Measuring perceived and acceptable risk: an application of survey approaches

Janet D. Gough

Information Paper No. 24

Centre for Resource Management

University of Canterbury and Lincoln University

June 1991

Centre for Resource Management
P.O. Box 56
Lincoln University
Canterbury
New Zealand

ISSN 0112-0875
ISBN 1-86931-061-6

The Centre for Resource Management is a research and teaching organisation at Lincoln University in Canterbury. Research at the Centre is focused on the development of conceptually sound methods for resource use which may lead to a sustainable future. The Centre for Resource Management acknowledges the financial support received from the Ministry for the Environment in the production of this publication. The Centre for Resource Management offers research staff the freedom of inquiry. Therefore, the views expressed in this publication are those of the author and do not necessarily reflect those of the Centre for Resource Management.

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Preface

Before beginning this report on a practical approach to estimating perceived risk and acceptable risk, I would like to clarify **why** we are interested in these concepts and suggest ways of deriving criteria for evaluating estimation approach.

Gough (1990) reports on reasons for studying perceived risk. The main propositions are that experience shows that experts and lay people 'perceive' risk differently, that experts **predictions** and lay **perceptions** of risk differ for a number of reasons and that a greater understanding of why these differences occur is likely to improve the acceptance of the risk decision-making process.

Although in this previous Information paper, objectives for the study of perceived risk were examined, it did not concentrate on the use of the **outputs** of perceived risk research. The literature suggests that the study of perceived risk which seeks to explain the ways in which the public responds to risky situations has shied clear of the application of its results. By inference, however, perceived risk and acceptable risk estimates and knowledge about the way in which people process risk information in order to arrive at these estimates are important determinants for the improvement of risk communication, and hopefully for the greater acceptability of particular risk decision-making processes.

If we are to use estimates of perceived risk we need to derive techniques and procedures that can be simply applied in a variety of situations. Different applications will have different requirements in terms of the information needed and also the varying approaches to measurement and analysis. Therefore risk analysts need to have at their disposal a number of different tools.

Three approaches to measuring and analysing perceived and acceptable risk are investigated in this publication: psychometric and attitude questionnaire approaches and simple social surveys.

1 Introduction

A number of different approaches to measuring perceived and acceptable risk have been developed over the past 10 years. This publication describes the pilot testing of three survey techniques each designed to look at different activities involving perceived and acceptable risk. The primary objective was to test the different methods which have been used and to evaluate them according to criteria relevant to practical applications.

This part of an ongoing research programme concentrates on the general approach of **expressed preferences**, where people are questioned directly about their preferences. From this information estimates of perceived and acceptable risk are inferred. Of necessity, the estimates obtained are **individual** estimates; in order to obtain societal estimates aggregation is required.

1.1 Why study perceived and acceptable risk?

The concept of risk itself has a number of characteristics. In previous publications (Gough 1988, 1989, 1990) it has been stressed that risk is characterised by a chance of loss or gain, a probability and a magnitude. To obtain appropriate answers, it may be necessary to use different ways of defining risk (as a probability, as simply a threat, or as a compounded concept) to determine which aspect of risk people feel most comfortable about describing. A further complication is that people think of risk and make their own implicit judgements in terms of different hazards. Some people may estimate risk (as do statisticians) simply in terms of numbers of deaths or injuries associated with an activity or technology. Others think of risks in terms of potential psychological damage or property damage.

Researchers have noticed that people respond to risks in everyday life in a manner that did not seem to correlate with the statistical likelihood of harm occurring. Simple examples of this included people's attitudes towards certain sporting events and aeroplane travel (response measured by means such as insurance cover). A number of factors were isolated that seemed to affect the way in which people responded to these risks. More sophisticated research looked at ways of **measuring** these perceptions and this publication considers some of these measurement techniques.

The importance of studying risk perceptions (and their effect on behaviour) lies in the way in which people respond to the introduction of new risks into their lifestyle and environment. These may include the siting of hazardous facilities such as chemical plants or hazardous waste facilities and also newly discovered risks such as the recent concern over long term exposure to low level radiation and non-ionising electromagnetic radiation. In order for government and regional authorities to respond appropriately and incorporate people's reactions into planning, they must understand: **how** people are likely to react; **why** their reaction may tend to be negative; **how** and **when** it is best to provide information to the public; and **how** to incorporate public reaction and opinion into the public sector decision-making process.

1.2 Survey design

One of the most important requirements in designing surveys is that the aims or goals of the investigation must be carefully defined, and the specific objectives that the particular vehicle (questionnaire) is designed to examine must also be clearly described.

The first step, therefore, is to determine the objective of the study or to decide 'what you want to know'.

There are several parts to good survey experimentation. They include:

(1) a clear specification of the model being addressed by the questionnaire;

(2) the design of questions that are both directed towards the issues being addressed, and that are able to be understood and correctly interpreted by the respondent; and

(3) analysis that both examines the robustness of the data obtained (in order to see whether in fact respondents have understood and correctly interpreted the questions) and tests the hypotheses under study.

1.3 General objectives

The general objectives of this study were to examine and evaluate ways of obtaining effective measures of people's perceptions of risk. In all three surveys a mailed questionnaire approach, as opposed to an administered questionnaire where an interviewer interacts on a one-to-one basis with the respondent, was used. A further important objective, therefore, was to test people's willingness and ability to answer complex questions on risk.

For each survey the particular aspects of risk being addressed have to be determined: perceived risk, acceptable risk, safety, threat or hazardousness. As well as this it is necessary to consider whether the researcher's primary area of interest is people's individual risk, societal risk or environmental risk.

1.4 Evaluation criteria

To evaluate alternative questionnaire approaches to estimating perceived risk, a set of evaluation criteria must be established prior to designing the questionnaires.

The criteria selected were:

(1) whether respondents could understand the questions and whether they found the questions straightforward to answer;
(2) whether the quality of the answers was appropriate to the statistical analysis to be performed and whether the assumptions required for the analysis were realistic;
(3) whether the analysis technique appeared to be credible and robust;
(4) the information content of the results;
(5) how easily the results could be incorporated into different decision-making processes; and
(6) whether it was possible to derive valid aggregate societal estimates from the individual responses.

1.5 Survey approaches

The different approaches to estimating perceived and acceptable risk which were used can be summarised as the:

(1) psychometric survey approach (two parts);
(2) attitude survey approach; and
(3) simple social survey.

These approaches are discussed fully in Gough (1990).

1.6 Report description

The (perceived) positive and negative aspects of each approach are discussed using the evaluation criteria listed above. Each survey had different specific objectives and was intended to consider different aspects of risk in terms of the type of risk being examined and the characteristics of the risk.

The questionnaires used are included as Appendix A. A comparative evaluation of the questionnaire approaches is presented in the form of a checklist matrix with a summary of the areas in which each of them might be most appropriately applied (Appendix B). This comparison addresses the success of each approach according to its own specific objectives as well as evaluating its success in terms of the evaluative criteria listed above.

2 Psychometric questionnaire approaches

2.1 Specific objectives (or what do we really want to know?)

Psychometric approaches have been used overseas to determine the factors that most affect people's perception of risk. These surveys have been used to determine general risk perception and have been applied to specific proposals and activities. The primary objective of this survey, therefore, was to obtain comparative estimates of perceived risk and to determine whether the factors derived as having the most effect on people's perceptions of risk in the New Zealand context are comparable to those factors derived from overseas studies. A secondary objective was to identify the type of risks and benefits that people associate with a given list of hazard types.

In addition, I wished to observe: whether people would be willing to attempt this type of questionnaire; whether it was possible to use a 'mail'-type approach when administering the questionnaire; and whether the answers to these two questions were likely to be affected by the group being surveyed.

Psychometric surveys for estimating perceived risk were first used by Decision Research in Eugene, Oregon in the late 1970's (Fischhoff *et al.*, 1978, 1981; Slovic *et al.*, 1979, 1981). Since then, the Decision Research group, led by Paul Slovic has developed the ability with the technique to the point where members of the group can administer quite complex questionnaires on a group basis to selected population groups for specific purposes. Their experience has made them comfortable with interpreting the resulting data within the limitations of the approach. In general use, psychometric surveys have been shown to be most useful in terms of identifying the factors affecting risk perceptions.

