.1101	.197
Years of Residence in Victoria	-.0456	.362

¹The household profile data is reproduced in Appendix F

Table 5.6 Years of Residence in South Fairfield
By Sound Frequency Data

Freq. Row Pct Col Pct	Frequency of Sounds Heard			Total
	10-29	30-49	50-69	
L 5	6 27.3 35.3	13 59.1 36.1	3 13.6 33.3	22
5-10	5 23.8 29.4	12 57.1 33.3	4 19.0 44.4	21
10-20	1 16.7 5.9	4 66.7 11.1	1 16.7 11.1	6
G 30	2 50.0 11.8	2 50.0 5.6	0 0.0 0.0	4
Total	17	36	9	62

Table 5.7 Years of Residence in Victoria
By Sound Frequency Data

Freq. Row Pct Col Pct	Frequency of Sounds Heard			Total
	10-29	30-49	50-69	
L 5	5 55.6 29.4	3 33.3 8.3	1 11.1 11.1	9
5-10	3 21.4 17.6	8 57.1 22.2	3 21.4 33.3	14
10-20	2 16.7 11.8	8 66.7 22.2	2 16.7 23.2	12
20-30	0 0.0 0.0	7 87.5 18.4	1 12.5 11.1	8
G 30	7 36.8 41.2	10 52.6 27.8	2 10.5 22.2	19
Total	17	36	9	62

Crosstabulations were also used to examine frequency of sounds mentioned in relation to the remaining household profile questions. For the most part, these tables did not reveal any significant patterns in the data, although the distribution of sound frequency by age group (Table 5.8) does suggest that older residents generally heard fewer sounds. In an attempt to offer some explanation to this pattern, questions 20 and 21 were examined to determine whether or not fewer sounds were mentioned because of a past or present hearing impairment. Although relatively high percentage of the respondents tended to be in an older age category (12.9% were 65 years or more), this did not correspond with an equally high percentage reporting hearing difficulties. Only 4.8 per cent of the respondents indicated a current hearing problem. There was no mention of past hearing problems although there was an 8.1 per cent no response rate to this question.

Table 5.8 Age By Sound Frequency

Sound Frequency	A G E					Total
	Freq					
	Row Pct Col Pct	18-30	31-44	45-64	G 65	
10-29	3	6	3	5		
	17.6	35.3	17.6	29.4	17	
	21.4	24.0	20.0	62.5		
30-49	10	16	9	1		
	27.8	44.4	25.0	2.8	36	
	71.4	64	60.0	12.5		
50-60	1	3	3	2		
	11.1	33.3	33.3	22.2	9	
	7.1	12.0	20.0	25.0		
Total	14	25	15	8	62	

The 6-point rating scales opposite each of the sounds in the community sound list provided a measure of whether the respondents liked or disliked hearing the sounds they recognized. The means for the scales are summarized in Table 5.4. The sounds receiving the most positive ratings or, in other words, the sounds respondents like hearing, were: small song birds; carillon bells; water; hang gliders; church bells; wind in trees; fog horns; and, peacocks. The respondents indicated that they disliked hearing such sounds as: vehicle brakes; trucks; construction equipment; motorcycles, etc.; vehicle horns; police, ambulance and fire sirens; and, shouting. In general, the respondents liked hearing most natural sounds but disliked hearing motor-transportation sounds.

To determine how well the means reflected the average response on the rating scales, standard deviations were also calculated (Table 5.4). Over 70 per cent of the standard deviations exceeded 1.0, which indicates that there was some lack of agreement on the rating of the sounds. Variations in individual evaluations are even more apparent in 23 per cent of the scales exhibiting standard deviations about 1.5. These results strongly suggest that attempting to separate the positively from the negatively perceived components of soundscape is pursuing an unobtainable objective.

For each respondent, an average of the rating scales for all of the sounds was also calculated. This provided an additional measure of the respondent's general evaluation of the study area soundscape. The mean of these average ratings was 3.2. This value indicates that, overall, the combination of sounds heard by respondents produced a rating towards the neutral or no-opinion position on the 6-point scale.

Although the overall mean represented a mid-range value, there was sufficient variation between the individual values to make them useful for crosstabulating with other variables.

As with the data for sound frequency, the relationship between these scores and the household profile variables were examined using both Pearson's correlation coefficients and crosstabulations. The results from the correlation coefficients were not statistically significant (Table 5.9), so it was necessary to use crosstabulations to check for possible patterns between the variables. The average ratings were condensed into three groups for the production of the tables. The categories were selected to represent meaningful positions on the evaluative scales. The three categories were initially crosstabulated with years of residence in both Victoria (Table 5.10) and in South Fairfield (Table 5.11). The low cell frequencies in the tables prevented statistical analysis of these relationships. The tables also failed to present obvious visible patterns between the variables which suggested that the respondents' average sound rating was not strongly influenced by familiarity of the soundscape. More definite patterns emerged when age was crosstabulated with the sound rating categories (Table 5.12). Of the eight respondents with positive sound ratings between 1.6 and 2.5, 5 were in the 45 - 64 year age group. There were no similar concentrations of a particular age group in either of the two remaining sound rating categories. On the whole, the results indicate a generally favourable rating of most sounds was associated with a tendency to consider neighbourhood sound quality as quiet to average (Table 5.13).

The frequency of sounds heard and the average sound ratings were

Table 5.9 Pearson Correlation Coefficients
For Averaged Sound Ratings

	Correlation Coefficients	Level of Significance
Household Size	-.0352	.393
Years of Occupancy	.0195	.440
Year in Victoria	-.1383	.142

Table 5.10 Average Sound Rating By Years
Of Residence In Victoria

	Freq. Row Pct Col Pct	Average Sound Rating			Total
		1.6-2.5	2.6-3.5	3.6-4.5	
L - 5		1	5	3	9
		11.1	55.6	33.3	
5 - 10		12.5	16.7	12.5	14
		0	8	6	
10 - 20		0.0	57.1	42.9	12
		0.0	26.7	25.0	
20 - 30		2	6	4	8
		16.7	50.0	33.3	
G - 30		25.0	20.0	16.7	19
		1	4	3	
TOTAL		12.5	50.0	37.5	62
		12.5	13.3	12.5	
		4	7	8	
		21.1	36.8	42.1	
		50.0	23.3	33.3	
		8	30	24	

Table 5.11 Average Sound Rating By Years
Of Residence in South Fairfield

Years of Residence	Freq.	Average Sound Rating			Total
	Row Pct				
	Col Pct	1.6-2.5	2.6-3.5	3.6-4.5	
L - 5	1	15	6		
	4.5	68.2	27.3	22	
	12.5	50.0	25.0		
5 - 10	3	11	7		
	14.3	52.4	33.3	21	
	37.5	36.7	29.2		
10 - 20	1	2	3		
	16.7	33.3	50.0	6	
	12.5	6.7	12.5		
20 - 30	3	1	5		
	33.3	11.1	55.6	9	
	37.5	3.3	20.8		
G - 30	-0	1	3		
	0.0	25.0	75.0	4	
	0.0	3.3	12.5		
TOTAL	8	30	24	62	

Table 5.12 Average Sound Rating by Age

Averaged Sound Rating	Freq.	A G E				Total
	Row Pct					
	Col Pct	18-30	31-44	45-64	G 64	
1.6-2.5	1	1	5	1		
	12.5	12.5	62.5	12.5	8	
	7.1	4.0	33.3	12.5		
2.6-3.5	7	17	4	2		
	23.3	56.7	13.3	6.7	30	
	50.0	68.0	26.7	25.0		
3.6-4.5	6	7	6	5		
	25.0	29.2	25.0	20.8	24	
	42.9	28.0	40.0	62.5		
TOTAL	14	25	15	8	62	

Table 5.13 Average Sound Rating by Impression of Neighbourhood Sound Quality

Averaged Sound Rating	Freq Row Pct Col Pct	Impression of Neighbourhood Sound Quality				Total
		Noisy	About Average	Quiet	Very Quiet	
1.6-2.5		0	0	5	3	8
		0.0	0.0	62.5	37.5	
2.6-3.5		0.0	0.0	15.6	33.3	30
		2	8	16	4	
3.6-4.5		6.7	26.7	53.3	13.3	24
		50.0	47.1	50.0	44.4	
TOTAL		4	17	32	9	62

also examined using the spatial framework of the sampling design. The resulting spatial distribution of sound frequency values (Figure 5.1), indicates that respondents in the interior of the study area heard the greatest number of sounds. Figure 5.2, mapping the average sound ratings, shows these same respondents as having the most negative ratings of recognized sounds. It would appear, therefore, that the respondents in this area heard a large proportion of the soundscape components but enough of these sounds were sufficiently disliked to produce a slightly negative rating. In comparison, the residents in the area monitored by position 9 heard fewer sounds but generally their average ratings were positive.

The profile of sounds heard by the residents within each of these two areas was examined in a little more depth by returning to the actual questionnaires. This revealed that the residents in the area monitored by position 9 recognized the keynote, natural and motor sounds but they also heard activity sounds produced by events occurring

FIGURE 5.1 Sound Frequency Contours

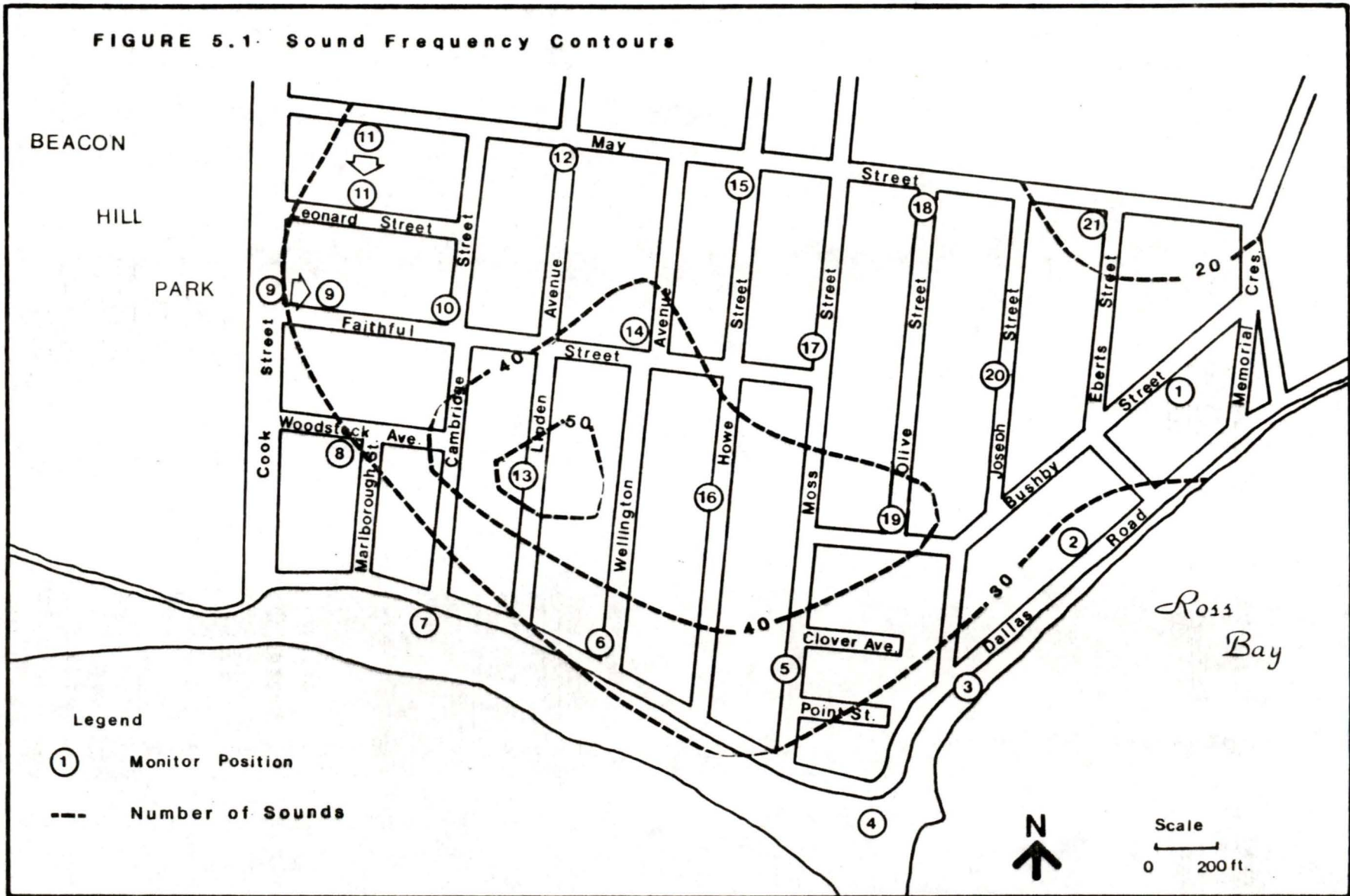
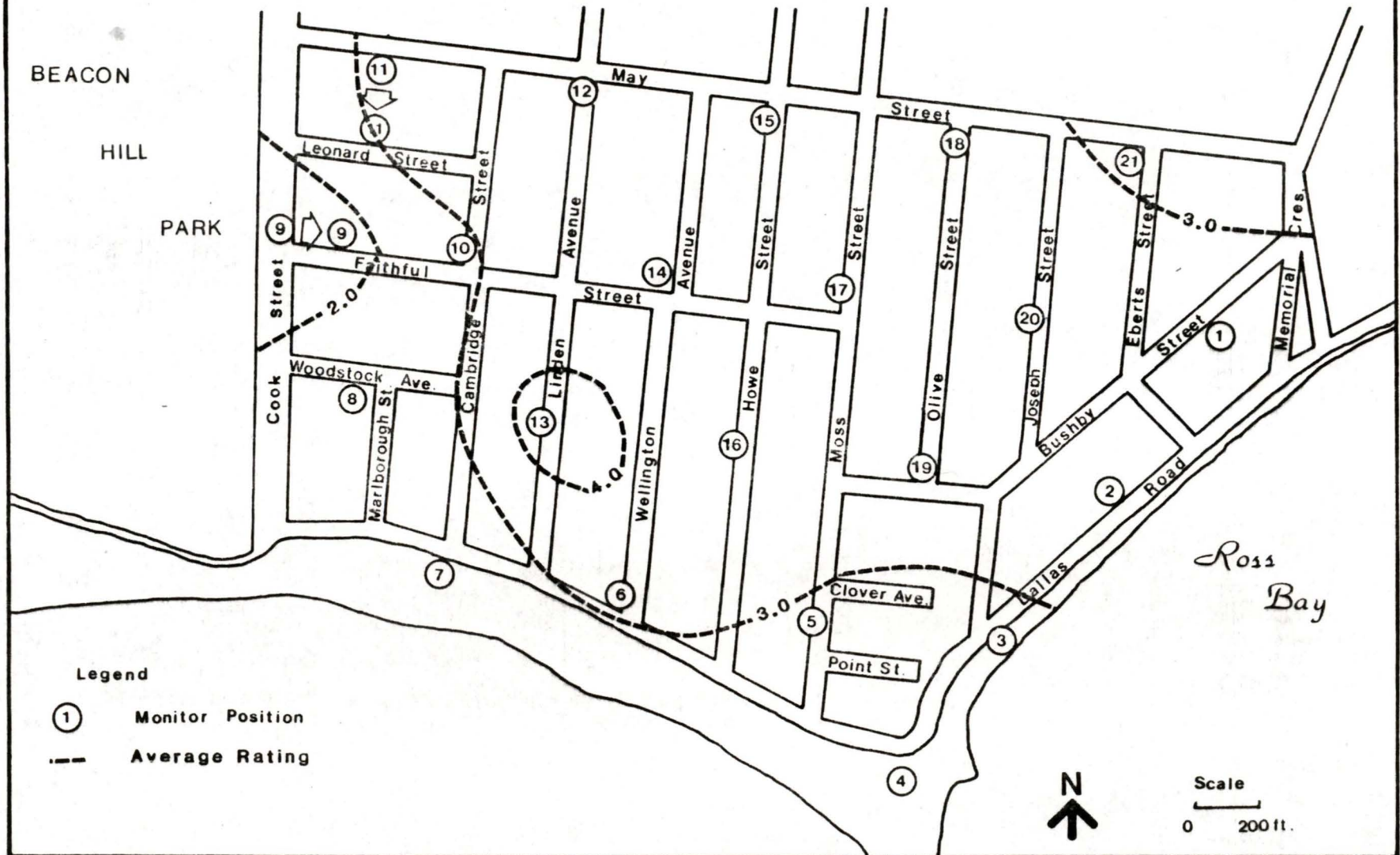


