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Overnight Facility Use in the **Tongariro Northern Circuit**

A thesis submitted to the
Institute of Information Sciences and Technology
in partial fulfilment of the requirements for the degree of
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Abstract

The Tongariro Northern Circuit is located in the central North Island on the volcanic plateau, and encompasses both Mt Ngauruhoe and Mt Tongariro. The Circuit has high day and overnight use during the summer season and has been classified as a Great Walk by the Department of Conservation who administer it. This thesis focuses on the summer season use of the overnight facilities on the Tongariro Northern Circuit (TNC) with the intention of providing DoC Management with an accurate and detailed profile of users, the factors that influence use and the problems being generated by it.

- *Profile of users:* This describes who uses the facilities, when they are used, the tracks and directions predominantly used and methods of transportation to and from the Circuit.
- *Factors influencing use:* These include the time of year and week, the weather and the effect of weather forecasts.
- *Problems:* Congestion in huts is discussed, including the related hut design flaws.

The thesis makes comparisons with information gathered seven years ago and identifies the changes in the both the user groups and their preferred routes within the Circuit. The profile of the New Zealand users as a group differs significantly from that of international users. These differences are explored.

Two models are presented that account for about 80% of the variation in the highly fluctuating overnight use. These models also estimate the effects of weather on use.

Three main sources of data have been used in this thesis. They include a survey that was designed specifically—the full process of gaining approval, creating and running the Tongariro Northern Circuit 2000/1 summer survey is presented along with the results. The other two main sources of data include the Great Walks pass butts and the hut wardens' observations of use.

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I am also grateful to the many Tongariro Northern Circuit Hut Wardens who encouraged the overnight facility users to complete the surveys during the three and a half months the survey ran. Thanks too to Barbara Curtis and Kathleen Hubay who provided the complete set of Metservice weather forecasts used in the modelling.

From DoC Head Office: Thanks to Chris Edkins who provided the electronic copies of the Tongariro Northern Circuit map and DoC logo which were used in the survey; and to Gordon Cessford who provided fast access to relevant management documents, the 1993/4 Great Walks survey database, and who also relayed many bundles of completed surveys and weather forecasts to me for analysis.

Stuart Burgess of The National Institute of Water and Atmospheric Research Ltd (NIWA) provided various climatic datasets for model investigations, without which the overall modelling would not have been as comprehensive.

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- X ASTSA Residual analysis for the two models in Chapter 15
- Y GAM Model Coefficients

Certificate of Originality

I, David William Olsen certify that the research carried out for this thesis and the thesis itself represents my original work except where acknowledged.

Signed: *David William Olsen*

Date: *20/12/2008*

Part I

Preliminaries

Chapter 1

Introduction

This chapter outlines the rationale, aims and objectives of my research. It looks briefly at the needs of the Department of Conservation (DoC) for such information, introduces the area being researched, the primary sources of data, and outlines the structure of the thesis.

1.1 Rationale and goals

Management needs up-to-date information to effectively manage the areas that they are responsible for. This thesis and my related report *Overnight Facility Users on the Tongariro Northern Circuit—An analysis of the 2000/1 summer season use with comparisons from 1993/4* (October 2001/unpublished) for the Tongariro Northern Circuit Management team, provides detailed information about the overnight facility users on the Tongariro Northern Circuit.

The research and analysis carried out for this thesis provides the first detailed breakdown of the movement, or flow, of overnight facility users within the Tongariro Northern Circuit. Comparisons are made with similar information gathered during the 1993/4 summer season, and the major changes have been noted.

My thesis also helps to bring closure to my original investigations and report for the Tongariro Northern Circuit Management team from November 1994: *Tongariro Northern Circuit Summer Season Overnight Users Analysis – Part One – Analysis of Great Walk Pass Butts* (unpublished). The report emphasised the dearth of information on overnight facility users and use trends, and since the 1993/4 summer season (on which the report was based), all summer seasons have been recorded except for one: the 1994/5 summer season. With the increasing amount of historical data, more statistical opportunities become available and there is increasing statistical validity. The modelling investigations carried out for this thesis are one such example.

My original goals for this research and thesis were to:

- (i) gain approval for, develop and run a survey during the 2000/1 summer season gathering similar information on the user group and flow patterns to that gathered during the 1993/4 summer season
- (ii) determine and document the internal use patterns (routes followed) and general movement (combined flow) of overnight facility users within the Tongariro Northern Circuit
- (iii) compare changes in the user group and user patterns with data collected seven years ago
- (iv) *identify* past seasonal use patterns noting the extremes brought about by the Christmas holidays, Auckland Anniversary Weekend and Easter, and the general weekday versus weekend fluctuations. This also includes a nationality breakdown of users to illustrate that the New Zealanders' use pattern is significantly different from that of international users, and hence they will need to be treated differently in order to more accurately predict future use
- (v) investigate the issue of crowding in huts and document both the pressure on the individual overnight facilities, and the user impressions of crowding on the Tongariro Northern Circuit
- (vi) produce a preliminary report of the findings in a timely manner so as to be of use in the development of the new DoC business plan
- (vii) *quantify* the influence of the external factors mentioned previously—in part (iv)—on the number of overnight facility users in the Tongariro Northern Circuit. Also as background to modelling, determine if a relationship exists between overnight facility use and:
 - the number of international visitors to the country
 - the elements of the weather (such as wind, rain, sun and temperature)
 - weather forecasts.