2.2 Methodology

The survey was constructed in two parts. The first part consisted of a psychometric survey to examine perceived risk. Acceptable risk was not considered at this first stage. Respondents were asked to rank and then to rate 26 different hazard types of potential threats. These hazard types were stated at a level midway between the very specific (for example, 'the risk of driving across the Auckland Harbour Bridge at 5 p.m. on a Friday evening') and the very general (the risk of driving in Auckland). Overseas studies have used both ends of the spectrum, but in most cases the approach is more general than that used here. Questions Two through 12 asked respondents to rate each of these 26 hazard types according to a number of factors associated with knowledge, control, voluntariness, risk reduction etc. These questions were derived from overseas studies and represented the factors found to have had the greatest influence on perceived risk.

The second part of the survey used a follow-up approach and asked all of those who had responded to the first questionnaire to write down, firstly, all the possible risks that they felt could be associated with each of the 26 hazard types or activities, and secondly, all the associated benefits.

The intention was to make respondents explicitly consider the risks and benefits that they saw as being associated with the activity (this had previously been done implicitly in the first part of the survey). Respondents were asked to comment on whether or not the second questionnaire affected the way in which they would have answered the first questionnaire.

2.3 Sample population

Both questionnaires used in this initial survey were pilot tested by staff of the Centre for Resource Management. The first questionnaire was then given to 38 post-graduate students from the Centre for Resource Management and 15 post-graduate students from the Electrical and Electronic Engineering Department of the University of Canterbury. As an incentive to respond, each respondent was offered $5 photocopying plus the chance to win a $50 book token (simple lottery of those responses received within the given time).

2.4 Response

The response rates for both these questionnaires were very good. The first questionnaire had a response rate of 27 out of 38 (71%) for the Centre for Resource Management students and eight out of 15 (53%) for the Electrical and Electronic Engineering students. The second questionnaire was administered only to Centre for Resource Management students who had answered the first questionnaire. It elicited 19 out of 27 responses (70%) indicating a considerable willingness on the part of the students to participate.

Most respondents experienced some difficulty in answering the first questionnaire, and most responses contained comments on ways in which they felt that it could have been improved. I had anticipated that the second questionnaire would be easier to answer than the first. In fact, about two thirds of the respondents found the second questionnaire harder to answer.

2.5 Evaluation

This section is divided into subsections corresponding to the criteria outlined in Section 1.4.

2.5.1 *Understanding and answerability*

Respondents showed a good understanding of the questions being asked. However, most respondents reported difficulty in answering Question one in the first survey. They felt that the number of items which they were asked to rank and rate was too great, and that it was not possible to compare properly items so different in nature. Further criticism was that these items were too general in nature. These criticisms were interesting in the light of similar overseas questionnaires that tend to have many more items (up to 80) and where the activities being ranked are expressed in even more general terms.

2.5.2 *Quality of response and modelling assumptions*

Preliminary analysis of the comments received on the questionnaire suggested that the quality of the responses was not particularly good. Complete analysis of the data was not undertaken because the lack of consistency and an apparent non-understanding of some questions as well as small sample size indicated that the results would be misleading. Therefore only a simple statistical summary was made.

The main assumptions associated with the psychometric questionnaire are that people understand the questions that are being put to them, have sufficient information to make 'informed' decisions, and respond rationally and consistently. This small sample suggested that although people understood the questions they did not believe that they had sufficient information to make informed decisions, and therefore were not confident of their own ability to react rationally and consistently.

I believe that this was probably caused by the method of administering the questionnaire. New information from overseas suggests that a better approach to administering this type of questionnaire is by interviewing on a group basis in which the researcher makes a brief presentation and then presents questions to the individuals in the group.

The second questionnaire used for this survey did not require any major assumptions. Its purpose was simply to make the respondents think about all the possible factors that might have been of use in the first questionnaire. This questionnaire took a long time to complete and therefore the quality of the responses tends to deteriorate towards the end. In some cases the questionnaire was not completed.

2.5.3 *Credibility and sensitivity*

The formal analysis technique used for psychometric questionnaires is factor analysis. This is a very exact technique which produces apparently exact results. It is, of course, entirely dependent on the quality of the input data. In tightly specified experiments where medical data or directly measured data are used they can produce useful information. The main assumption is that the characteristic components or factors used to describe the aspect under study are complete, that is, the factors cover the whole possible range. This is very difficult to achieve in practice. Its use in sociological work where the factors used may not cover the full range and where the input data require considerable manipulation is less certain, and it should be used with caution.

The credibility of this technique depends on its ability to reproduce similar factors for similar experiments. It is not therefore possible to judge credibility without repeating the experiments a number of times and comparing the results. Other researchers have shown that repeatability is possible.

2.5.4 *Information content*

Since the implicit objective of any survey is to produce information, the information content of the data obtained is of prime importance. In this case, the main information gain is in identifying and placing relative weights on the importance of the factors affecting perceived risk. The information content of the second questionnaire used in this survey is important since the results provide information on relevant factors for use in further surveys.

2.5.5 *Application*

Since the survey was not directed towards a particular issue, the results are of a general nature. Their applicability lies in their use as an indicator of comparability with overseas studies.

This approach to obtaining information as to the public's likely response to 'risk' has been found to be a useful way of identifying the factors that have the greatest effect. The results obtained are probably not suitable for direct input into the public sector decision-making process. They are, however, useful in terms of identifying areas where public concern is focused thus allowing communication efforts to be appropriately directed.

2.5.6 *Aggregation*

Aggregation is achieved by averaging all the responses. Experience suggests that the results are applicable only within similar sociological groups, that is, the results cannot be extrapolated to the general population. Also, the approach is not suitable for small sample studies.

2.6 Summary

Although researchers have been using psychometric surveys to estimate risk perceptions for over 10 years, the technique is still relatively undeveloped. The analysis technique is complex and requires experience with adjusting factors in order to obtain satisfactory (that is, robust and consistent) results. Therefore, at present I believe that it is a useful experimental technique, which should be explored further in surveys such as the one under discussion but that it is not immediately appropriate for use by local and regional authorities as a general tool.

3 Attitude questionnaire approaches

3.1 Specific objectives (or what do we really want to know?)

The objective of the second survey was to examine people's attitudes towards the newly installed water and sewerage scheme in Governors Bay, a small harbourside community near Christchurch. About five years ago a referendum was held in which the residents voted against the scheme (approximately 80% against). Subsequently, without any consultation, the scheme was arbitrarily imposed by the Health Department. The main reasons for resident opposition were: cost (approximately $8000 per household); lack of valid reasons why the scheme was required; environmental concerns about damage to property and the problems of insufficient flushing in the harbour; and concern that the scheme would mean a large increase in the local population, thus changing the character of the community and resulting in current residents subsidising future residents.

Supporters of the scheme were largely landowners who stood to gain by being able to subdivide their properties (previously not allowed).

With the scheme almost completed, many of the residents' concerns have proved justified. Construction has caused considerable damage to public and private property and in many cases has not been satisfactorily repaired, and there are signs of many major subdivisions (probably beyond the capacity of the scheme). Land and house prices are increasing substantially thus changing the socio-economic base of the community. Low income residents face rate increases as well as having to cope with the burden of paying for the scheme.

Attitude studies and models are concerned with people's response. Beliefs measured by opinion polls are not measures of attitude. Attitude models multiply belief measures by people's evaluation of that belief and this provides a built-in validation check. In general these questionnaires are easier to answer than psychometric questionnaires in that they do not require any complex evaluations.

Attitude surveys were first used for perceived risk studies by Otway and Fishbein, working at IIASA in the mid to late 1970s. Although there are comparatively few practical studies to be found in the more recent perceived risk literature, the approach has been used with some success in a number of different areas, including willingness-to-pay, non-market valuation studies.

3.2 Methodology

The first step in this type of survey is to derive a list of all attitudes and beliefs that people associate with the activity being considered. It is important that this list should be as complete as possible. The usual approach would be to use a pilot questionnaire to derive attitudes and beliefs. In this case, the list shown below was derived from Thomas (1981) and Otway (1975, 1977) and adapted to the situation being considered. Therefore, as some beliefs and attitudes may have been omitted, the results of this survey should be treated cautiously.

The activity being studied was sewerage disposal for Lyttelton harbour communities. Three alternatives were mooted:

(a) all to be piped to Bromley;
(b) localised treatment and final outflow to harbour; and
(c) status quo (in most cases, septic tanks).

The selected beliefs considered as likely to be reflected in the perceived effects of the activity were grouped in terms of:

(1) economic value (eg value for money)

(2) quality of life
  (a) change in lifestyle
  (b) effect on health
  (c) enjoyment of activity

(3) environmental quality - modification of environment
  (a) water quality
  (b) air quality
  (c) fishery

(4) institutional factors
  (a) dependence on city
  (b) dependence on experts
  (c) understanding of technology

(5) equity

The questionnaire was divided into three sections. The first section asked for general information about the respondent's activities and lifestyle within the harbour basin. The second section asked about how the alternative activities might affect this lifestyle and the environment and the third section considered attitudes and beliefs.