FIGURE 5.2 Sound Rating¹ Contours



in Beacon Hill Park. The generally positive rating of sounds associated with this monitor position was due to the positive evaluation of these sounds as well as the tendency to rate the natural keynote sounds as extremely well-liked sounds. The residents in the area monitored by position 13 also heard and liked these sounds but they reported additional sounds which were less favourably evaluated. The sounds consistently disliked were generally motor sounds, but sirens, several varieties of birds, as well as some neighbour sounds were also given negative ratings. This area was identified during the objective analysis as one of the monitor positions with relatively simple sound profiles and low SPL. As a result it was grouped in the cluster of monitor locations with low sound frequency and low activity rates. Clearly the residents identified a different sound profile than the one obtained during the objective analysis, suggesting that the 'quieter' interior of the study area was conducive to greater acoustic awareness. The correspondence of high sound recognition with a slightly negative average sound rating suggests that the residents of this area may also have been more aware of their soundscape quality and therefore more sensitive to the nature of the components.

5.3 SOUNDSCAPE INFORMATION

Three questions were designed to examine the information respondents gathered from their environment. Question 7 employed a direct approach, simply asking the respondents to list any of the sounds they heard that provided them with information. They were also

asked to outline the information provided by the sound they had listed. The aim of question 8 was to determine whether any of the sounds heard interfered with activities respondents could be engaged in around their homes. The specific concern was to determine whether any of the informative sounds tended to be particularly intrusive. The successful use of interference in noise studies examining annoyance reactions suggested that it would provide an understanding of an additional and important aspect of the sounds. Question 9 was the final question included to examine the information content of particular sounds. This question asked respondents to list sounds associated with seasonal change. Seasonal variation in the soundscape was examined because it had been repeatedly identified in the 5 European villages (Schafer, 1977b) as one of the most significant features of the soundscape to provide residents with information about their environment.

Two thirds of the respondents (66.1 per cent) listed at least 2 sounds that provided them with information (Table 5.14). Almost half of the respondents mentioned at least 4 sounds but no one mentioned more than 5. As expected in this type of open-ended question, there was a great deal of variety in type of information respondents associated with the sounds. Natural sounds were listed frequently with sound sources, such as wind or birds, usually providing information about changes in the weather or the seasons. Indicator sounds, or sounds meant to provide information, represented the most frequently mentioned group. Examples of prominent indicator sounds are the fog horns and the activities in Beacon Hill Park, particularly the jazz concerts and the pipe band practices. Sirens were an additional indicator sound often heard by the respondents and they were usually

Table 5.14 Informative Sounds - Question 7

<u>Sound</u>	<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>	<u>5</u>	<u>Total</u>
Water	1					1
Weather	7	2	5	6		20
Pets	1		3	1	3	8
Birds	3	5	4		1	14
Insects		1		1		2
Childrens Voices		1	1	2	1	5
Mixed Voices	2				4	6
Buses		1	1	3		5
Cars	1	3	3	5	4	16
Planes		1				1
Helicopters	1		1		2	4
Footsteps	1			1		2
Vehicle Horn Brakes	1				1	2
Mechanical Tools	1			3	1	5
Jazz Concerts	3	3	2		2	10
Pipe Band		4	1			5
Church Bells	2		1			3
Boat Whistle	1	5			2	8
Sirens	5	7	4		1	17
Children Playing		2			2	4
Gardening		2				2
Garbage Cans		1			1	2
Fog Horns	11	3	4	8	1	27
Distant Traffic			1			1
<hr/>						
TOTAL	41	41	31	30	26	
% Of Respondents	66.1	66.1	50	48.4	41.9	

associated with information about danger in the neighbourhood. The major sources of motor sounds were cars and buses. These sounds provided information about seasonal and daily increases in the scale of activity in the study area. Respondents noted an increase in motor sounds during the summer as well as fluctuations throughout the day. This latter condition, as well as the regularly scheduled city bus service, provided information about time of day.

The informative sounds heard by respondents tended to be a mixture of both figure and ground sounds. Traffic sounds, a major component of the ambience of urban soundscapes and usually considered to be ground rather than figure sounds, acted as important sources of information for several residents. Sounds from all of the groups provided at least a few respondents with some type of information about their surroundings.

The results from question 8 summarizing sounds that interfered with various household activities, are presented in Table 5.15. Over half of the respondents (61.3%) heard sounds which interfered with their sleep while less than one third identified sounds which interfered with conversation (30.6%) or listening to the radio or T.V. (21.0%). Cars were identified as the sounds which caused the most interference in these activities. Other important traffic and motor related sounds included buses, planes, and motorcycles.

Sirens were the only indicator sounds mentioned with any frequency. Similarly, birds produced the only natural sounds identified by several respondents and these were primarily associated with sleep interference. The fact that bird sounds were mentioned in this table offers some explanation for the large standard deviations

Table 5.15 Sounds Causing Interference - Question 8

	A C T I V I T Y					
	<u>Conversation</u>		<u>Sleep</u>		<u>Listening to Radio or T.V.</u>	
No	33	53.2%	19	30.6%	37	59.7%
Yes	19	30.6%	38	61.3%	13	21.0%
No Response	10	16.1%	5	8.1%	12	19.3%
TOTAL	62	100%	62	100%	62	100%

<u>Sound</u>	Frequency in Order Mentioned								<u>Total</u>
	<u>1</u>	<u>2</u>	<u>3</u>	<u>1</u>	<u>2</u>	<u>3</u>	<u>1</u>	<u>2</u>	
Cars, Horns, Doors Brakes				4	1	2	2		9
Cars	5	1	2	14	5	1	3		31
Motorcycles	1				1			1	3
Buses		1	1	1	3			1	7
Planes	2	3	1				1		7
Sirens	4		1	5	1	5	4		20
Voices	3			1	2	3	2		11
Pets	1			5	2		1		9
Construction Equipment	3	2		2	2	1			10
Mechanical Tools		1	1		2		1		5
Radio, T.V., Stereo				3	2	2			7
Birds		1		1	3	1			6
Storms				2	1				3
Fog Horns					1				1
Jazz Concerts							1		1
Telephone							1		1
TOTAL	19	9	6	38	26	15	16	2	

associated with these sounds. An inspection of the questionnaires revealed that some of the response variation was due to the negative rating given to these sounds by respondents who found that birds interfered with their sleep. In general, Table 5.15 indicates that figure, and what have been traditionally referred to as ground sounds, were important aspects of the respondent's experience of the environment. In providing some explanation of the variations of sound ratings, this table also provides further evidence of the wide variety of subjective interpretations of the soundscape.

Question 9 received a slightly higher response rate as 79 per cent of the respondents mentioned at least one sound that varied with the season. Only 8 respondents mentioned as many as 6 sounds but 56.5 per cent could identify at least 3 sounds (Table 5.16). The significance of seasonal variation in the soundscape is reaffirmed by these responses.

A few more sounds are identified in Table 5.16 than in Table 5.14, but they both contain sounds from all sound groups. Again, birds were the most frequently mentioned natural sounds and the respondents generally noticed an increase in their numbers during the summer. Breezes and storms were the second most frequently mentioned sound and they were found to be more frequent in the winter. Cars and other traffic related sounds were rarely mentioned so it does not appear that seasonal variation was a major aspect of the perception of these sounds. Activity sounds and sounds made by neighbours dominate Table 5.16. These sounds were found to increase during the summer, providing information about the outdoor activities of neighbours and the occurrence of activities. Fog horns were the most frequently

Table 5.16 Seasonally Varying Sounds - Question 9

<u>Sound</u>	Frequency in Order Mentioned						<u>Total</u>
	<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>	<u>5</u>	<u>6</u>	
Water	1						1
Breezes, Storms	10		1	1	1	1	14
Birds	3	10	2	3	2	1	21
Peacocks	2	1	1				4
Insects			2				2
Childrens Voices	2	1	2	1			6
Mixed Voices	2	2		1		1	6
Tour Buses		1	1				2
Cars	1	3	4		1	3	12
Planes					3	1	4
Footsteps	1	1					2
Vehicle Brakes		1					1
Construction Equipment		1					1
Mechanical Tools	4	3	2	2	1		12
Park Sports Events	4		1		1		6
Playground Activity	2	4	3	2	2	1	14
Jazz Concert	4	5	2	2	1		14
Pipe Band Practise	1	2	5	2		1	11
Sirens			2				2
Conversation		1					1
Radio, T.V., Stereo			1				1
Children Playing	1			2	4		7
Gardening	4	3	1	6	3		17
Household Construction		1					1
Fog Horns	7	2	5		2		16
TOTAL	49	43	35	25	19	8	
% Of Respondents	79	69	56.5	40.3	30.6	12.9	

mentioned indicator sounds and they were found to be most numerous during the fall and winter.

The major seasonal variations identified by the respondents were changes in the frequency of a reported sound. Differences in the sounds made by motor traffic and breezes and storms contained the only reference to seasonal variation in sound quality. Summer activity was found to produce a "louder" motor sound content while the respondents found storms to be a "louder" component in the winter soundscape. These responses provide additional support to Schafer's comments (1977a) regarding the difficulties associated with the expression of acoustical perceptions. The sounds mentioned in Table 5.14 and Table 5.16 were perceived as figure sounds because they were consciously heard and remembered as an informative component of the soundscape. Several of these sounds were also felt to be intrusive as they were listed as sounds respondents found to interfere with their activities. One of the most significant features of the 3 tables is that there was little agreement between respondents in terms of the type of sounds they heard and the information they associated with the hearing of these sounds.

5.4 SUMMARY

The scale rating of sound quality, representing the initial focus of the questionnaire, revealed that the majority of the respondents had a generally favourable impression of neighbourhood sound quality. The respondents were not overly aware of change in sound quality as indicated by the relatively low response rate to the three questions

investigating perception of soundscape change. Where change was identified it was often associated with an increased scale of activity in the study area.

Rating scales in the community sound list provided an additional method of determining perceptions of sound quality. The respondents' averaged rating of all the sounds they heard was a score which gravitated towards the middle or no opinion position on the scale. Examination of the individuals' averaged scale rating together with the record of sounds heard revealed identifiable spatial patterns in the subjective soundscape. The strongest evidence favoured identification of the interior of South Fairfield as an area of high sound recognition and a slightly negative rating of sounds heard.

Almost all of the sounds in the community sound list were recognized by the respondents, but only about one-third of these sounds were associated with the actual transfer of information. Seasonal change was identified as an important aspect of the soundscape and frequency of occurrence was the main acoustical feature reported to vary.

A relatively low percentage of the respondents heard sounds which interfered with selected household activities. When interference was reported it was most apparent as a factor affecting sleep.

CHAPTER 6

CONCLUSION

Initially this chapter provides an integrated summary of the objective and subjective analysis. The second section suggests modifications which would improve upon the research methodology for future soundscape studies. The final section outlines some specific problem areas of soundscape analysis for which further research is recommended.

6.1 SUMMARY OF SUBJECTIVE AND OBJECTIVE SOUNDSCAPES

The researcher's initial impressions regarding the diversity of soundscape components characterizing the study area were supported in both the subjective and objective stages of the research design. Numerous sound types were identified during both research stages but for the individual cases, either respondents or monitor positions, few different sound types were actually recorded. For the objective analysis this meant that there was little similarity between monitor positions in terms of the sounds characterizing the 21 sampling locations. The sound of car traffic was the only ubiquitous sound in South Fairfield.

There was also a great deal of variety in the types of sounds identified on the questionnaires, although the respondents reported hearing more sounds than were identified during the objective analysis. Cars and other motor and traffic related sounds were frequently heard but natural and indicator sounds were also important.

The description of soundscape composition as well as the

generalization about perceived soundscape components were complicated by the problems associated with the design of a classification system for sounds. The difficulty of finding unifying themes to organize sounds into groups was made clearly apparent during both research stages.

The subjective analysis revealed that sound type could not be easily classified because of the wide range in individual perceptions of sounds. The problems of designing meaningful systems of classification were also made apparent during the objective analysis when the reliability test failed to draw support for the WSP's conceptually formed groups. Unfortunately, the data from either stage were not well suited to being used in an alternative classification system.

Our understanding of the relationships between sounds and perceptions of these sounds clearly requires further analysis. As this study has shown, it is an area worthy of further research as it surpasses SPL in the level of understanding of the soundscape that is achieved. The objective - subjective approach emphasizes the value of pursuing the major goal of soundscape study, which is an attempt to understand the soundscape through a study of its individual elements and not by treating it as a single measureable object.

The analysis also revealed that examination of the soundscape would benefit from a better understanding of the figure - ground relationship of sounds. Previous studies have indicated that motor sounds are the major contributor to the ambience of urban soundscapes; therefore, they function primarily as ground sounds. This study indicated that motor sounds had the most obvious relationship to sound

pressure level, but these sounds did not always serve as the frame against which other sounds were perceived. During the objective analysis there was some evidence of masking by motor sounds but the motor sounds appeared to be sufficiently intermittent to allow softer sounds to be heard or recorded. Similarly, questionnaire respondents noted changes in the soundscape's motor sound content and they also associated particular information with the hearing of these sounds. These results indicate that the most frequently heard element of the soundscape can function as both a figure and a ground component.

The high motor sound content identified with the South Fairfield soundscape also served to re-emphasize this aspect of the urban environment. Motor sounds were among the most negatively perceived sounds in the community sound list and generally, "we complain more often about traffic noise than any other noise in our cities" (Cottrell, 1980:9).

This study provides an indication of the amount of information to be gained from hearing these sounds. It draws support for continuing soundscape analysis as many of the sounds are in danger of being masked by the rising sound level characteristic of most urban areas. The low response rate and the several poorly completed questionnaires may have been indicating low acoustic awareness, but the soundscape is still an important feature of South Fairfield as it was used by some residents to obtain information about their environment.

In this area of favourable sound quality, change was not a well recognized aspect of the soundscape. When change was identified it was associated with an increase in the density of residential development in South Fairfield. Since an increasing proportion of the population

is becoming concentrated in urban areas, the effect of increased development on this aspect of the environment must be considered. It will be important for planners and practitioners to have an understanding of the nature of soundscape so they can better assess the impacts of their actions on the quality of the urban soundscape and how this relates to the quality of life for urban residents.

6.2 RESEARCH MODIFICATIONS

Owing to the pioneering nature of soundscape study additional work is required to develop proven research methodologies. The following list outlines methodological problems encountered in this study, presenting possible modifications that should be considered when designing future soundscape research.

- The printout from the acoustic analyzer produced some evidence of the effect of environmental factors (primarily wind) on the taping.
The use of wind screens could reduce this effect but it would require a different sampling procedure at the monitor positions to account for the directional bias. A longer sampling period (e.g. several weeks) is another alternative as particularly windy days could then be omitted from the analysis.
- Sound frequency was harder to identify for some sounds.
For example, during the sensitized listening and when listening to the tapes it was easier to count the number of cars passing than birds singing. It would be useful to have more sensitized listeners, each concentrating on various aspects of the soundscape.
- Sampling design did not produce spatially continuous monitoring.
It was difficult to determine the spatial extent of specific sounds because the length of time it took to cover the study area exceeded the duration of the sound (e.g. jazz concert). It would be useful to experiment with the monitoring procedure by: adding more researchers; altering the number of positions; or, varying the monitor period.

- The small sample size limited statistical analysis. The range of sound type and the diversity of individual perceptions will always complicate statistical analysis but experimentation with questionnaire design as well as different research techniques could reduce non-response rates. The small sample size for both the questionnaire and the soundscape monitoring was also due to the financial and time constraints imposed on this study.

6.3 RECOMMENDATIONS FOR SOUNDSCAPE STUDY

This study provides further evidence of the importance of the soundscape as one of the many factors which ultimately determines the quality of life in urban areas. The numerous reports published by the United States Environmental Protection Agency in the early 1970s and the reports which are now being published by the Environmental Council of Alberta are indicative of the type of continued concern being given to this aspect of the environment. There is a growing interest in the entire acoustic environment and a move away from source specific studies. The Environmental Council of Alberta also provides evidence of the recent trend towards making the public more "acoustically aware". This is most apparent in the Environmental Council's hearings which aimed at providing the public with a forum to express their views regarding the quality of the acoustic environment in Alberta. This type of continued and growing interest provides abundant support for pursuing research in the general field of soundscape study.

A priority among the many issues requiring more detailed study is an examination of the nature and the relationships between these elements of wanted and unwanted soundscape components. Physical sound properties and perceptual characteristics make this a complicated task, one that must be dealt with continuously by acoustic designers.

The science of acoustics is a difficult vocation, poorly

integrated into building and urban design. Acoustic engineers generally work with architects in very specific settings, such as theatres, concert halls, museums, or auditoriums. They are usually forced to take a defensive strategy, pinpointing and planning to eliminate interior and exterior noise zones. Acoustics is both a science and an art but neither discipline is capable of supplying the designer with a handbook of solutions to the problems being faced. Often the scientific aspects of acoustics are poorly handled but it is likely that the aesthetic aspects will not even be considered. In the exterior environment both the science and art of acoustics are regularly neglected. Clearly there is a need for future soundscape research and the potential issues to be examined are unlimited.

One of the specific areas of concern involves investigating the effect of using recognition over recall when examining acoustic perceptions. This issue has received only passing attention in previous studies (Kawano, 1981), and it is still necessary to determine whether recognition tests (the community sound list) prompt responses that do not adequately reflect acoustic perceptions. The alternative is to measure recall (asking respondents to make a list of the sounds they hear) to determine the sounds respondents actually perceived. Simultaneous use of these two techniques seems a logical option for future studies as it would allow comparative analysis.

A final research recommendation concerns the nature of the study areas being examined. Replication of studies in areas with similar characteristics will allow comparative analysis of research results, but there is also a need to examine a broader range of the environments we experience in our everyday lives.

BIBLIOGRAPHY

- ABBEY-WIKRAMA, I., BROOK, M.G., GATTONI, F. and HERRIDGE, C. F.
(1969), "Mental Hospital Admissions and Aircraft Noise," Lancet
297: 1275-1278.
- AHRLIN, U. and OHRSTOM, E. (1978), "Medical Effects of Environmental
Noise on Humans," J. Sound and Vibration 59: 78-89.
- BARR, T. (1886), "Enquiry into Effects of Loud Sounds on the Hearing
of Boiling Makers and Others Who Work Amid Noisy Surroundings,"
Proc. Glasgow Phil. Soc. 17: 223-255.
- BRADLEY, J. S. (1975), Exterior Vehicle Traffic Noise and Effects,
Transport Canada, Road and Vehicle Traffic Safety Branch.
- BUNGE, W. (1962), Theoretical Geography Sweden: University of Lund
Publications.
- BUTTNER, A. (1969), "Social Space in Interdisciplinary Perspective,"
Geographical Review 59(3): 417-426.
- BUTTNER, A. (1976), "Grasping the Dynamism of Lifeworld," A.A.A.G.
66: 277-292.
- CENTRAL MORTGAGE & HOUSING CORPORATION (1972), New Housing & Airport
Noise NHA #5059. Ottawa: Central Mortgage & Housing
Corporation.
- CENTRAL MORTGAGE & HOUSING CORPORATION (1977), Road & Rail Noise:
Effects on Housing. NHA #5156. Ottawa: Central Mortgage
& Housing Corporation.
- CHAPPELL, J. E. Jr. (1976), "Comment in Reply," A.A.A.G. 61(1):
169-173.
- CITY OF VICTORIA (1980), Social and Economic Data. Victoria:
Department of Community Development.
- COHEN, S., GLASS, D. C., and PHILLIPS, S. (1977), "Environment
and Health," in Handbook of Medical Sociology, edited by
H. E. Freeman, S. Leving and L. G. Reeder. Englewood Cliffs,
N. J.: Prentice Hall.

- COHEN, S. and LEZAK, A. (1977), "Noise and Inattentiveness to Social Cues," Environment & Behaviour 9(4): 559-562.
- COLES, R. R. A. and RICE, C. G. (1971), "Assessment of Risk of Hearing Loss Due to Impulse Noise," in Occupational Hearing Loss, edited by D. W. Robinson, London: Academic Press.
- CONNOR, D. M. (1972), "From Partisans to Partners," Community Planning Revue 22(1): 15-17.
- COTTRELL, T. (1980), Noise In Alberta. Alberta: Environmental Council of Alberta.
- CRAIK, K. and ZUBE, E. H., eds., (1976) Perceiving Environmental Quality. New York: Plenum Press.
- DUNCAN, J. S. (1978), "The Social Construction of Unreality: An Interactionist Approach to the Tourist's Cognition of the Environment," in Humanistic Geography: Prospects & Problems edited by D. Ley and M. Samuels, Chicago: Maaroofo Press Inc.
- DUNN, B. E. (1980), "The Noise Environment of Man" Noise in the Human Environment Vol. 2 edited by H. W. Jones Alberta: Environmental Council of Alberta: 193-258.
- ENTRIKIN, J. N. (1977), "Geography's Spatial Persepective and the Philosophy of Ernst Cassirer," The Canadian Geographer 31(3): 209-222.
- FORBES, J. ed. (1974), Studies in Social Science and Planning New York: John Wiley and Sons, Inc.
- FRAZIER, J. W. (1978), "On the Emergence of an Applied Geography" The Professional Geographer 30(3): 233-237.
- GLASS, D. C. and SINGER, J. E. (1972), Urban Stress, New York: Academic Press.
- GOLD, J. (1980), Introduction to Behavioral Geography, New York: Oxford University Press.

- GREEN, R. G. and O'NEAL, E. G. (1969), "Activation of Cue Elicited Agression by General Arousal," J. of Personality & Social Psychology 11: 289-292.
- GUELKE, L. (1974), "An Idealist Affirmative in Human Geography," A.A.A.G. 64(2): 193-202.
- GUSKI, R. (1978), "Defensive Activation Toward Noise," J. Sound and Vibration. 59: 107-110.
- HANSEN, J. H. and STUSSI, R. R. (1972), Noise in the Human Environment An Occasional Student Paper, The Centre for Transportation Studies, University of British Columbia. Vancouver, B. C.
- HARRISON, I. D. and LARSEN, R. D. (1977), "Geography and Planning: The Need for An Applied Interface," The Professional Geographer 29(2): 139-147.
- HULL, H. and NIE, N. (1979), SPSS Update New York: McGraw-Hill Book Company.
- IHDE, D. (1973), Sense and Significance. Pittsburgh: Duquesne University Press.
- IHDE, D. (1976), Listening and Voice, A Phenomenology of Sound. Athens, Ohio: University of Ohio Press.
- JONES, H. W. (1980), "A Physical Descriptions of Noise" Noise in the Human Environment Vol. 2 edited by H. W. Jones. Alberta: Environmental Council of Alberta: 259-284.
- KASPERSON, R. E. and BRIETBART, M (1974), Participation, Decentralization, and Advocacy Planning. Washington, D.C.: Association of American Geographers Resource Paper 25.
- KAWANO, M. (1981), "The Soundscape of Victoria's Inner Harbour" unpublished B A. Thesis, Department of Geography. Victoria: University of Victoria.
- KENNEDY, L. W. and FAULKNER, M. G. (1980), "Problems of Measuring Community Reaction to Noise" in Noise in The Human Environment Vol. 1 edited by H. W. Jones. Alberta: Environmental Council of Alberta: 1-12.