3.3 Sample population

This survey was distributed in a random fashion in Governors Bay. Fifty questionnaires were placed in letter boxes. There was no identification process and therefore it was not possible to use any follow-up procedure. As an incentive, all respondents were offered the chance of entering a simple lottery for a $50 book token. To enter they were required to return the questionnaire (either completed or uncompleted) with their telephone number on it. A stamped addressed envelope was included with the questionnaire.

3.4 Response

The response rate for this survey was very good, especially considering that it was a 'one shot' questionnaire with no follow-up (the normal expected response for this type of survey would be approximately 30%). In the first survey, although there was no formal follow-up, individual students were given reminders. For this second survey, 27 replies were received, giving a response rate of 54%.

Most respondents included some comment on either the questionnaire or the scheme. One reason for the excellent response was that people were interested and concerned about the issue and viewed the questionnaire as a means of expressing their views. A number of respondents requested a copy of this publication.

3.5 Evaluation

3.5.1 *Understanding and answerability*

As with the psychometric questionnaire, most respondents appeared to understand the questions being asked and in this case they did not indicate any general difficulty in answering them. One respondent did express difficulty in the evaluation (is this good . . . . bad), but other respondents appeared to cope satisfactorily. The first section asked simple questions concerning lifestyle, providing an easy introduction to the more complex questions in Sections two and three. This was in contrast to the first survey where the first question was probably the most difficult to answer.

3.5.2 *Quality of response and modelling assumptions*

The main assumptions associated with this type of questionnaire are that people understand the questions, that they behave rationally and consistently, and that all the beliefs associated with the activity are included in the questionnaire. In this case it is not possible to say whether the third assumption is valid since a pilot survey to extract beliefs was not undertaken.

The quality of the responses was very good and indicated a high level of interest.

3.5.3 *Credibility and sensitivity*

The credibility of the analysis depends greatly upon whether all beliefs have been accounted for. As a followup to this survey it is hoped to run a series of similar surveys in other harbour basin communities in 1991. This should give some indication of the sensitivity of the results.

3.5.4 *Information content*

The information content of this particular survey was limited because of the small sample size. However, the response does represent approximately 20% of the community directly affected by the sewerage scheme and therefore the results should be treated seriously. The information content of the general approach is very good, and analysis can be performed at different levels depending upon the type and quality of data collected.

3.5.5 *Application*

This survey addressed a particular problem, rather than the general problem addressed by the first questionnaire. The results obtained from this type of survey are therefore more directly applicable and can be used as direct input to decision-making processes.

3.5.6 *Aggregation*

A modal approach to aggregating the individual responses is required. This is not entirely satisfactory, but is the only approach available. It is again not amenable to small sample studies.

3.6 Summary

This type of survey is simple to construct and can be used to provide results for direct input to the decision-making process. If a willingness-to-pay concept is incorporated into the attitude questionnaire, then it may be even more useful as a means of quantifying people's concerns about personal and environmental health and safety. It does, however, require extensive pilot study to identify completely the beliefs associated with the activities or options being considered in order for the assumptions of the analysis to be validated.

4 Simple social survey

4.1 Specific objectives

The third survey was selected because it was anticipated that it would provide an interesting viewpoint on the way in which people's attitudes to risk issues change over time. In the early 1980s an LPG pipeline between Lyttelton and Woolston in Christchurch was proposed and built. At the time it aroused a great deal of interest and considerable opposition from people living in the areas most likely to be affected. Arguments for the pipeline were largely based on economic grounds. A safety element was introduced as a result of one of the alternatives being the transport of LPG by tanker through the Lyttelton Road tunnel. A quantitative risk assessment (QRA) was performed by an overseas company with experience in this area. A major criticism of the proposal and the Inquiry held was that there was insufficient public involvement in the process. It was also felt that the QRA was too limited in its coverage of potential hazards and was intolerant of local social conditions and community environmental concerns.

The reason for conducting this survey was to try to investigate the ways in which people's attitude to risk changes over time, and whether this is a practical approach to examining these changes.

The questionnaire includes questions about people's feelings towards an activity. It is not amenable to sophisticated analysis, but can provide decision makers with useful information about people's feelings towards specific activities. In terms of perceived risk research, this type of questionnaire provides information about people's perceptions but does not explore the ways in which these perceptions arise.

4.2 Methodology

The questionnaire is divided into three parts. The first section was identical to the first section of the attitude questionnaire and asks questions about lifestyle. The second section was concerned with whether people had lived in the area at the time of the building of the pipeline and how aware they were of it. The final section, to be answered only by those people who were in the area in 1980-81, was split into questions about attitudes at the time and current attitudes towards the pipeline.

4.3 Sample population

This survey was distributed in a random fashion in the area of Lyttelton located immediately above the petrol storage tanks. Those people would be expected to be aware of potential hazards associated with the tanks and with the LPG pipeline.

Again, questionnaires were placed in letter boxes and included a stamped addressed envelope for return. A book token prize was offered in a similar fashion as for the second survey.

4.4 Response

Forty-nine questionnaires were distributed and 25 replies received, giving a response rate of 51%. This response is excellent considering that the issue being addressed is 10 years old and that people who have recently moved to the area would be unlikely to reply. In this case I believe that it is unlikely that a follow-up would significantly improve the response.

4.5 Evaluation

4.5.1 *Understanding and answerability*

The responses received suggested that respondents did not have any particular difficulty in answering the questions apart from some confusion in the last question in Section One, due to poor wording of the question (this criticism holds also for the questionnaire used for the second survey since Section One was identical for the two surveys).

4.5.2 *Quality of response and modelling assumptions*

There are no specific modelling assumptions required with this form of questionnaire other than the normal expectation that respondents will behave in a rational, consistent manner.

An examination of the returned questionnaires suggests that the quality of the data is good.

4.5.3 *Credibility and sensitivity*

The type of analysis possible for this survey is restricted to the presentation of simple tabulations and cross-tabulations of data. This analysis is credible as long as complex correlations are not attempted without explicit modelling.

It is difficult to comment on the sensitivity of the results. People have been asked to try to remember their feelings of a long time ago, and their response may depend upon factors such as recent events associated with LPG and other gas type incidents both in New Zealand and overseas. The heuristics associated with people's judgements of risk have been well investigated by Tversky and Kahneman (1982). The small sample involved is likely to affect this sensitivity.

4.5.4 *Information content*

The information available from this type of survey is limited by the analysis technique which is restricted to simple tabulations and statistics such as percentages, means and variances. These simple statistics do, however, provide useful information for decision makers seeking to consult the opinions and desires of the people they represent.

4.5.5 *Application*

The results from this type of survey are directly useful to decision makers. In this instance the activity is being addressed retrospectively, however, it does indicate continued concern in the community, a willingness to contribute and a desire to be consulted in future decisions of this nature.

4.5.6 *Aggregation*

Results can be simply aggregated by averaging.

4.6 Summary

This type of survey is useful for gauging public opinion on a variety of topics. There are a number of different ways of posing questions to avoid biasing and to provide checks for consistency of the results. Willingness-to-pay questions can also be introduced and used to determine whether and how much people are willing-to-pay for increased (perceived) safety. In many cases, however, this method would be counter-productive because of people's belief that their safety should not be compromised beyond the status quo for any reason or price.

5 Conclusions and recommendations

Development of the questionnaires used for the three surveys was a major part of this study. When the study was initially proposed it was intended to use only one questionnaire approach. The expectation was that a small pilot test would be conducted and that this would be followed by a major survey, using the same general approach and a slightly modified questionnaire.

At a fairly early stage it was decided that rather than examine a single issue in depth, greater benefit and knowledge would be obtained from considering a number of different issues using a series of different survey approaches. Of necessity the surveys involved would be smaller, but experience with more than one approach would be gained, and it would be possible to compare several survey approaches and questionnaire types. This change meant that a considerably greater time than anticipated was spent in questionnaire development, since three questionnaires were required to be developed (the second was a simple extension of the first), rather than one.

Analyses of the results of Surveys Two and Three are presented in Appendices C and D. Preliminary analysis of Survey One indicated that the sample size was too small to provide consistency and therefore no further analysis was proceeded with.

Six criteria were selected to evaluate the survey approaches, and each survey has been discussed in terms of these six criteria. The table included as Appendix B gives a brief summary of the results of this evaluation.

Recommendations arising from this project can be discussed in terms of three areas: survey design and administration, survey respondents, and use of survey techniques.

5.1 Survey design and administration

As with all survey work the most important and time-consuming aspect is the design of the questionnaire. Unless the structure of the questionnaire is correct and the right questions are asked, the objectives of the survey will not be met. This also means that the specific objectives of the survey have to be very clearly specified from the beginning. Therefore, it is important firstly, to allocate sufficient time for full pilot testing and secondly, to be prepared to amend the time-table and allow additional time if it is found that the questionnaire design process is taking longer than anticipated. Pilot testing may often be an iterative process. For example, when prior information such as the types of beliefs and attitudes associated with an activity is required, it may be necessary to use several pre-tests to ensure that all the required factors have been identified.

The administration of questionnaires is important also. The more complex the questionnaire the less likely it is that people will provide useful answers. Therefore, when complex questionnaires are used respondents must be given as much assistance as possible in answering. Some questionnaires are simply not appropriate for mail delivery. Telephone approaches have limitations also in that it is difficult to judge the quality of the answers. Telephone calls are intrusive and at times telephone interviewers call at inconvenient times. With all administered questionnaires the quality of the answers is dependent upon the administrator. The response rate can sometimes be a good indication of the interest in the topic and quality of response, however, an inappropriate approach time may reduce the usefulness of the response.

5.2 Respondents

One of the important conclusions that can be reached from the results of this study is that people are interested and very willing to respond to questions about concerns and activities affecting areas where they live and recreate. In the two questionnaires involving the Lyttelton Harbour Basin there was a feeling that people welcomed the opportunity (albeit belated in both circumstances) to express their views with some expectation of being heard. People are generally keen to be involved in their community (and community may be defined in a number of different ways according to the issue or activity being considered) and wish to have their views heard.

5.3 The use of survey techniques

If public authorities are going to use survey techniques as a means of gauging public opinion, then it behoves them to be cautious, and not to abuse the goodwill of the public. First of all, the purpose of using a questionnaire approach should be well defined and the objectives need to be made quite clear to the intended respondents. People will not continue to answer questionnaires with integrity if they feel that the information they are giving is not being put to any useful purpose. Therefore, it is important to see surveys as a two-way process in which the public provides information to the questioning authority and then the authority returns information in the form of summarised results and a concise statement about their intended use.

Survey results concerning risky issues can and should be used as input to decision-making processes by local and regional government **to complement** expert risk assessment but not as **an alternative**. The need to involve the public does not mean that survey results should necessarily be used as a form of referendum or that the results should be considered to bind the authority to any particular action. It is crucial that the objectives, in terms of both questionnaire design and use of the results, be stated explicitly before a questionnaire is used.

5.4 In conclusion

It appears that there is remarkably little expertise available internationally in connection with the use of expressed preference techniques for estimating perceived risk. Therefore, projects such as this where questionnaire approaches are applied to real problems are important in the building up of experience and for demonstrating the potential use of the methodology.

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Appendix A

Questionnaires

QUESTION 1

Please study carefully the following list of items which consist of a mixture of substances and activities. Think of the hazards or threats to people which are associated with each item, and try to ignore any benefits that might also be associated.

Consider threats to people in terms of the risk of death, serious injury or forced change in lifestyle.

Then **rank** the items in increasing order of 'threat' from:
1 the least threat; to
26, the most serious threat.

Give the item ranked as (1) a **rating** of 10.

Then, taking each item in ranked order from 2 to 26, please give each one a **rating**, in such a way that a rating of 50 means that you believe the activity is 5 times more risky or threatening than the least threatening (rated at 10).

	Items	**Rank** 1-26	**Ratir** least=
1	having more than one alcoholic drink per day	.	
2	a major flood in Canterbury	.	
3	driving to work every day	.	
4	allowing the use of open fires in Christchurch	.	
5	ski-ing for 5-10 days per year	.	
6	the current disposal of treated sewerage in Lyttelton harbour	.	
7	allowing nuclear power plants in New Zealand	.	
8	regular fishing near the mouth of a major river mouth	.	
9	the use of spray cans with fluorocarbon propellants	.	
10	allowing nuclear powered ships in our harbours	.	
11	living close to a petrol station with LPG storage tank	.	
12	transporting chemicals by road (tanker) through the central city	.	
13	a major earthquake in the South Island	.	
14	eating more than one fast food meal per week	.	
15	living near high voltage power lines	.	
16	going tramping for 10-20 days per year	.	
17	smoking more than two packets of cigarettes per week	.	
18	the disposal of untreated sewerage in Lyttelton harbour	.	
19	the LPG pipeline between Lyttelton and Woolston	.	
20	the use of air conditioning in cars	.	
21	living near a radio or television tower	.	
22	riding a bicycle to work every day	.	
23	playing social rugby on weekends	.	
24	hydro-electric power generation	.	
25	packaging of retail products	.	
26	disposal of batteries in household rubbish	.	

For the following questions, please consider each of the potential hazards and think of them on t scale as given for each question.

Detach the sheet at the end of this questionnaire which contains the list of threats as in question 1, and consider each of the following questions in turn.

Please write a number equating to a position on the scale in the box beside each item as listed. If you do not feel confident about answering any part of the question, leave it, and go on to the next part. If you do not feel the question is appropriate to the item please write na in the box.

QUESTION 2

Does the average person understand the risk associated with this item?

average people understand well	1	2	3	4	5	average people do not understand

QUESTION 3

Do you believe that scientists understand this item?

scientists understand very well	1	2	3	4	5	scientists do not understand

QUESTION 4

Can the risks associated with this item be controlled by those exposed to the risk?

those exposed have no control	1	2	3	4	5	those exposed have complete control

QUESTION 5

Is our generation's use of this activity or technology likely to cause harm to future generations?

great harm to future generations	1	2	3	4	5	no harm to future generations

QUESTION 6

Are these threats generally voluntarily accepted, or are they forced on people in some way?

completely voluntary	1	2	3	4	5	forced on people

QUESTION 7

Do any threats associated with these items seem to have arisen within the past 5 years or have we always known about them and thought about them?

new	1	2	3	4	5	old

QUESTION 8

Are the threats posed by these activities more likely to cause injury (illness) or death?

injury or illness	1	2	3	4	5	death

QUESTION 9

Do you believe that there is any easy way of reducing the threat associated with these items?

easy reduction of threat	1	2	3	4	5	no easy reduction of threat

QUESTION 10

Most risks have some benefit associated with them. Do the risks posed by these items fall on the same groups of people as those who are likely to receive the benefits?

risks and benefits fall on different people	1	2	3	4	5	risks and benefits fall on the same people

QUESTION 11

Are the effects of 'something going wrong' likely to have most effect globally or on individuals?

Main effect is on individuals	1	2	3	4	5	main effect is likely to be global

QUESTION 12

Do you believe that you are personally likely to be at risk from this activity or substance?

personally very much at risk	1	2	3	4	5	personally at very little risk

DETACHABLE SHEET FOR QUESTIONS 2-12 substances and activities

ITEMS		QUESTION 2	3	4	5	6	7	8	9	10	11	12
1	having more than one alcoholic drink per day											
2.	a major flood in Canterbury											
3	driving to work every day											
4	allowing the use of open fires in Christchurch											
5	ski-ing for 5-10 days per year											
6	the disposal of treated sewerage in Lyttelton harbour											
7	allowing nuclear power plants in New Zealand											
8	regular fishing near the mouth of a major river mouth											
9	the use of spray cans with fluorocarbon propellants											
10	allowing nuclear powered ships in our harbours											
11	living close to a petrol station with LPG storage tank											
12	transporting chemicals by road through the central city											
13	a major earthquake in the South Island											
14	eating more than one fast food meal per week											
15	living near high voltage power lines											
16	going tramping for 10-20 days per year											
17	smoking more than two packets of cigarettes per week											
18	the disposal of untreated sewerage in Lyttelton harbour											
19	the LPG pipeline between Lyttelton and Woolston											
20	the use of air conditioning in cars											
21	living near a radio or television tower											
22	riding a bicycle to work every day											
23	playing social rugby on weekends											
24	hydro-electric power generation											
25	packaging of retail products											
26	disposal of batteries in household rubbish											

QUESTIONNAIRE 2

QUESTION 1

Please study each of the following items, and think carefully about the **risks** or **hazards** which y **feel** are associated with them.
Could you then please list these risks or hazards in order of importance **to you**.
If you need extra space, please go over the page, or write on a separate sheet.