- KRYTER, K. D. (1970), The Effects of Noise on Man, New York: Academic Press.
- KRYTER, K. D. (1973), "Impairment to Hearing from Exposure to Noise," J. Acoust. Soc. Amer. 53: 1211-1234.
- LOWENTHAL, D. (1961), "Geography, Experience, and Imagination: Towards a Geographical Epistemology," A.A.A.G. 51: 241-260.
- LEY, D. (1980), "Geography Without Man: A Humanistic Critique," Geography Research Paper No. 24. Oxford: School of Geography Univerity of Oxford.
- LEY, D. and SAMUELS, M. (1978), "Introduction: Contexts of Modern Humanism in Geography," in Humanistic Geography: Prospects and Problems edited by D. Ley and M. Samuels. Chicago: Maaroofa Press, Inc.: 1-21.
- LYNCH, K. (1976), Managing The Sense of a Region. Cambridge, Mass.: M.I.T. Press.
- MacNEIL, J. W. (1974), "Urban Environment" in O. P. Dwivedi. The Environment. Toronto, Copp Clark Publishing: 39-60.
- MATHEWS, K. and CANON, L. K. (1975), "Environmental Noise Level as a Determinant of Helping Behaviour," J. Personality & Social Psychology. 32: 571-577.
- MATHEWS, K., CANNON, L. K. and ALEXANDER, K. (1974), "The Influence of Level of Empathy and Ambient Noise on the Body Buffer Zone," Preced. of the American Psychological Assoc. Division of Personality and Social Psychology. 1: 367-370.
- MILLER, J. D. (1974), "Effects of Noise on People," J. Acoust. Soc. Amer. 56: 729-764.
- MITCHELL, R. C. (1980), "How 'Soft', 'Deep', or 'Left?' Present Constituencies in the Environmental Movement for Certain World Views," Natural Resource Journal. 20: 345-358.
- MORRISON, D. E. (1980), "The Soft Cutting Edge of Environmentalism: Why and How the Appropriate Technology Notion is Changing the Movement," Natural Resource Journal. 20: 275-298.

- MOSER, S. and KALTON, G. (1977), Survey Methods in Social Investigation. London: Heinemann Educational Books.
- ONTARIO MINISTRY OF THE ENVIRONMENT (1976), Model Municipal Noise Control By-Law. Final Report, Toronto: Ministry of Environment.
- O'RIORDAN, T. (1976), Environmentalism. London: Pion.
- OSGOOD, C. E., SUCI, G. J. and TANNENBAUM, P. H. (1957), The Measurement of Meaning. Urbana: University of Illinois Press.
- PAGE, R. A. (1977), "Noise and Helping Behaviour," Environment & Behaviour, 9(3): 211-224.
- PORTEOUS, J. D. (1977), Environment & Behavior: Planning and Everyday Urban Life. Reading, Massachusetts: Addison-Wesley Publishing Company.
- PORTEOUS, J. D. (1979), "Urban Social Geography" in C. N. Forward (ed.) Vancouver Island: Land of Contrasts, Victoria, B. C.: Western Geographical Series Vol. 17: 309-327.
- RELPH, E. (1970), "An Enquiry into the Relations Between Phenomenology and Geography," The Canadian Geographer 14(3): 193-201.
- RYALDNER, R. (1978), "Medical Effects of Noise Exposure: Basic Considerations," J. Sound and Vibration, 5: 61-65.
- SAARINEN, T. F. (1976), Environmental Planning: Perception and Behavior. Boston: Houghton Mifflin.
- SCHAFER, R. M. (1974), "Listening," Sound Heritage III(4): 10-17.
- SCHAFER, R. M., ed. (1975), European Sound Diary Vancouver: A.R.C. Publications.
- SCHAFER, R. M. (1977a), The Tuning of The World Toronto: McClelland and Stewart Ltd.
- SCHAFER, R. M., ed. (1977b), Five Village Soundscapes Vancouver: A.R.C. Publications.

- SCHAFER, R. M., ed. (1978), The Vancouver Soundscape Vancouver: A.R.C. Publications.
- SCHULTZ, T. J. (1972), Community Noise Ratings Applied Science Publishers.
- SEAMON, D. (1979), A Geography of the Lifeworld New York: Lt. Martin's Press.
- SEWELL, W. R. D. (1979), "Where is Public Participation Going," Banff, Alberta: Unpublished Paper Presented for the Canadian National Workshop on Public Participation.
- SEWELL, W. R. D. and O'RIORDAN, T. (1976), "The Culture of Participation in Environmental Decision-Making," Natural Resources Journal, 16(1) (January 1976): 1-21.
- SOMMER, R. (1974), Tight Spaces: Hard Architecture and How to Humanize It. Englewood Cliffs, N.J.: Prentice-Hall.
- SOUTHWORTH, M. (1969), "The Sonic Environment of Cities," Environment and Behavior 1: 49-70.
- STEVENS, K. N., ROSENBLITH, W. A. and BOLT, R. H. (1955), "A Communities Reaction to Noise: Can it be Forecast?" Noise Control. 1: 63-71.
- TARNOPOLSKY, A. (1978), "Effects of Aircraft Noise on Mental Health," J. of Sound and Vibration. 59: 89-97.
- TARNOPOLSKY, A. and McLEAN, E. (1976), "Noise as a Psychosomatic Hazard," in Trends in Psychosomatic Medicine, edited by O. Hill, London: Butterworths: 90-101.
- TRUAX, B., ed. (1978), Handbook For Acoustic Ecology. Vancouver: A.R.C. Publications.
- TUAN, Y-F. (1971), "Geography, Phenomenology & Human Nature," The Canadian Geographer 25(3): 181-192.
- TUAN, Y-F. (1974), Topophilia. Englewood Cliffs, N.J.: Prentice-Hall.

- TUAN, Y-F. (1976), "Humanistic Geography," A.A.A.G. 66: 266-276.
- U.S. ENVIRONMENTAL PROTECTION AGENCY, (1973), Public Health & Welfare Criteria for Noise. Washington, D. C., U.S. Government Printing Office.
- WARD, W. D. (1960), "Latent and Residual Effects in Temporary Threshold Shift," J. Acoustic Soc. Amer. 32:135-137.
- WARD, W. D. (1970) "Temporary Threshold Shift and Damage Risk Criteria for Intermittent Noise Exposure," J. Acoust. Soc. Amer. 48: 561-574.
- WARD, W. D., GLORIG, A. and SKLAR, D. L. (1959), "Relation Between Recovery from Temporary Shifts from Impulses," J. Acoust. Soc. Amer. 33: 781-793.
- WESTERKAMP, H. (1974), "Sound Walking," Sound Heritage, III(4): 18-277.
- WILSON, A., et al. (1963), Noise-Final Report. London: Her Majesty's Stationary Office.
- WRIGHT, J. K. (1947), "Terrae Incognitae: The Place of Imagination in Geography," A.A.A.G. 37: 1-15.
- ZIMBARDO, P. G. (1969), "The Human Choice: Individuation, Reason, and Order versus Deindividuation, Impulse, and Chaos," in Nebraska Symposium on Motivation, edited by W. J. Arnold and D. Levine. Lincoln: University of Nebraska Press.

APPENDIX A
COMMUNITY SOUNDWALK SHEET

	TIME :	TOT	TIME :	TOT
MOTOR VEHICLES	cars			cars
	trucks			trucks
	motorcycles			motorcycles
	other/planes			other/planes
	sub-total :			sub-total :
VEHICLE SOUNDS	signals			signals
	brakes			brakes
	doors			doors
	other			other
	sub-total :			sub-total :
TRAFFIC NON-MOTOR	footsteps			footsteps
	bicycles			bicycles
	other			other
	sub-total :			sub-total :
HUMAN SOUNDS	male voice			male voice
	female voice			female voice
	children			children
	mixed voices			mixed voices
	non-verbal			non-verbal
	sub-total :			sub-total :
DOMESTIC ANIMALS	dog			dog
	bird			bird
	farm animal			farm animal
	other			other
	sub-total :			sub-total :
OUTDOOR NON-MOTOR	construction			construction
	gardening			gardening
	waterworks			waterworks
	other			other
	sub-total :			sub-total :
OUTDOOR MOTOR	construction			construction
	gardening			gardening
	other			other
	sub-total :			sub-total :
INDOOR, MANMADE	doors			doors
	kitchen			kitchen
	other			other
	sub-total :			sub-total :
ELECTRO ACOUST	loudspeakers			loudspeakers
	telephone			telephone
	a.c. hum			a.c. hum
	sub-total :			sub-total :
NATURAL SOUNDS	water			water
	drainage			drainage
	wind			wind
	birds			birds
	other			other
	sub-total :			sub-total :
NON-LOCAL	signals			signals
	traffic			traffic
	human sounds			human sounds
	animals			animals
	electroacoustic			electroacoustic
	natural			natural
	aircraft; jet			aircraft; jet
	" ; other			" ; other
	trains			trains
	sub-total :			sub-total :
	TOTAL		TOTAL	

WORLD SOUNDSCAPE PROJECT
COMMUNITY SOUNDSCAPE SURVEY

DATA SHEET
SOUNDWALK

COMMUNITY :
AREA :
DATE :

OBSERVER :

APPENDIX B
COMMUNITY SOUND QUESTIONNAIRE


FAIRFIELD COMMUNITY SOUND QUESTIONNAIRE

I am a geography student at the University of Victoria and I am currently doing a household survey in your area as part of the research for my Masters thesis.

The survey is about the quality of neighbourhood sound. It is concerned with sounds which occur outside (as opposed to inside) your home. Rather than simply measuring noise levels, I am interested in the actual sounds residents hear, how they react to them, and their value as a source of information. Since this is such a vast topic it is necessary to ask you to focus on the sounds you associate with your neighbourhood during summer weekday evenings between 5 and 9 pm.

Please answer all questions fully and to the best of your ability. All information will be treated with the strictest confidence and all responses will remain anonymous. If you would like to make any additional comments, feel free to do so in the space provided at the end of the questionnaire.

Your assistance in taking time to fill out this questionnaire is greatly appreciated.


Jane F. Mastin
Department of Geography
University of Victoria.
477-6911 Ext. 4322

1. On the whole, would you describe this neighbourhood as (circle one) ...?

very noisy 1
 noisy 2
 about average .. 3
 quiet 4
 very quiet 5

2. Have you noticed any changes in the quality of the sound in this area since you have lived here? (If yes) What are the changes?

No ... 1
 Yes .. 2

3. Are there any changes you would like to experience ? (If yes) What are they?

No ... 1
 Yes .. 2

4. Are there any changes you would not like to experience? (If yes) What are they?

No ... 1
 Yes .. 2

5. On the next two pages sounds are listed which you may or may not hear around your home on summer weekday evenings between 5 and 9 pm. Please read through the list and indicate which sounds you do hear by placing a checkmark in the first column. If there are any additional sounds you hear that are not on the list, please add them to the end of the list in the space provided.

COMMUNITY SOUND LIST

	✓ IF YOU HEAR	LIKE HEARING IT VERY MUCH					DISLIKE HEARING IT VERY MUCH	
		1	2	3	4	5	6	
WATER	---	1	2	3	4	5	6	
WIND IN TREES	---	1	2	3	4	5	6	
BREEZES, STORMS	---	1	2	3	4	5	6	
THUNDER & LIGHTNING	---	1	2	3	4	5	6	
HORSES	---	1	2	3	4	5	6	
DOGS, CATS OR OTHER PETS	---	1	2	3	4	5	6	
SMALL SONG BIRDS	---	1	2	3	4	5	6	
PEACOCKS	---	1	2	3	4	5	6	
ROOSTERS	---	1	2	3	4	5	6	
CROWS	---	1	2	3	4	5	6	
SEAGULLS	---	1	2	3	4	5	6	
PIGEONS	---	1	2	3	4	5	6	
INSECTS	---	1	2	3	4	5	6	
MALE VOICE	---	1	2	3	4	5	6	
FEMALE VOICE	---	1	2	3	4	5	6	
CHILDRENS VOICES	---	1	2	3	4	5	6	
MIXED VOICES	---	1	2	3	4	5	6	
NON-VERBAL (LAUGHING, COUGHING, ETC.)	---	1	2	3	4	5	6	
CITY BUSES	---	1	2	3	4	5	6	
CHARTER TOUR BUSES	---	1	2	3	4	5	6	
CARS	---	1	2	3	4	5	6	
MOTORCYCLES, ETC.	---	1	2	3	4	5	6	
TRUCKS	---	1	2	3	4	5	6	
TRAINS	---	1	2	3	4	5	6	
SEA PLANES & OTHER SMALL PLANES	---	1	2	3	4	5	6	
JETS	---	1	2	3	4	5	6	
HELICOPTERS	---	1	2	3	4	5	6	
SHIPS	---	1	2	3	4	5	6	
FERRIES	---	1	2	3	4	5	6	
BICYCLES	---	1	2	3	4	5	6	
ROLLER SKATERS	---	1	2	3	4	5	6	
HANG GLIDERS	---	1	2	3	4	5	6	
STROLLERS, BUGGIES, ETC.	---	1	2	3	4	5	6	
FOOTSTEPS	---	1	2	3	4	5	6	
VEHICLE HORNS	---	1	2	3	4	5	6	
VEHICLE DOORS	---	1	2	3	4	5	6	
VEHICLE BRAKES	---	1	2	3	4	5	6	

6. Returning to the list, please rate how you feel about hearing each one of the sounds that you have already checked. Circle the response that best describes your feelings, noting that: 1 = like hearing it very much, 2 = like hearing it, 3 = like hearing it a little, 4 = dislike hearing it a little, 5 = dislike hearing it, 6 = dislike hearing it very much.

7. Sounds can be a valuable source of information, telling us about; the occurrence of events, time, changes in the weather, etc. Do any of the sounds you hear provide you with any information?

----- : -----
(sound) (information)

----- : -----
(sound) (information)

----- : -----
(sound) (information)

----- : -----
(sound) (information)

----- : -----
(sound) (information)

----- : -----
(sound) (information)

8. Do any of the sounds you hear interfere with?

i) conversation No ... 1 (If Yes) List sounds _____
Yes .. 2 _____

ii) sleep No ... 1 (If Yes) List sounds _____
Yes .. 2 _____

iii) listening to No ... 1 (If Yes)
radio or T.V. Yes .. 2 list sounds _____

8 (con't). Do any of the sounds you hear interfere with any other activities ?

iv) _____ list of sounds _____
(activity)

v) _____ list of sounds _____
(activity)

9. Do any of the sounds you hear vary with the season ? If yes, please list the sounds and the changes you hear.

SOUND

CHANGE

10. Taking account of all the sounds around here, both pleasant and unpleasant, would you say this area is

- an ideal place 1
- a good place 2
- a fair place 3
- an unsatisfactory place 4
- an extremely unsatisfactory place . . 5

APPENDIX C

CITY OF VICTORIA TRAFFIC VOLUMES



CITY OF VICTORIA B.C.

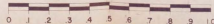


LEGEND

- P INDEX
- S PARKS
- S SCHOOLS
- H HOSPITAL
- M MUNICIPAL BOUNDARY
- W WARD BOUNDARY

TRAFFIC VOLUME SCALE
1" = 40,000 v.p.d.

KILOMETERS



NO.	REVISION DESCRIPTION		DATE
CORPORATION OF THE CITY OF VICTORIA			
PROJECT	24 HOUR TRAFFIC VOLUMES.		
DWG. TITLE			
LOCATION			
DRAWN BY R.D.H.		CHECKED BY CITY ENGINEER	
DESIGNED BY L.R.		SCALE 1" = 10,000.	
DRAWN BY R.D.H.		DATE MAR 15/78	
CHECKED BY CITY ENGINEER		SHEET NO. 1 OF 1	
TC-260.			

APPENDIX D

SCATTERGRAMS: SOUND PRESSURE BY SOUND GROUPS

Figure D.1 Sound Pressure by Motor Sound

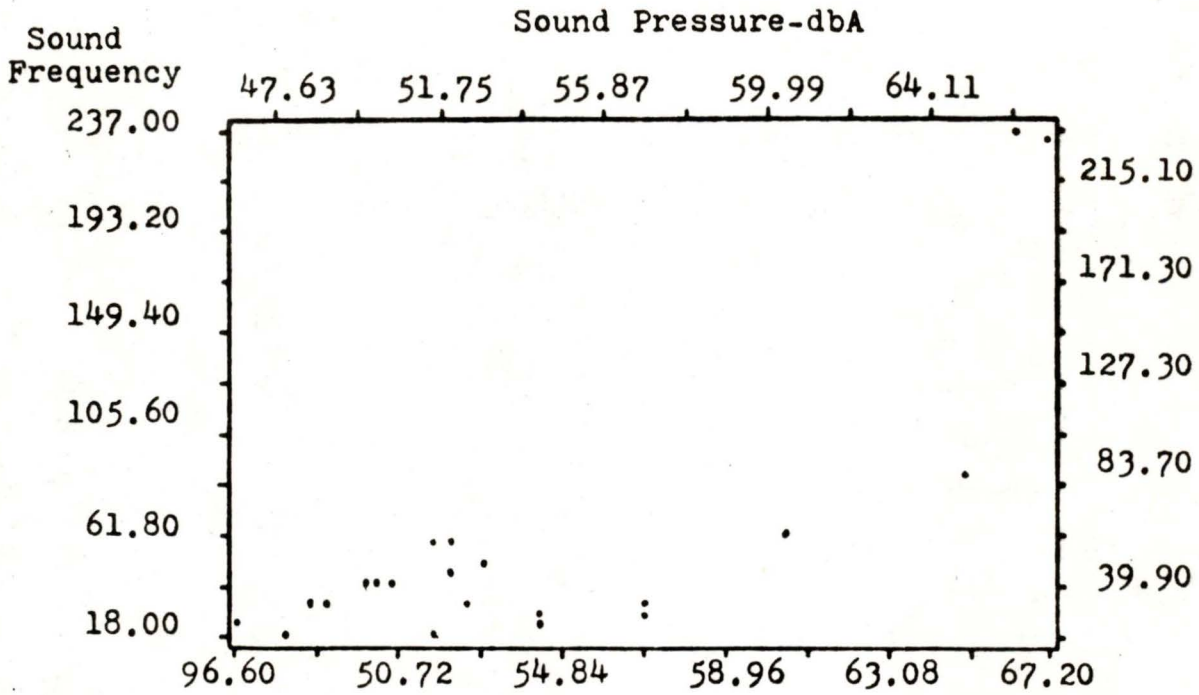


Figure D.2 Sound Pressure by Human Sound

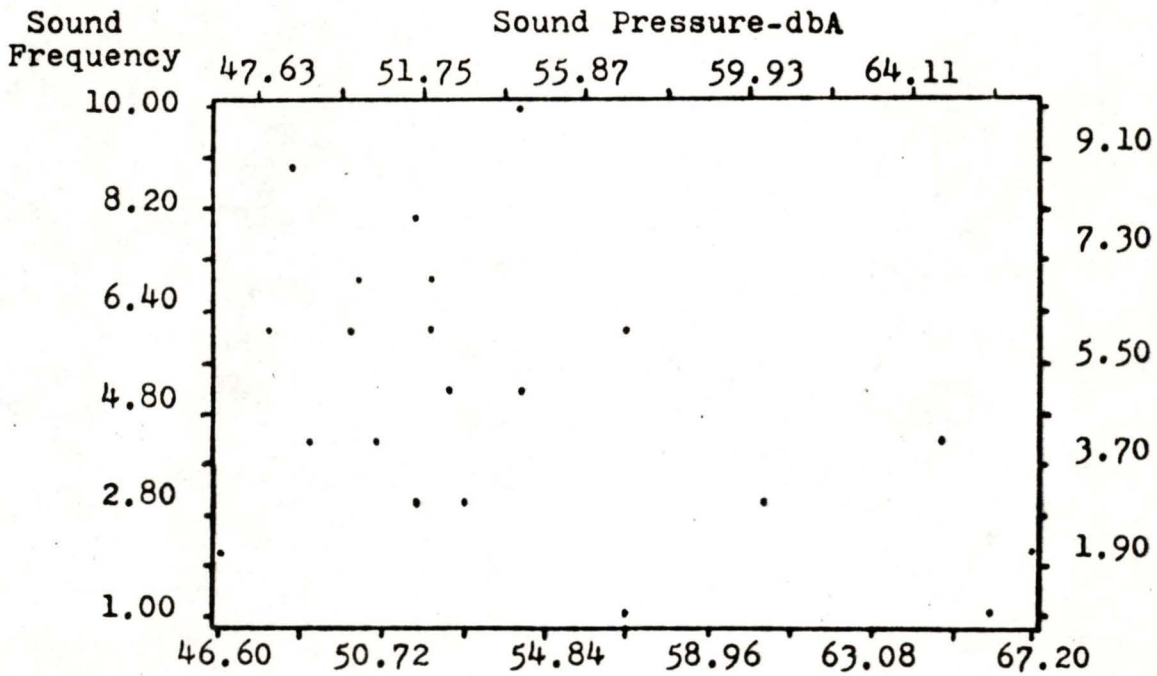


Figure D.5 Sound Pressure by Activity Sound

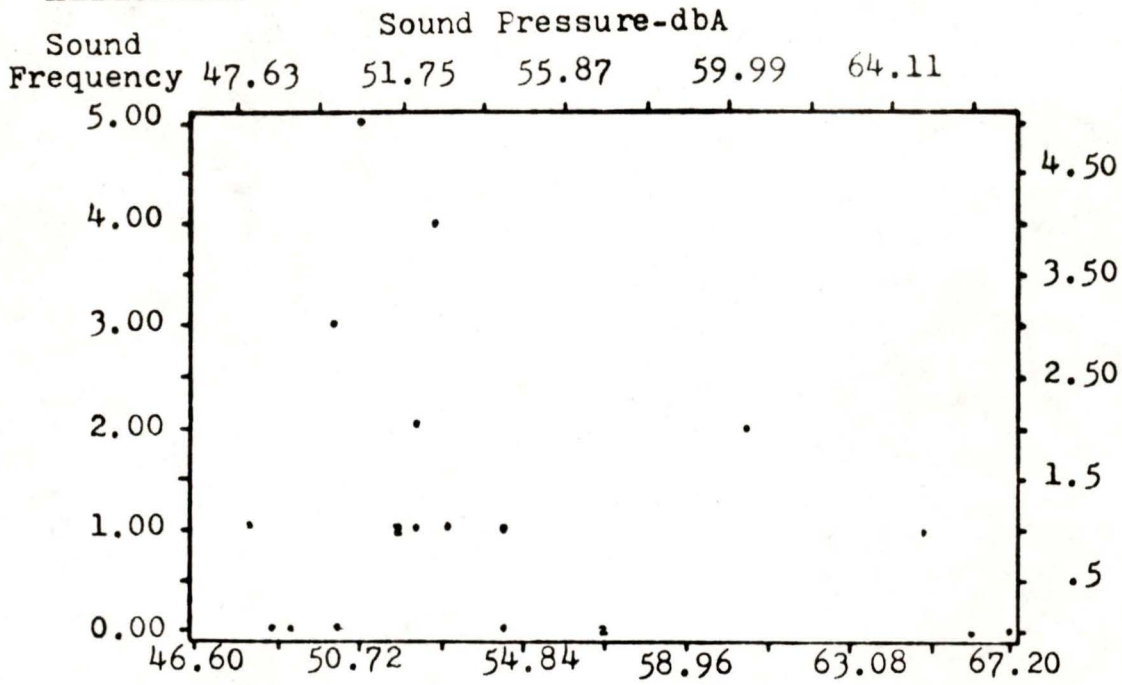
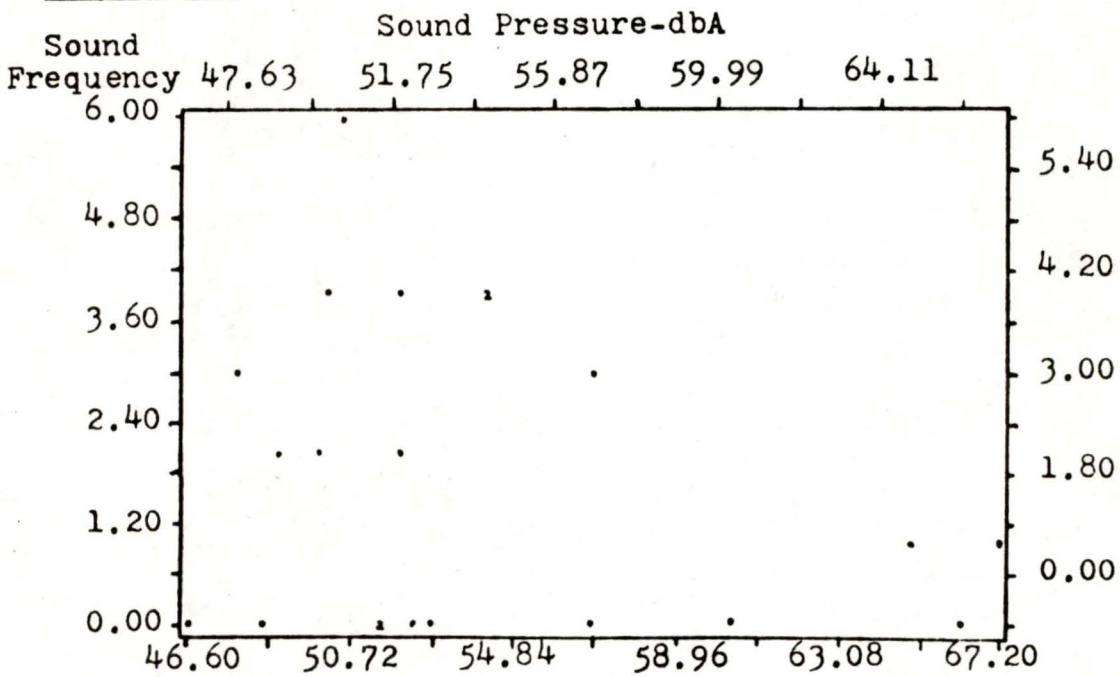