1 having more than one alcoholic drink per day
most important
1
2
3
4
5
least important

2 a major flood in Canterbury
most important
1
2
3
4
5
least important

3 driving to work every day
most important
1
2
3
4
5
least important

4 allowing the use of open fires in Christchurch
most important
1
2
3
4
5
least important

5 ski-ing for 5-10 days per year

most important
1
2
3
4
5
least important

6 the current disposal of treated sewerage in Lyttelton harbour

most important
1
2
3
4
5
least important

7 allowing nuclear power plants in New Zealand

most important
1
2
3
4
5
least important

8 regular fishing near the mouth of a major river mouth

most important
1
2
3
4
5
least important

9 the use of spray cans with fluorocarbon propellants

most important
1
2
3
4
5
least important

10 allowing nuclear powered ships in our harbours

most important
1
2
3
4
5
least important

11 living close to a petrol station with LPG storage tank

most important
1
2
3
4
5
least important

12 transporting chemicals by road (tanker) through the central city

most important
1
2
3
4
5
least important

---

13 a major earthquake in the South Island

most important
1
2
3
4
5
least important

14 eating more than one fast food meal per week

most important
1
2
3
4
5
least important

15 living near high voltage power lines

most important
1
2
3
4
5
least important

16 going tramping for 10-20 days per year

most important
1
2
3
4
5
least important

---

17 smoking more than two packets of cigarettes per week

most important
1
2
3
4
5
least important

18 the disposal of untreated sewerage in Lyttelton harbour

most important
1
2
3
4
5
least important

19 the LPG pipeline between Lyttelton and Woolston

most important
1
2
3
4
5
least important

20 the use of air conditioning in cars

most important
1
2
3
4
5
least important

---

21 living near a radio or television tower

most important
1
2
3
4
5
least important

22 riding a bicycle to work every day

most important
1
2
3
4
5
least important

23 playing social rugby on weekends

most important
1
2
3
4
5
least important

24 hydro-electric power generation

most important
1
2
3
4
5
least important

---

25 packaging of retail products

most important
1
2
3
4
5
least important

26 disposal of batteries in household rubbish

most important
1
2
3
4
5
least important

QUESTION 2

This question is similar to question 1 except that I would like you to think about **the benefits** associated with the activities.
Could you then please similarly list these benefits in order of importance **to you**.
If you need extra space, please go over the page, or write on a separate sheet.

1 having more than one alcoholic drink per day
most important
1
2
3
4
5
least important

2 a major flood in Canterbury
most important
1
2
3
4
5
least important

3 driving to work every day
most important
1
2
3
4
5
least important

4 allowing the use of open fires in Christchurch
most important
1
2
3
4
5
least important

5 ski-ing for 5-10 days per year

most important
1
2
3
4
5
least important

6 the current disposal of treated sewerage in Lyttelton harbour

most important
1
2
3
4
5
least important

7 allowing nuclear power plants in New Zealand

most important
1
2
3
4
5
least important

8 regular fishing near the mouth of a major river mouth

most important
1
2
3
4
5
least important

9 the use of spray cans with fluorocarbon propellants

most important
1
2
3
4
5
least important

10 allowing nuclear powered ships in our harbours

most important
1
2
3
4
5
least important

11 living close to a petrol station with LPG storage tank

most important
1
2
3
4
5
least important

12 transporting chemicals by road (tanker) through the central city

most important
1
2
3
4
5
least important

13 a major earthquake in the South Island

most important
1
2
3
4
5
least important

14 eating more than one fast food meal per week

most important
1
2
3
4
5
least important

15 living near high voltage power lines

most important
1
2
3
4
5
least important

16 going tramping for 10-20 days per year

most important
1
2
3
4
5
least important

---

17 smoking more than two packets of cigarettes per week

most important
1
2
3
4
5
least important

18 the disposal of untreated sewerage in Lyttelton harbour

most important
1
2
3
4
5
least important

19 the LPG pipeline between Lyttelton and Woolston

most important
1
2
3
4
5
least important

20 the use of air conditioning in cars

most important
1
2
3
4
5
least important

---

21 living near a radio or television tower

most important
1
2
3
4
5
least important

22 riding a bicycle to work every day

most important
1
2
3
4
5
least important

23 playing social rugby on weekends

most important
1
2
3
4
5
least important

24 hydro-electric power generation

most important
1
2
3
4
5
least important

---

25 packaging of retail products

most important
1
2
3
4
5
least important

26 disposal of batteries in household rubbish

most important
1
2
3
4
5
least important

QUESTIONNAIRE 3 ATTITUDES

PART 1

This section contains questions about your personal involvement with the Lyttelton harbour basin.

1. How many years have you lived in the harbour basin area?

☐ <2 ☐ 2-5 ☐ 5-10 ☐ 10

2. Do you go recreational boating or fishing in the harbour basin area?

☐ yes ☐ nc

If yes, how many times per year?

☐ <5 ☐ 5-10 ☐ 10-

3. Do you go recreational walking in the harbour basin area?

☐ yes ☐ nc

If yes, how many times per year?

☐ <5 ☐ 5-10 ☐ 10-

4. Do you go recreational swimming in the harbour basin area?

☐ yes ☐ no

If yes, how many times per year?

☐ <5 ☐ 5-10 ☐ 10-

5. Which areas can you see from your house? (you may tick more than one of these)

the ☐ harbour ☐ hills ☐ heads ☐ Quail

6. Do you ?

☐ work in Harbour area ☐ work Chri chur

or are you?

☐ not currently in paid employ-ment ☐ retired ☐ o

PART 2

The questions in this section are concerned with the reasons why you might support a change to current arrangements for sewerage disposal in the Harbour Basin communities.

Please tick the appropriate part of the scale.

Do you think that requiring all communities in the Harbour area to pipe sewerage to Bromley would:

		very	fairly	neutral	fairly	very	
1. affect the chances of catching fish in Lyttelton Harbour?	likely	:	:	:	:		u
2. reduce water pollution in the Harbour?	likely	:	:	:	:		u
3. be expensive?	likely	:	:	:	:		u
4. increase the Harbour Basin's dependance on Christchurch City?	likely	:	:	:	:		u
5. be an easy thing to do?	likely	:	:	:	:		u
6. affect your recreation in the Harbour Basin?	likely	:	:	:	:		u
7. affect your enjoyment in living in the Harbour Basin?	likely	:	:	:	:		u
8. be fair to everyone living in the area?	likely	:	:	:	:		u

Do you think requiring all the Harbour communities (including Lyttelton) to build sewerage treatment plants, and pumping treated effluent into the harbour would:

		very	fairly	neutral	fairly	very	
9. affect the chances of catching fish in Lyttelton Harbour?	likely	:	:	:	:		u
10. reduce water pollution in the Harbour?	likely	:	:	:	:		u
11. be expensive?	likely	:	:	:	:		u
12. increase the Harbour Basin's dependance on Christchurch City?	likely	:	:	:	:		u
13. be an easy thing to do?	likely	:	:	:	:		u
14. affect your recreation in the Harbour Basin?	likely	:	:	:	:		u
15. affect your enjoyment in living in the Harbour Basin?	likely	:	:	:	:		u
16. be fair to everyone living in the area?	likely	:	:	:	:		u

PART 3

The questions in this section are concerned with your feelings about the likelihood of some of possible outcomes that could result from the options for sewerage disposal for the Harbour Ba communities. We are also asking you to say how good or bad you think that these outcomes wo be.

Please mark only one point for each part of the question and place your mark in the middle of scale, as shown in the following example.

Example:

If you think that it is fairly likely to rain tomorrow and that this is very bad because you have a lo washing to do, you would mark the score lines in the following manner.

		very	fairly	neutral	fairly	very
Q. Do you feel that it will rain tomorrow?	likely	:	:	:	:	u
how good or bad do you think this would be?	good	:	:	:	:	b

Do you think that requiring all communities in the Harbour area to pipe sewerage to Bromley woul

		very	fairly	neutral	fairly	very
1. make you feel more inclined to go fishing in the Harbour Basin	likely	:	:	:	:	u
how good or bad do you think this would be?	good	:	:	:	:	b
2. make you feel like going swimming more in the Harbour Basin	likely	:	:	:	:	u
how good or bad do you think this would be?	good	:	:	:	:	b
3. make you feel that you were getting 'value for money' from your rates payments	likely	:	:	:	:	u
how good or bad do you think this would be?	good	:	:	:	:	b
4. make you feel that the Harbour Basin authority was getting too dependant on Christchurch City	likely	:	:	:	:	u
how good or bad do you think this would be?	good	:	:	:	:	b
5. make you feel confident that the sewerage disposal system would keep working	likely	:	:	:	:	u
how good or bad do you think this would be?	good	:	:	:	:	b
6. make you feel that your recreational opportunities in the harbour area were being improved	likely	:	:	:	:	u
how good or bad do you think this would be?	good	:	:	:	:	b
7. make you feel happy about living in the Harbour Basin	likely	:	:	:	:	u
how good or bad do you think this would be?	good	:	:	:	:	b
8. make you feel that you were being treated unfairly in comparison with other harbour residents	likely	:	:	:	:	u
how good or bad do you think this would be?	good	:	:	:	:	b