Figure D.6 Sound Pressure by Indication Sound



APPENDIX E
SCATTERGRAMS FOR ALL SOUND GROUPS

Figure E.1 Motor Sound by Natural Sound
Sound Frequency

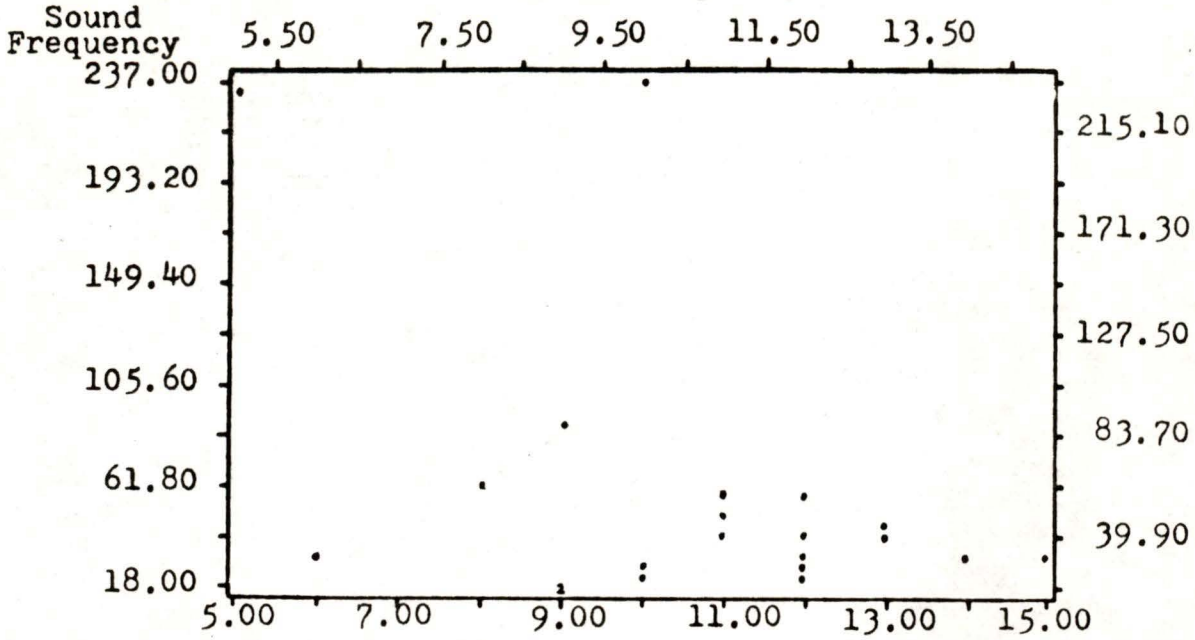


Figure E.2 Motor Sound by Human Sound
Sound Frequency

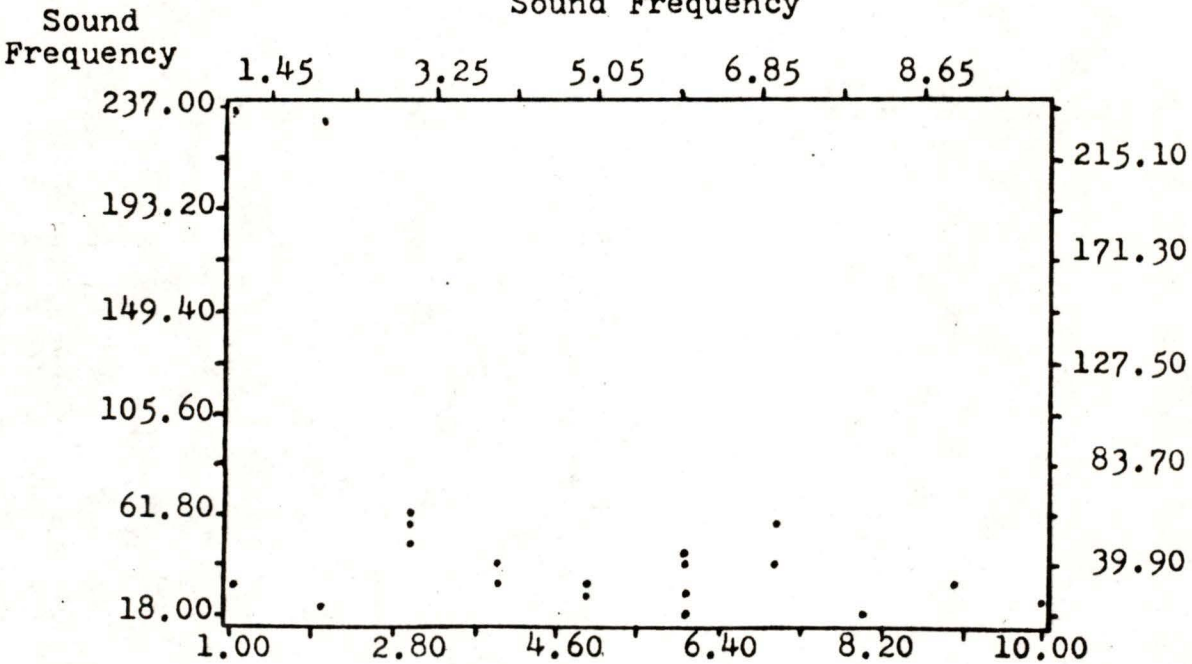


Figure E.3 Motor Sound by Activity Sound

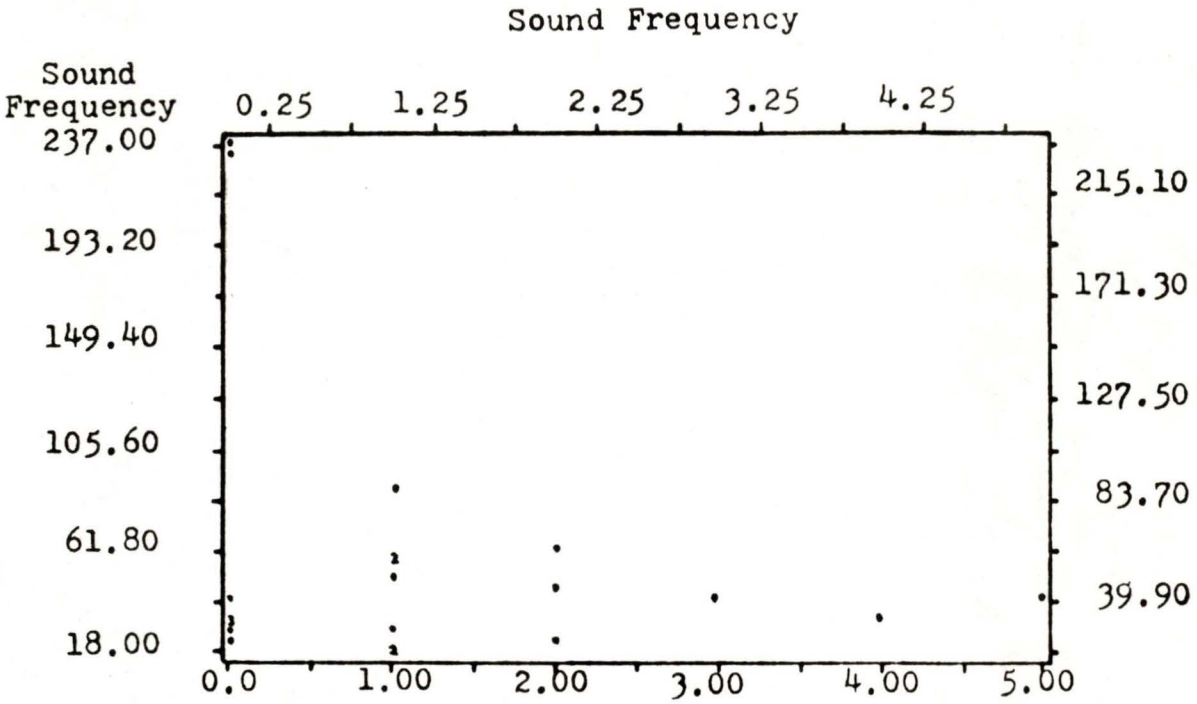


Figure E.4 Motor Sound by Indicator Sound

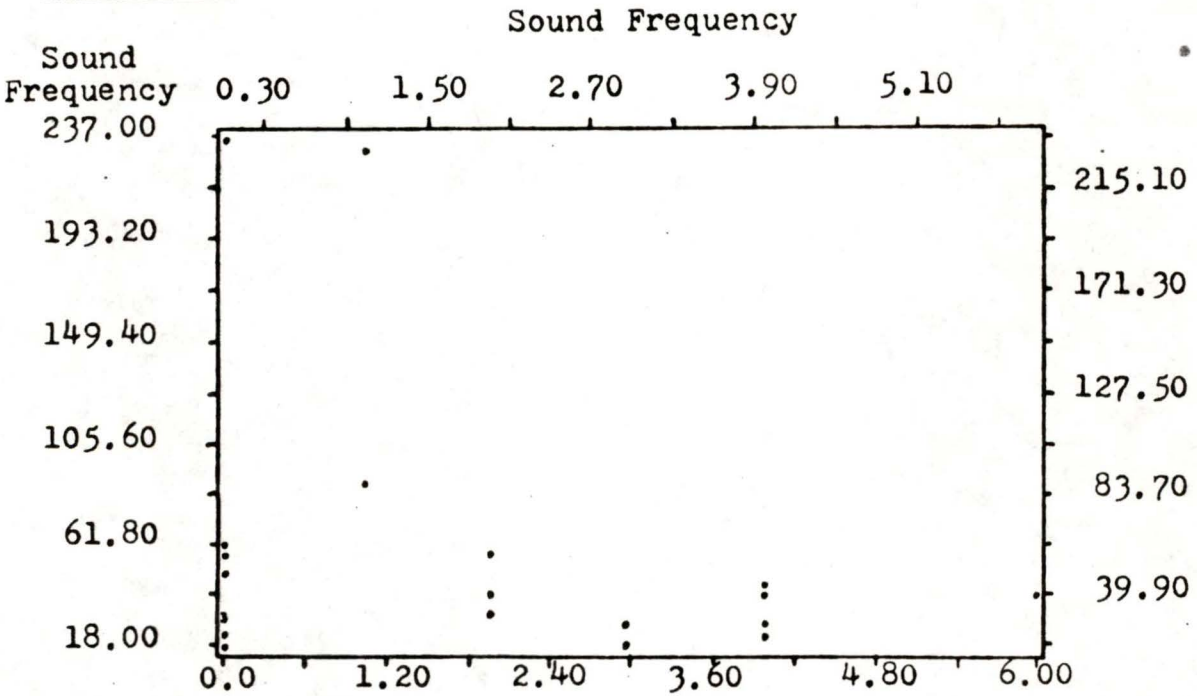


Figure E.5 Motor Sound by Neighbour Sound
Sound Frequency

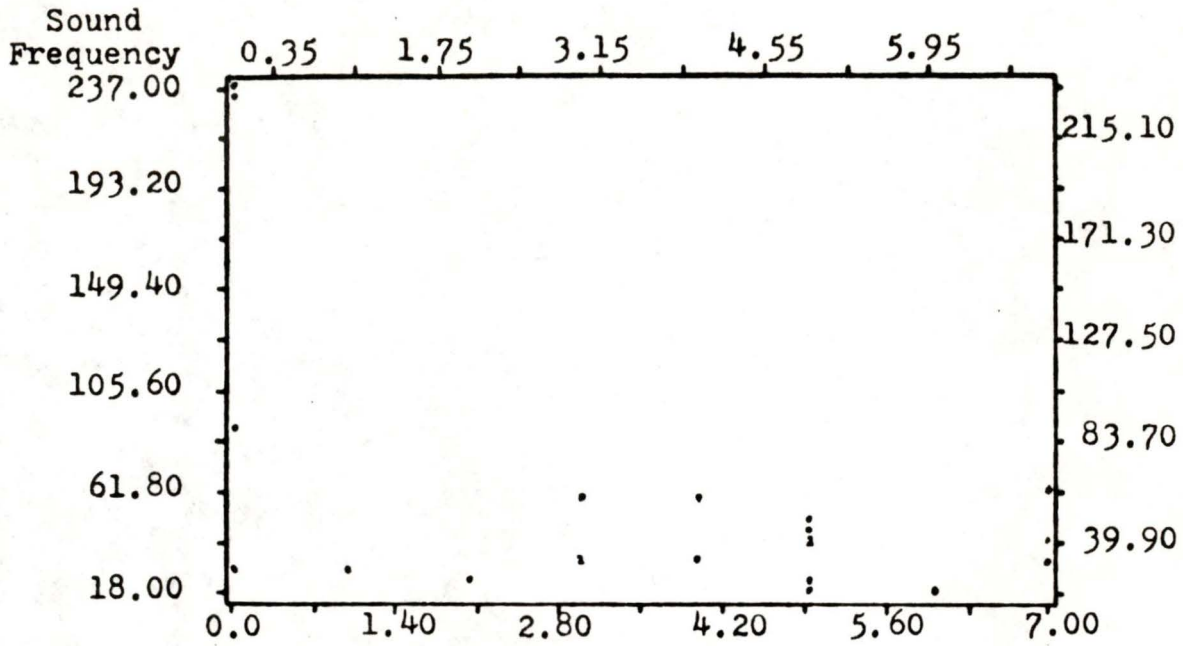


Figure E.6

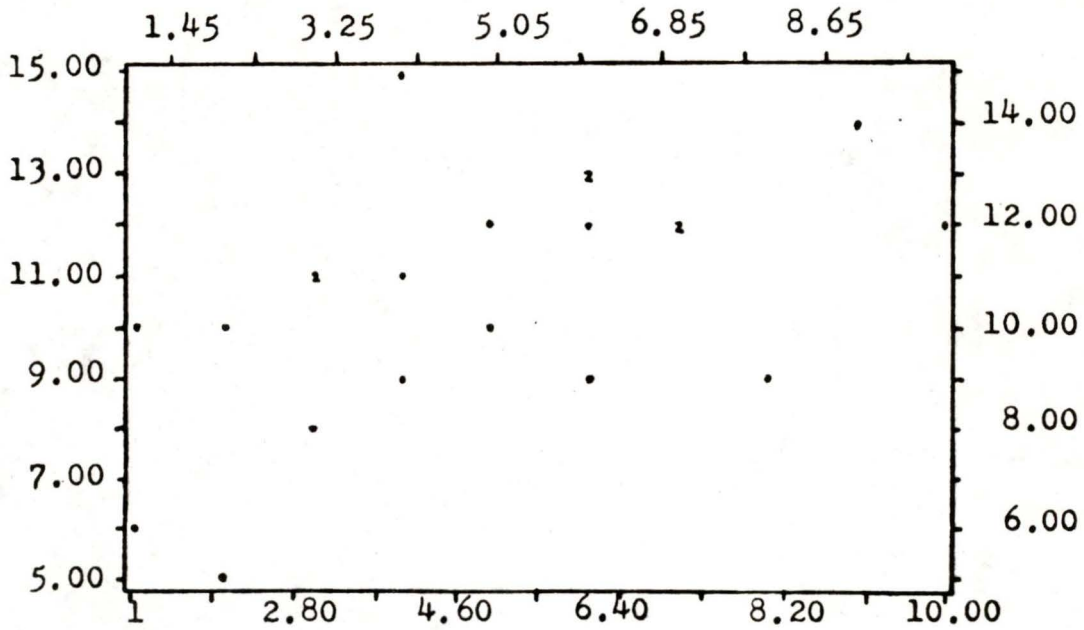


Figure E.7 Natural Sound by Activity Sound

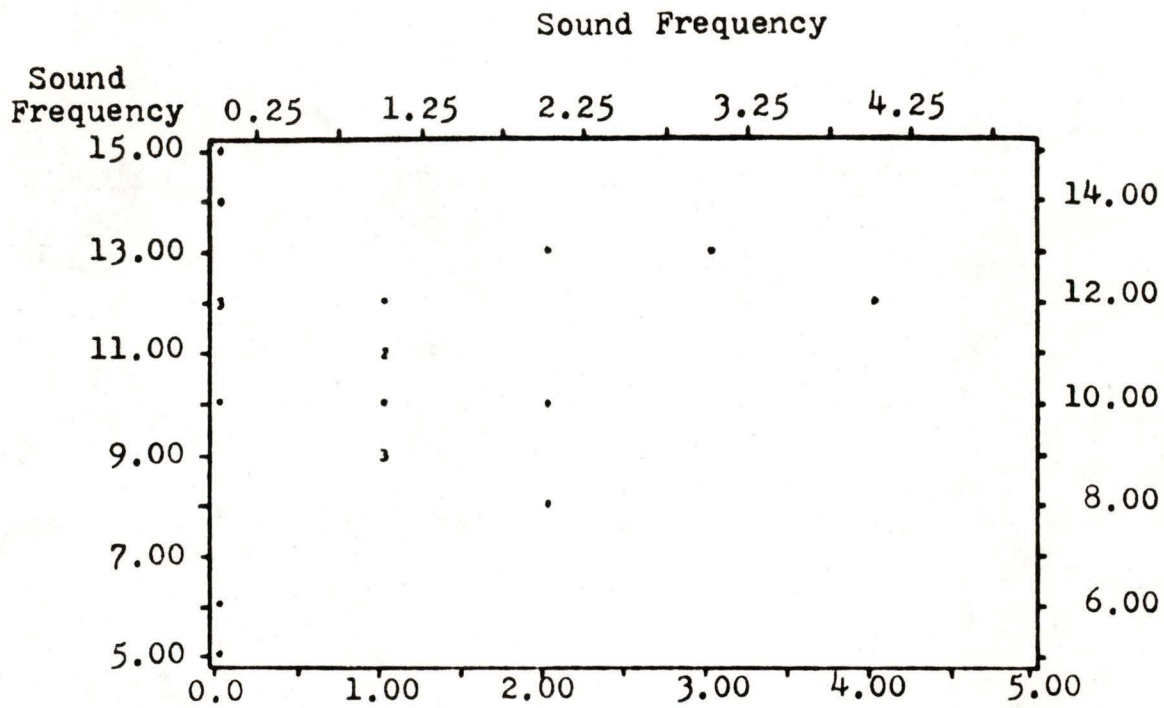


Figure E.8 Natural Sound by Indicator Sound

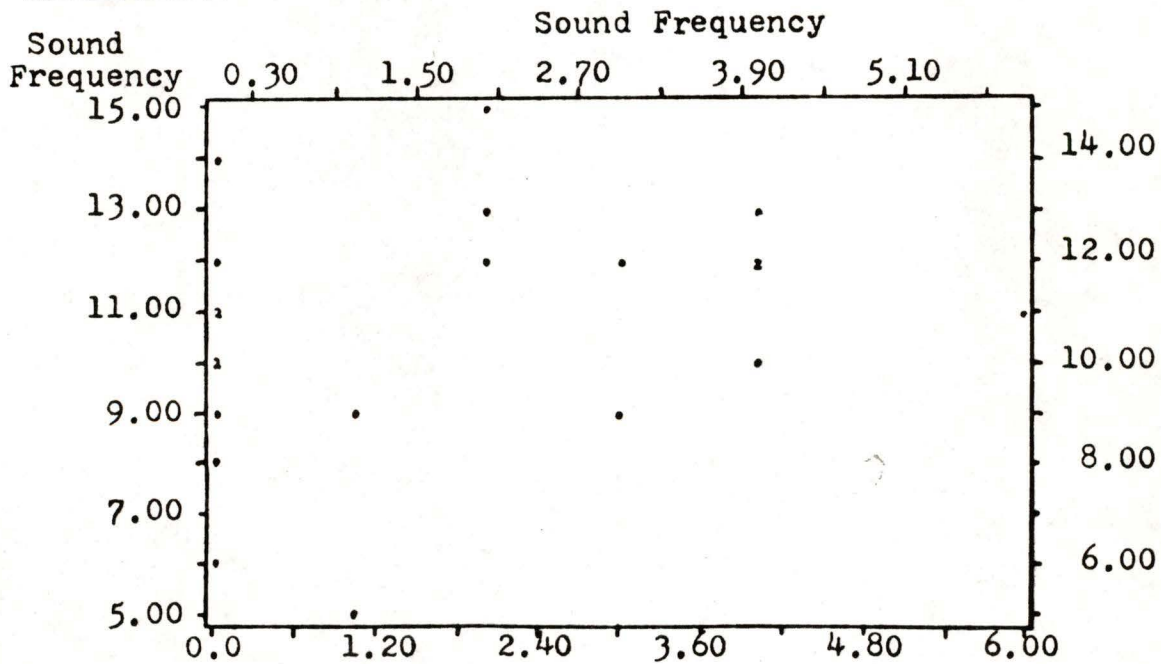


Figure E.9 Natural Sound by Neighbourhood Sound
Sound Frequency

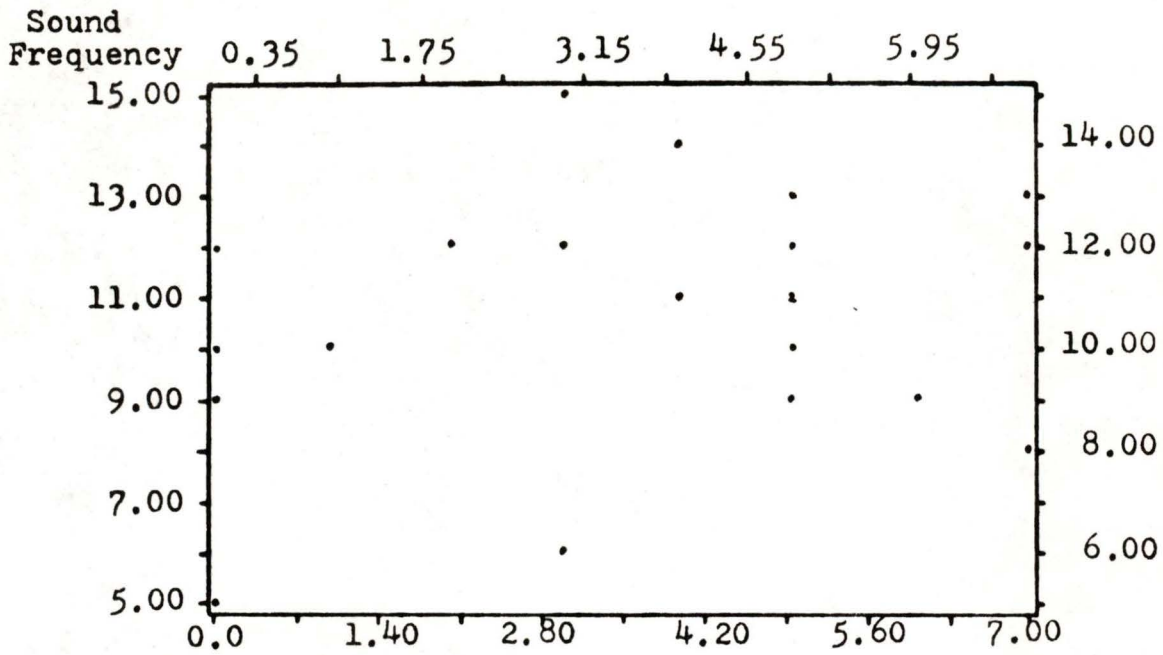


Figure E.10 Human Sound by Activity Sound
Sound Frequency

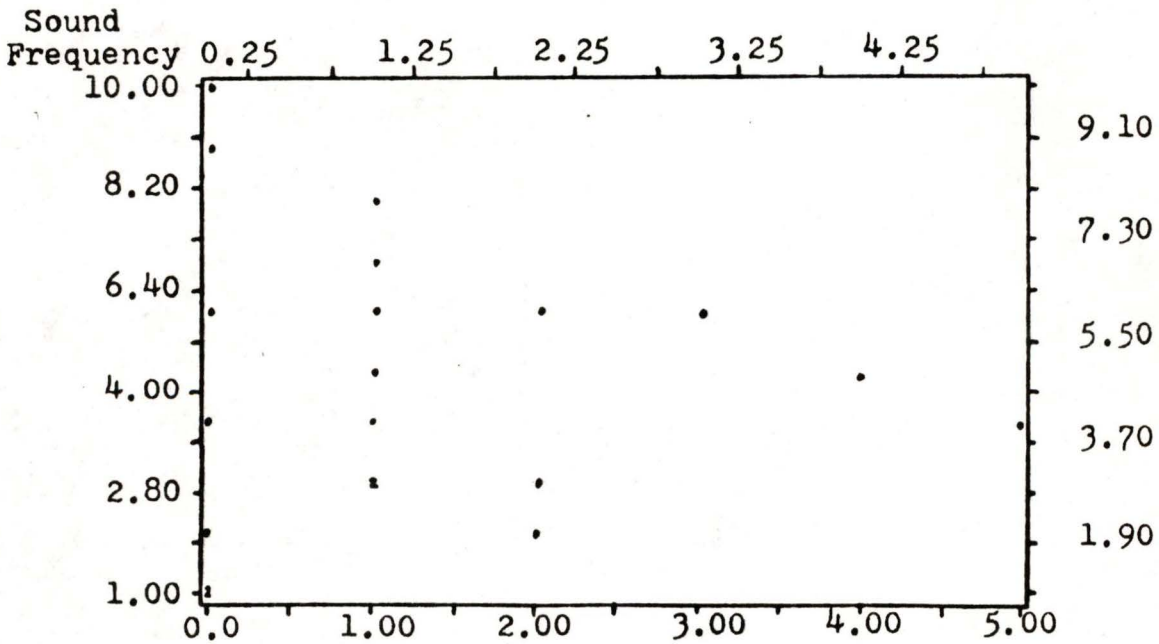


Figure E.11 Human Sound by Indicator Sound
Sound Frequency

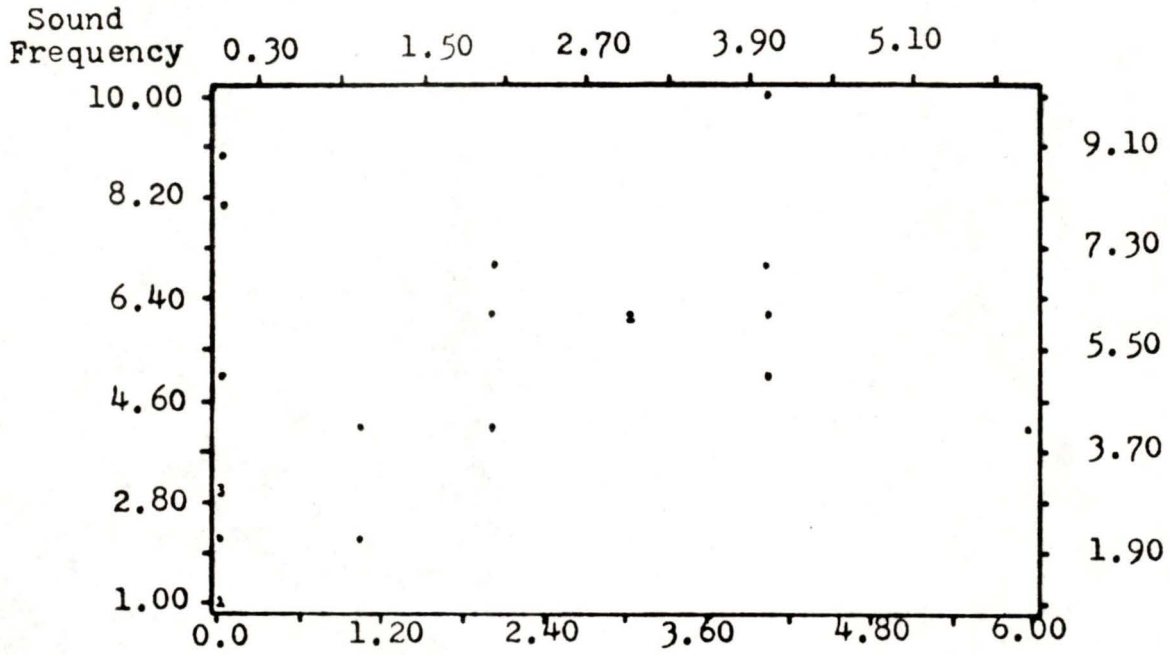


Figure E.12 Human Sound by Neighbourhood Sound
Sound Frequency

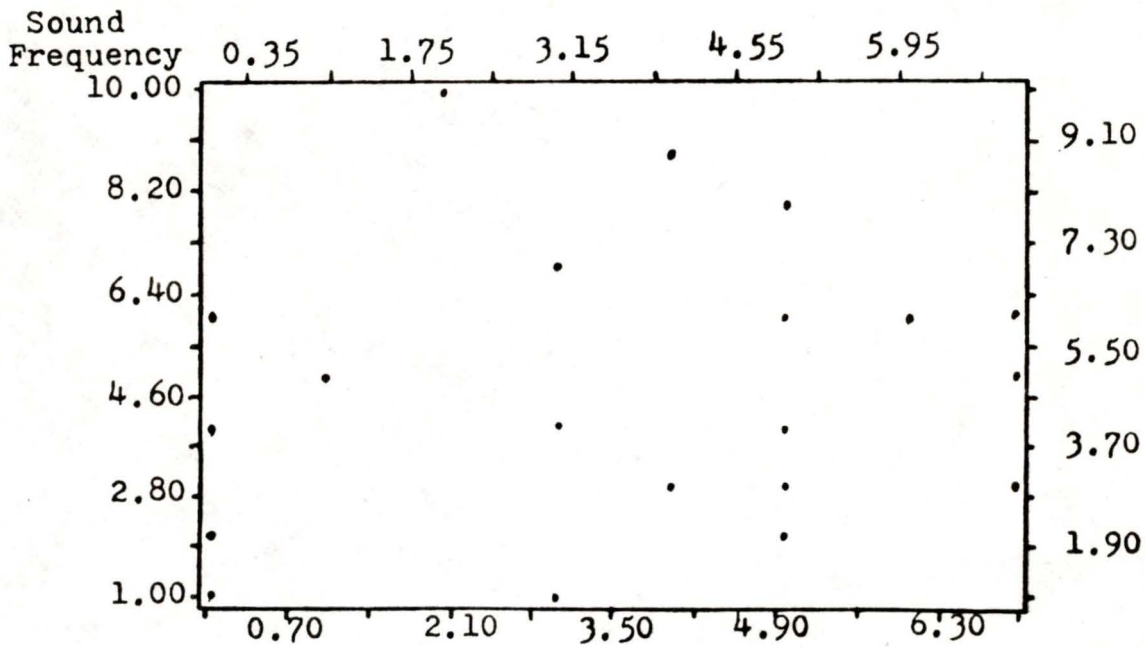


Figure E.13 Activity Sound by Indicator Sound
Sound Frequency

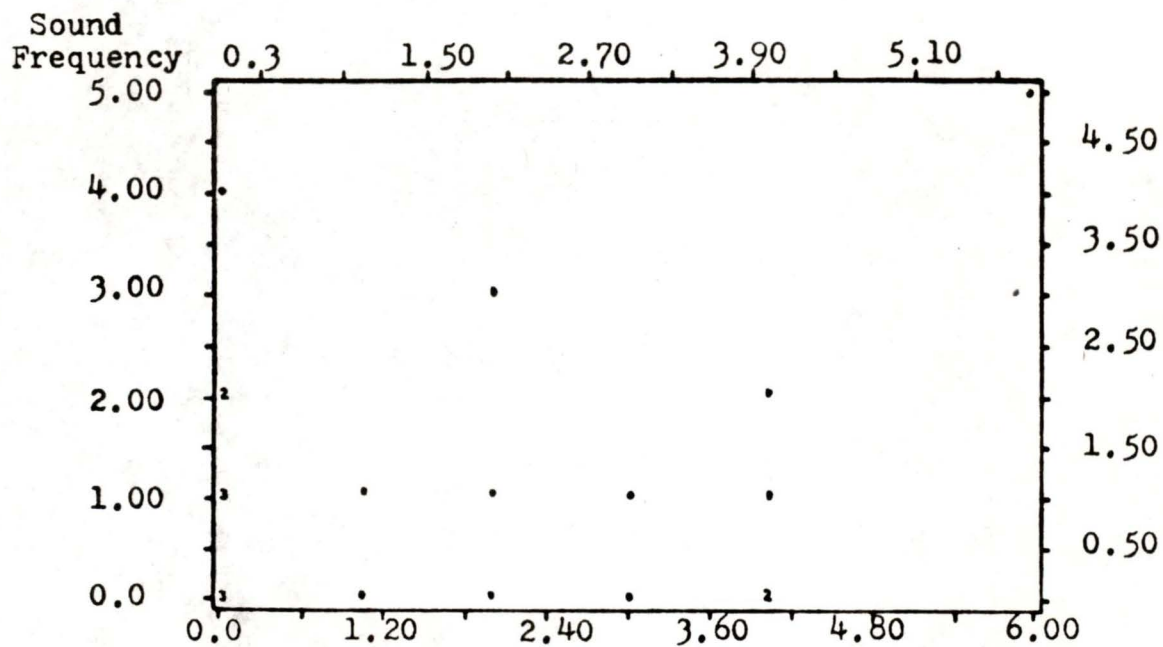


Figure E.14 Activity Sound by Neighbourhood Sound
Sound Frequency

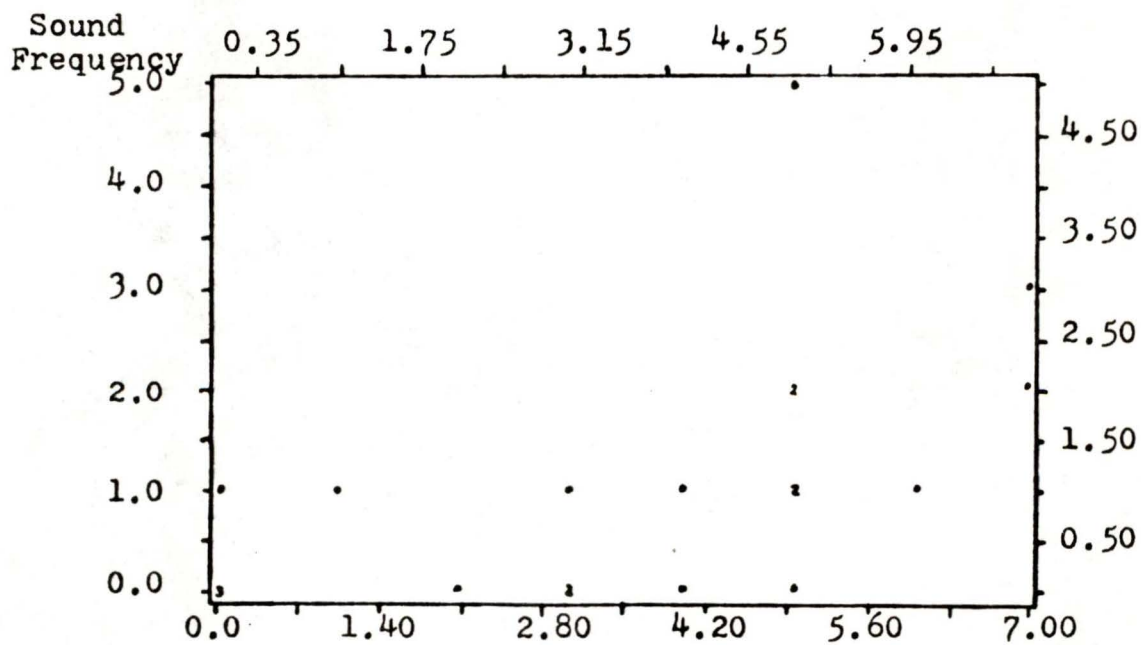
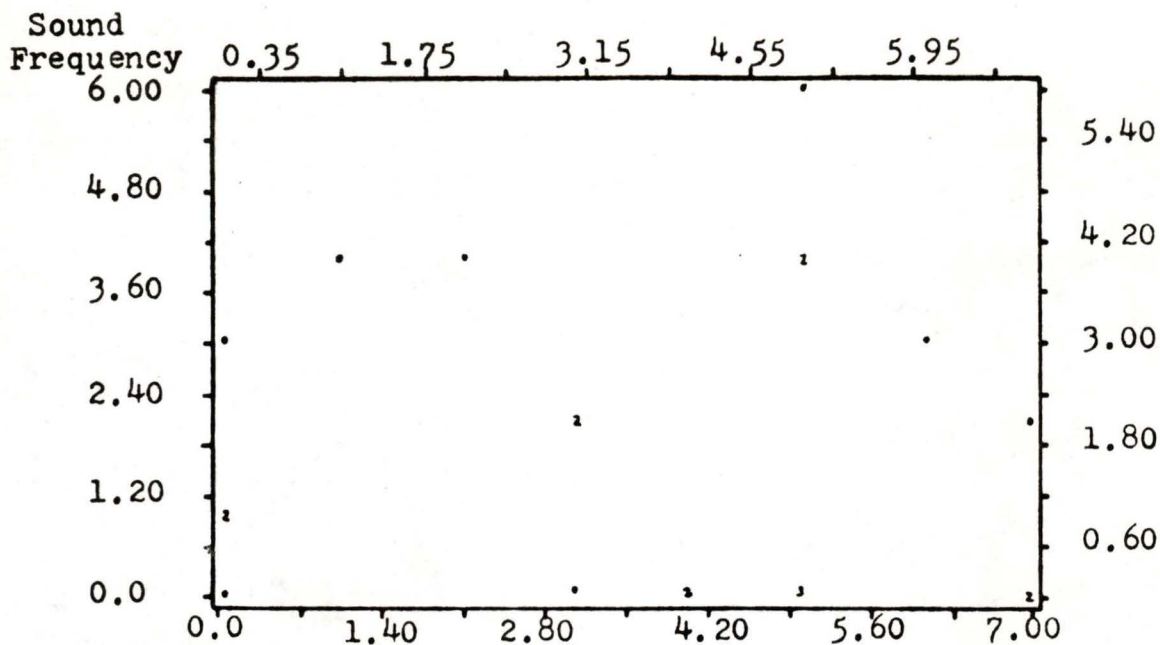


Figure E.15 Indicator Sound by Neighbourhood Sound
Sound Frequency



APPENDIX F
RESPONSES TO HOUSEHOLD PROFILE QUESTIONS

APPENDIX F - Responses to Household Profile Questions

12. How many people live in your household, including yourself?

Total In Household			Over 18			Under 18		
No.	Freq.	%	No.	Freq.	%	No.	Freq.	%
1	5	8.1	0	5	8.1	0	32	51.6
2	22	35.5	1	48	77.4	1	15	24.2
3	17	27.4	2	7	11.3	2	14	22.6
4	15	24.2	3	1	1.6	3	1	1.6
5	3	4.8	4	1	1.6			

13. Type of dwelling unit?

	<u>Freq.</u>	<u>%</u>
Single Family	55	88.7
Side Duplex	2	3.2
Level Duplex	1	1.6
Apt. Block	3	4.2
Converted Apt.	1	1.6

14. Do you own or rent?

	<u>Freq.</u>	<u>%</u>
Own	48	77.4
Rent	14	22.6

15. Respondent?

	<u>Freq.</u>	<u>%</u>
Male	29	46.8
Female	33	53.2

16. How long have you lived at this address?

<u>Years</u>	<u>Freq.</u>	<u>%</u>
L 5	22	35.5
5 - 10	21	33.9