QUESTIONNAIRE 3 ATTITUDES

Do you think that requiring all communities in the Harbour area to build and maintain their o sewerage disposal systems would:

		very	fairly	neutral	fairly	very
9. make you feel more inclined to go fishing in the Harbour Basin	likely	:	:	:	:	u
how good or bad do you think this would be?	good	:	:	:	:	b
10. make you feel like going swimming more in the Harbour Basin	likely	:	:	:	:	u
how good or bad do you think this would be?	good	:	:	:	:	b
11. make you feel that you were getting 'value for money' from your rates payments	likely	:	:	:	:	u
how good or bad do you think this would be?	good	:	:	:	:	b
12. make you feel that the Harbour Basin authority was getting too dependant on Christchurch City	likely	:	:	:	:	u
how good or bad do you think this would be?	good	:	:	:	:	b
13. make you feel confident that the sewerage disposal system would keep working	likely	:	:	:	:	u
how good or bad do you think this would be?	good	:	:	:	:	b
14. make you feel that your recreational opportunities in the harbour area were being improved	likely	:	:	:	:	u
how good or bad do you think this would be?	good	:	:	:	:	b
15. make you feel happy about living in the Harbour Basin	likely	:	:	:	:	u
how good or bad do you think this would be?	good	:	:	:	:	b
16. make you feel that you were being treated unfairly in comparison with other harbour residents	likely	:	:	:	:	u
how good or bad do you think this would be?	good	:	:	:	:	b

PHONE NUMBER
(optional, but required if you wish to enter the lottery for the book token)

YOUR COMMENTS

NOTE: As stated in the introductory letter, the Ministry for the Environment is interested in findi out more about the ways in which we look at risk to ourselves, our community and the environme One way of getting this information is to question people directly as to their perceptions of ris associated with different substances and activities. Unfortunately, the type of questionnaire required very complex. Therefore, as a first step towards understanding how people perceive risks and w they look at different risks in different ways we are testing a series of different questionna approaches. This is the second questionnaire we have used. We used students to test the first o which was rather more complicated than this one. We will be trying out a more simple, social surv on residents of other parts of the harbour basin. If you are interested in the results of this work, th I can send you a copy of the report later this year.

QUESTIONNAIRE 4 **SOCIAL SURVEY**

PART 1

This section contains questions about your personal involvement with the Lyttelton harbour basin.

1. How many years have you lived in the harbour basin area?

   ☐ <2 ☐ 2-5 ☐ 5-10 ☐ 10 -

2. Do you go recreational boating or fishing in the harbour basin area?

   ☐ yes ☐ no

   If yes, how many times per year?

   ☐ <5 ☐ 5-10 ☐ 10+

3. Do you go recreational walking in the harbour basin area?

   ☐ yes ☐ no

   If yes, how many times per year?

   ☐ <5 ☐ 5-10 ☐ 10+

4. Do you go recreational swimming in the harbour basin area?

   ☐ yes ☐ no

   If yes, how many times per year?

   ☐ <5 ☐ 5-10 ☐ 10+

5. Which areas can you see from your house? (you may tick more than one of these)

   the ☐ harbour ☐ hills ☐ heads ☐ Quail

6. Do you ?

   ☐ work in Harbour area ☐ work Chris churc

   or are you?

   ☐ not currently in paid employ-ment ☐ retired ☐ ot

QUESTIONNAIRE 4 **SOCIAL SURVEY**

PART 2

1. Are you aware of the LPG pipeline between Lyttelton and Woolston?

☐ yes ☐ no

2. Do you know where the pipeline goes?

☐ yes ☐ no

If yes, please describe route.

3. If you were living in Lyttelton at the time of the LPG Pipeline Inquiry in 1981, were you then in favour of the building of the pipeline?

☐ yes ☐ no ☐ don kno

why?

4. Do you still feel the same?

☐ yes ☐ no

If not, please give one or more reasons for your change.

5. Do you think that the LPG pipeline is a greater threat to Lyttelton than the petrol storage tanks?

☐ yes ☐ no

PART 3

Please answer this section only if you were living in the Harbour Basin area at the time of the L Pipeline Inquiry.

(1)Do you think that the pipeline poses any health risk to you and your family?

☐ yes ☐ no ☐ don kno

(2)Do you think that you were at risk while the pipeline was being built?

☐ yes ☐ no ☐ don kno

(3)Do you think that the pipeline provided useful employment whilst it was being built?

☐ yes ☐ no ☐ don kno

(4)Do you consider that building the pipeline damaged the environment?

☐ yes ☐ no ☐ don kno

(5)Do you think that the environment is threatened by the pipeline?

☐ yes ☐ no ☐ don kno

(6)Did you at the time expect that building the pipeline would cause environmental damage?

☐ yes ☐ no ☐ don kno

(7)Would you be against building another pipeline?

☐ yes ☐ no ☐ don kno

(8)Do you think that property values have been damaged by the presence of the pipeline?

☐ yes ☐ no ☐ don kno

(9)Did you expect that property values might be affected by building the pipeline?

☐ yes ☐ no ☐ don kno

(10)Did you consider that building the pipeline would cost more money than it would save?

☐ yes ☐ no ☐ don' kno

(11)Do you think that building the pipeline was cheaper than taking the LPG through the tunnel from Lyttelton by tanker?

☐ yes ☐ no ☐ don' kno

(12)Do you think that having the pipeline is safer than taking LPG through the tunnel by tanker?

☐ yes ☐ no ☐ don' kno

PHONE NUMBER
(optional, but required if you wish to enter the lottery for the book token)

YOUR COMMENTS

NOTE: As stated in the introductory letter, the Ministry for the Environment is interested in findi out more about the ways in which we look at risk to ourselves, our community and the environme One way of getting this information is to question people directly as to their perceptions of ris associated with different substances and activities. Unfortunately, the type of questionnaire required very complex. Therefore, as a first step towards understanding how people perceive risks and w they look at different risks in different ways we are testing a series of different questionna approaches. This is the third questionnaire we have used. We used students to test the first o which was rather more complicated than this one. The second questionnaire looked specifically people's attitudes towards sewerage disposal in the harbour area. If you are interested in the resu of this work, then I can send you a copy of the report later this year.

Appendix B

Evaluation

This brief table summarises the evaluation criteria discussed in the report for each of the four questionnaires used in three surveys and gives a rating on five point scale. A summary score is then calculated for each questionnaire.

The scales and scores used are poor (-2), fair (-1), average(acceptable) (0), good (+1), excellent (+2). This scale is not entirely appropriate in all cases, however, it was considered important to use the same scale in all cases to allow for comparisons.

	questionnaire number			
	one	**two**	**three**	**four**
response rate	71%	53%	54%	51%
understanding	good	good	good	good
answerability	poor	poor	good	good
quality of response	fair	fair	good	good
credibility and sensitivity of technique	average	good	average	good
information content	good	poor	good	average
ease of application	average	poor	good	good
ease of aggregation	fair	poor	good	good
SCORE	**-2**	**-7**	**6**	**6**

Appendix C

Report on Survey Two

This report describes briefly the results of the survey which questioned residents of Governors Bay about their attitudes towards sewage disposal in the Lyttelton Harbour Basin, with particular reference to the Governors Bay sewerage scheme.

Conclusions

The statistical analysis described below produced three major conclusions.

Firstly, a significant number of the people responding to this questionnaire are active recreators in the Lyttelton Harbour Basin area, taking part in walking, boating and swimming.

Secondly, people were given two hypothetical options for Harbour Basin sewage: piping all sewage to Bromley; and requiring all communities to build and maintain locally based sewage treatment plants. Respondents were then asked to evaluate the likely effects of these two options according to a set of given propositions. The results indicated that respondents did hold opinions as to the likelihood of these effects but that they did not feel that the effects of the two options were likely to be significantly different.

Thirdly, when respondents were asked to state their attitudes towards the two options in terms of their beliefs as to the likely outcomes and their feeling as to whether the postulated outcomes were good or bad, differences did emerge. The attitude exhibited towards both options was positive, however, there was a significant difference between the options for a number of the outcomes. Overall attitudes were more positive towards the piping option than the alternative of individual community schemes.

Survey procedure and statistical analysis

Fifty questionnaires were placed in letter boxes in the Governors Bay sewerage scheme area, and 27 responses were received. This response rate of 54% was excellent, considering that no followup procedure was employed. It represents approximately 14% of the households affected by the Governors Bay sewerage scheme.

The first section of the questionnaire (see attached) concerned people's activities in the Harbour basin. Of those replying, 70% had lived in the area for five or more years. Fifty-six percent worked in Christchurch and 22% worked in the Harbour Basin area.

Table 1 summarises the information obtained on recreational activities.

Table 1. 1Frequency of participation in activities in the Harbour Basin (percentage).

	percentage of respondents who		
	walk	boat	swim
not at all	11	30	37
less than five times per year	7	15	15
five to 10 times per year	26	30	7
more than 10 times per year	56	26	41

The second section asked respondents to consider two possible options for sewage disposal. The first of these was piping sewage from all Harbour Basin communities to Bromley. The second alternative consisted of requiring all Harbour Basin communities to build and maintain their own sewerage treatment plants.

Respondents were asked to rate a series of possible outcomes on a scale of one to five, where one indicated that they thought that the outcome was very likely and five indicated that they thought that it was very unlikely. These results are shown in Tables 2 and 3.

The ordering of the questions in the questionnaire and in the tables below is different. In the questionnaire the questions were deliberately presented in a manner designed to separate certain questions which required independent answers. The responses recorded in the tables below have been sorted into three groups: the first of these represents questions associated with lifestyle, the second group consists of economic questions and the third group consisting of two loosely related questions requires technical and ethical evaluations.

[1] Percentages may not add to 100, due to rounding errors.

Table 2. Opinions as to likely effects of piping sewage to Bromley (percentage)

OPTION 1

	very likely	fairly likely	uncertain[2]	fairly unlikely	very unlikely
Do you think that piping all Harbour Basin sewage to Bromley would . . .	%	%	%	%	%
affect chances of catching fish	33	26	19	11	11
reduce water pollution	78	22	0	0	0
affect 'your' recreation	41	15	7	15	22
affect 'your' enjoyment	30	22	4	19	26
be expensive	74	19	4	0	4
increase dependence on city	33	52	7	0	7
be easy	7	26	11	19	37
be fair	31	23	23	4	19

Table 3. Opinions as to likely effects of requiring all communities to build sewerage treatment plants (percentage).

OPTION 2

	very likely	fairly likely	uncertain	fairly unlikely	very unlikely
Do you think that requiring all communities to build individual sewage treatment plants would . . .	%	%	%	%	%
affect chances of catching fish	31	27	12	23	8
reduce water pollution	37	30	0	7	26
affect 'your' recreation	33	22	11	15	19
affect 'your' enjoyment	37	15	11	15	22
be expensive	63	22	4	7	4
increase dependence on city	7	4	4	7	78
be easy	7	19	15	30	30
be fair	31	23	19	8	19

[2] In the questionnaire the option given for this middle category was neutral. The answers in this category have been interpreted as meaning 'uncertain' or 'don't know'. A preferable approach would have been to use only four categories for the answer and to have a separate category for a 'don't know' response.

The number of people entering neutral responses (uncertain) averaged 10% of valid responses for both options. This suggests that most people did hold opinions with respect to the questions being asked, the notable exception being the question about fairness.

Table 4 shows the results of χ^2 tests comparing the individual questions for the two options. In order to calculate the χ^2 values the results shown in Tables 2 and 3 have been aggregated into three groups, so that 'very likely' and 'fairly likely' have been grouped together as 'likely' and 'very unlikely' and 'fairly unlikely' have been grouped as 'unlikely'. This was necessary because of the small sample size and the need to avoid empty cells in the two way tables created for each question. Even with this modification, more than 20% of the cells had less than five elements in them which means that the results of the significance tests should be treated cautiously.

In Table 4 the hypothesis being tested is that the two options are different (that is, that there is no relationship between the variables). Taking question 1 as an example this means that we are testing the hypothesis that piping sewage to Bromley will have a different effect on the chances of catching fish than requiring all communities to set up individual sewage treatment plants.

Table 4. Chi squared (χ^2) values for the two options

		χ^2	degrees of freedom	probability
1.	affect chances of catching fish	23.41	4	0.000
2.	reduce water pollution	see text	-	-
3.	affect 'your' recreation	35.00	4	0.000
4.	affect 'your' enjoyment	13.98	4	0.007
5.	be expensive	8.42	4	0.077
6.	increase dependence on city	3.59	4	0.464
7.	be easy	12.54	4	0.014
8.	be fair	10.35	4	0.035

Chi squared values have not been calculated for the 'water pollution' question since for the 'piping' option, 100% of responses fell into the 'likely' category, reducing the number of degrees of freedom to zero.

The probability column gives the probability of obtaining a χ^2 value as large or greater than that calculated **by chance**, when the variables are in fact independent. The low probabilities shown for questions 1,3,4,5,7 and 8 suggest that it is extremely likely that there is no difference between the two options. The χ^2 value for question 6 has a probability of 0.46. In this case, we cannot reject the hypothesis of no relationship.

It must be remembered that because of the small sample size the significance results should be treated cautiously, however, the answers to the questions posed in Part 2 of the questionnaire suggest that people view the two options of piping sewage to Bromley and building individual community sewerage plants similarly in terms of the questions posed.

In Part 3 of the questionnaire, respondents were asked to state their beliefs concerning the **probability of the outcomes** that they were questioned about in Part 2. They were then asked to evaluate their belief as to the desirability **of those outcomes**.

The beliefs were scored on a scale of 1 to 5 (very unlikely, fairly unlikely, neutral, fairly likely, very likely). The evaluations were scored from -2 to +2 (very bad, bad, neutral, good, very good).

Table 5 summarises this belief and evaluation information.

Table 5. Mean values for beliefs and evaluations

	Piping to Bromley		Community based schemes	
make you feel	average belief	average evaluation	average belief	average evaluation
more inclined to go fishing	3.62	+1.23	2.73	+0.23
more likely to go swimming	3.69	+1.15	2.81	+0.15
that recreation would improve	3.96	+1.35	3.15	+0.23
happy about living in the area	3.65	+0.85	3.20	+0.40
as if you were getting good value	3.42	+0.65	2.92	+0.12
that the Harbour Basin was too dependent on the city	3.04	-0.31	1.96	+0.19
confident of the option working	3.81	+0.92	3.15	+0.15
you were being treated unfairly	2.44	+0.20	2.04	+0.21

The evaluation of the outcomes should be independent of the belief. For example, considering questions 1 and 9 in Part 3, people were asked whether they believed that 'feeling more inclined to go fishing' was good or bad. If the questions have been answered properly, then the evaluation should be the same for both options. This is examined in Table 6.[3]

[3] A more consistent result would be obtained by separating the questions on beliefs and evaluations. This could be done by having sections on beliefs for each option being tested, and then a single separate set of questions asking respondents to evaluate the outcomes. This should reduce the difficulty respondents have in trying to determine exactly what it is they are trying to evaluate.

Table 6. **Tests for consistency of evaluation of outcomes (degrees of freedom in brackets)**

	Option 1 Piping	Option 2 Community schemes				
	average evaluation	average evaluation	χ^2 (dof)	prob	t (dof)	prob
more inclined to go fishing	+1.23	+0.23	19.76(8)	0.011	2.29(25)	0.007
more likely to go swimming	+1.15	+0.15	33.68(12)	0.001	3.09(25)	0.005
that recreation would improve	+1.35	+0.23	26.06(8)	0.001	3.34(20)	0.003
happy about living in the area	+0.85	+0.40	24.64(9)	0.003	1.37(24)	0.184
as if you were getting good value	+0.65	+0.12	14.11(12)	0.294	0.41(25)	0.170
that the Harbour Basin was too dependent on the city	-0.31	+0.19	31.04(16)	0.013	-1.70(25)	0.102
confident of the option working	+0.92	+0.15	27.73(12)	0.006	1.96(25)	0.062
you were being treated unfairly	+0.20	+0.21	24.64(16)	0.076	0.00(23)	1.000

The χ^2 test is being used here to examine the relationship between the two evaluations. The hypothesis being tested is that there is no relationship, that is, that people did not evaluate the outcomes the same way both times. The probabilities associated with the χ^2 values suggest that the hypothesis can be rejected for all questions except question 5 (good value). That is, that there is a relationship between the way in which people evaluated the outcomes for the two options.

Paired sample t statistics were calculated also to test the difference between the **mean** evaluations associated with the two options. A two-tailed test was used to test the null hypothesis that the means of the two samples were the same. Using a significance level of 5% we can reject the null hypothesis for questions 1,2,3 and 7. That is, for these questions the means were not the same. We cannot reject the null hypothesis for questions 4,5,6 but this does not necessary imply the converse that the means are the same. In the case of questions 8 with a probability of 1 we can, however, safely assume this.