10 - 20	6	9.7
20 - 30	9	14.5
G 30	4	6.5

APPENDIX F - Responses to Household Profile Questions Continued

17. How long have you lived in Victoria

<u>Years</u>	<u>Freq.</u>	<u>%</u>
L - 5	9	14.5
5 - 10	14	22.6
10 - 20	12	19.4
20 - 30	8	12.9
G - 30	19	30.6

18. Do you plan to move in the near future, say within the next year?

	<u>Freq.</u>	<u>%</u>
Yes	5	8.1
No	54	87.1
No Response	3	4.8

19. What age group are you in?

	<u>Freq.</u>	<u>%</u>
18 - 30	14	22.6
31 - 44	25	40.3
45 - 64	15	24.2
G - 64	8	12.9

20. Do you have any hearing problems?

	<u>Freq.</u>	<u>%</u>
Yes	3	4.8
No	59	95.2

21. Have you ever had any hearing problems?

	<u>Freq.</u>	<u>%</u>
Yes	0	0.0
No	57	91.9
No Response	5	8.1

VITA

Surname: Mastin Given Name: Jane Franklin

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UNIVERSITY OF VICTORIA, BRITISH COLUMBIA 1979 to 1982

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Honours and Awards:

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University of Victoria, Teaching Assistantship Supplement, 1980/81

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Author



Signature

Jane Franklin Mastin

April 20/82

Date