An attitude score for each question was then computed by multiplying the beliefs and evaluations. The maximum possible attitude score for an individual is +10 (very likely and very good) and the minimum is -10 (very unlikely and very bad). These attitude scores are summarised in Table 7.

Overall attitude scores were calculated for each individual response as the sum of the attitudes for the individual questions. The maximum possible score is 80 and the minimum is -80. The mean attitude score represents the calculated sample attitude for each option.

Table 7. Attitude scores for two options (degrees of freedom in brackets)

	Attitude to pipe to Bromley			Attitude to Community based scheme				
	min	max	mean	min	max	mean	t	prob
more fishing	0	+10	+5.50	-2	+10	+2.81	2.56(25)	0.017
more swimming	-2	+10	+5.62	-3	+10	+2.42	3.24(25)	0.003
improved recreation	0	+10	+6.19	-2	+10	+2.85	3.27(25)	0.003
positive about lifestyle	-2	+10	+4.42	-4	+10	+3.12	1.07(24)	0.294
good value	-2	+10	+3.62	-2	+10	+2.08	1.19(25)	0.246
dependence on the city	-10	+10	-1.08	-10	+10	+0.35	-1.87(25)	0.073
confidence in technology	-4	+10	+4.81	-4	+10	+2.54	1.69(25)	0.104
fair treatment	-10	+4	-0.24	-4	+4	+0.33	-0.79(23)	0.437
Overall attitude scores	-10	+72	+29.88	-19	68	16.1	1.64(22)	0.115

The overall attitude scores for both options are positive suggesting that people felt positively about both the option of piping sewage to Bromley and initiating local community schemes. The attitude towards piping appears to be stronger (nearly double) that of the attitude towards community based schemes. The only negative attitudes are shown in question 6, option 1, where there is a negative attitude towards greater dependence on the city, resulting from piping sewage to Bromley, and in question 8 option 1, where there is a slight negative attitude towards the fairness of pumping to Bromley is shown.

Taking the null hypothesis that the population means are the same (that is, there is no difference between the means of the attitudes for both options) and setting a significance level of 5% then the null hypothesis can be rejected for questions 1,2 and 3. This means that the mean attitudes towards more fishing, more swimming and improved recreation are different for the two options.

At a 10% significance level, then the null hypothesis of no difference can be rejected for questions 6 (dependence) and barely 7 (confidence in technology).

For the overall attitude scores, the probability is 0.115. If question 8 is omitted then the t value is 1.756 with 24 degrees of freedom and a probability of 0.092. This means than the hypothesis of equality can be rejected at the 10% level.

This indicates that if question 8 is excluded then we can state that people hold a more positive attitude towards piping sewage to Bromley than to setting up of individual community based schemes.

Appendix D

Report on Survey Three

Results of survey examining attitudes to risk

This report describes briefly the results of the survey which questioned Lyttelton residents living in the vicinity of the petrol storage tanks and the LPG pipeline about their attitudes towards the pipeline and its effects.

Conclusions

> ***The simple nature of this questionnaire precluded any sophisticated statistical analysis. However, a number of general conclusions can be reached. These are:***
>
> ***that people welcomed the opportunity to state their opinions and would like to see this type of survey approach incorporated in planning decisions;***
>
> ***that two-thirds of the people living in the area of the LPG pipeline when it was being built were opposed to the pipeline;***
>
> ***that none of these residents have changed their opinion since the pipeline was built; and***
>
> ***that 90% of residents accept that the pipeline is safer than the alternative of transporting LPG by tanker through the Lyttelton tunnel.***

Survey procedure and statistical analysis

Forty-nine questionnaires were placed in letter boxes in Cressy Terrace and nearby streets immediately above the reclaimed land where the petrol storage tanks are situated. The LPG pipeline also passes through this area, and residents living in the area at the time would have been well aware of the pipeline construction. Twenty-seven responses were received giving a response rate of 55%. This was even more notable than the 54% response rate obtained for the Governors Bay survey since again no followup procedure was employed and in this case the issue being studied was 10 years old.

The first section of this questionnaire (see attached) was identical to the Governors Bay sewerage scheme survey. It concerned people's activities in the Harbour basin. Of those replying, 82% had lived in the area for five or more years. Twenty-two percent worked in Christchurch and 33% worked in the Harbour Basin area. Twenty-six percent were retired.

Table 1.[1] Frequency of participation in activities in the Harbour Basin (percentage).

Table 1 summarises the information obtained on recreational activities.

	percentage of respondents who		
	walk	boat	swim
not at all	7	37	26
less than five times per year	19	26	22
five to 10 times per year	15	19	11
more than 10 times per year	59	19	41

The second section asked respondents a series of general question about the LPG pipeline. All respondents were asked to answer these questions whether they lived in the area at the time of the installation or not.

Out of the 27 responses, only one person was not aware of the pipeline and 22 respondents were able to describe the route of the pipeline. Nineteen respondents were living in the area at the time of the LPG pipeline Inquiry in 1981. At that time, six people were in favour of the pipeline and 12 were opposed. One respondent didn't know.

The reasons given for opposing the pipeline were:

- that LPG tanks should be located away from populated areas
- that the siting involved risking the lives of the residents of Lyttelton
- that the pipeline was too close to built up areas
- that it is dangerous
- the risk of accidents due to human error
- the dangers of LPG are far in excess of the dangers of petrol and there has already been an accident with a petrol tank
- that safety regulations have already been broken since the pipe was installed (retrospective)
- that LPG storage compounds the risk already in existence

Reasons for favouring the pipeline were:

- that Lyttelton is an industrial area and not a seaside resort
- the town's gas supplies were reticulated underground for almost 100 years without accident
- that it would be more dangerous to transport LPG through the tunnel

All 19 respondents living in the area at the time of the building of the pipeline indicated that they currently felt the same way about the pipeline.

[1] Percentages may not add to 100, due to rounding errors.

A final question in this section asked whether respondents felt that the LPG pipeline posed a greater threat to Lyttelton (threat undefined) than the petrol storage tanks. Twelve replied "yes" and 12 replied "no".

The final section of the questionnaire referred only to those 19 respondents who were resident at the time of the building and installation. Table 2 summarises the questions and the responses.

Table 2. Beliefs about the pipeline by residents living in the area at the time of the Inquiry.

	%age answering		
	yes	no	don't know
1. Do you think that the pipeline poses any health risk to you and your family?	53	42	5
2. Do you think that you were at risk while the pipeline was being built?	11	79	11
3. Do you think that the pipeline provided useful employment whilst it was being built?	56	33	11
4. Do you consider that building the pipeline damaged the environment?	37	63	
5. Do you think that the environment is threatened by the pipeline?	56	44	
6. Did you (at the time) expect that building the pipeline would cause environmental damage?	42	58	
7. Would you be against building another pipeline?	58	32	11
8. Do you think that property values have been damaged by the presence of the pipeline?	21	58	21
9. Did you expect that property values might be damaged by building the pipeline?	37	42	21
10. Did you consider that building the pipeline would cost more money than it would save?	26	32	42
11. Do you think that building the pipeline was cheaper than taking the LPG through the tunnel by tanker?	42	26	32
12. Do you think that having the pipeline is safer than taking LPG through the tunnel by tanker?	90		11

The most notable conclusions which can be drawn from this table are that nearly 80% of residents felt that there was no risk during the building phase and that 90% believe that the pipeline is safer than trucking LPG by tanker through the Lyttelton tunnel. Sixty-three percent were originally against building the pipeline and 58% would be against building another pipeline. This change is due to an increase in the 'don't know' category.

Some of the questions were grouped in an attempt to determine whether people's opinions had changed and whether their original concerns were justified.

Questions four and six suggest that there was less environmental damage caused by building the pipeline than people feared, although the presence of the pipeline is still considered to be a threat to the environment.

Similarly, questions eight and nine suggest that property values have been less damaged than was anticipated.

A number of respondents made general comments at the end of the questionnaire. These generally indicated concern that the pipeline and LPG storage facility was in fact compounding a hazard already present in the form of the petrol storage tanks. Mention was made several times of the fact that there had been an explosion in one of these tanks. The comments indicated a frustration that residents opinions were not taken into account (especially considering that the area involved is a very old residential area) suggesting that lack of control is a major factor in people's attitude towards this type of threat. There was a very positive response towards the idea of using questionnaires of this type to gauge people's opinions for planning purposes.