These last two factors were expected to determine and/or alter users' trip patterns, and impact on the number of nights they stayed in the park.

- (viii) develop a simple heuristic model, a mathematical/time-series model and if time permitted a simulation model for overnight facility use
- (ix) forecast use for the next three, five and ten years, providing limits of accuracy for the forecasts.

However not all of these goals have been able to be met, and the reasons for this are:

- incomplete NIWA data for most of the earlier years
- the overnight facility use patterns were not well suited for time-series modelling due to the extreme influence of weather
- time constraints

and all of these factors contributed to difficulties in long term forecasting.

1.2 The lack of information on overnight facility users

Intermittently between 1988 and the start of the 1993/4 summer season I was a volunteer hut warden concerned about the lack of detailed information on both the use of facilities and the user groups. During this time I introduced various forms for hut wardens to record observations of use while working, though staff coverage at most facilities was, at best, intermittent and did not extend over the full summer season. No comprehensive data on the use or users of overnight facilities on the Tongariro Northern Circuit had ever been collected. This made it impossible to monitor changes in the user group or use patterns as there was no data to compare against.

During the 1993/4 summer season two main events took place to rectify the problem:

- I instigated the first comprehensive attempt to record the numbers of overnight facility users on the Tongariro Northern Circuit. This was the second year with a limited number of paid hut-wardens employed throughout the summer season, and I was employed as the senior hut-warden/hut-warden co-ordinator during the first few months of the season, which provided me with the ideal opportunity to ensure that the data was being collected. Volunteer hut-wardens boosted paid-staff coverage of the facilities and when facilities could not be staffed at all, extraordinary efforts were made by the other staff within the TNC to obtain accurate information on occupancy levels.

- The Great Walks Survey, coordinated by Gordon Cessford from DoC Head Office, gathered detailed information about the overnight user group and their experiences. A map was added to the questionnaire for those surveyed to record the users' movement within the Tongariro Northern Circuit.

The main success in recording seasonal use and the ability to identify the different seasonal use of New Zealanders versus international users came later in 1994 with the processing of the 1992/3 and 1993/4 Great Walks pass-butts. Through the efforts of the 1993/4 hut-wardens, compliance (checking passes to ensure users have paid) rates increased, and by processing the Great Walks pass-butts certain patterns emerged. My 1994 report to DoC Tongariro Northern Circuit Management provided the first comprehensive documentation of the fluctuating use within the seasons. This report contained an outline of procedures used to analyse the data with the hope that other conservancies would be interested in gathering similar information about their overnight facility user group and use patterns.

Since 1993/4, with the exception of 1994/5, annual reports for each summer season have been completed, including monthly totals for both use and nationality of users, as well as financial information.

In 1993/4 Head Office produced a report to try to standardise—and encourage—the collection of track-use information. Track counters were introduced at various locations on the Tongariro Northern Circuit, however these are still not functioning as they should and Management has no hard data on which to estimate the number of day-walkers completing the *Tongariro Crossing*.

1.3 Information needs of the Department of Conservation

This section looks briefly at the needs of the Department of Conservation for information in the context of this research on recreational use. It then identifies where this research may fit into the Department's mandate for information gathering and dissemination. This is done to highlight the dearth of information available in certain areas and give meaning to the recommendations that have been made.

Problem areas—the need for information

There are two main groups that need recreational information: Management, and the recreational users themselves.

Within Management there are three main issues relating to information:

- (i) **The underlying need for information in order to manage the Tongariro Northern Circuit most effectively.** This issue relates primarily to the shortage of data/information. Often decisions have had to be made without the hard data to be guided by, as it has not been available.
- (ii) **Identifying what information is best to collect, and how to collect and present it to aid in the decision-making process.** This requires Management to be proactive and foresee future needs as well as develop a plan to meet them. While it is not always possible to predict future needs for information, many information needs are in fact predictable and procedures need to be put in place to ensure the efficient collection of relevant information. Regular reporting procedures need to be established where appropriate.
- (iii) **Predicting future use.** Park use is increasing, which puts pressure on existing facilities. It is important for Management to foresee and plan for increased use. Knowledge of the carrying capacities of the existing facilities and when they are likely to be exceeded, or reach unsatisfactory levels, is essential for effective management.

Recreational users need the information, as it will allow them to choose the experiences they desire. They need to know what the conditions are likely to be at the time they plan to visit.

The Department of Conservation's solution

Management within the Department of Conservation are working proactively to improve their information-gathering and reporting procedures. Much of the following material has been obtained from the Department's Strategic Directions Document (2 October 2000) to assist Management with the preparation of their current business plans.

In the introduction the DoC Director-General, Hugh Logan, has written:

“There will be a strong emphasis on promoting recreation, to encourage public enjoyment and to strengthen a sense of public ownership of protected areas. A wide range of recreational opportunities will be provided *by focusing and aligning recreation facilities and information services*. We will seek to ensure that recreation facilities meet appropriate standards and that a balance is achieved between the long-term maintenance requirements of the facilities provided and the resources available.” (my italics)

Logan also provides the following diagram identifying the key steps required in order to meet government goals:

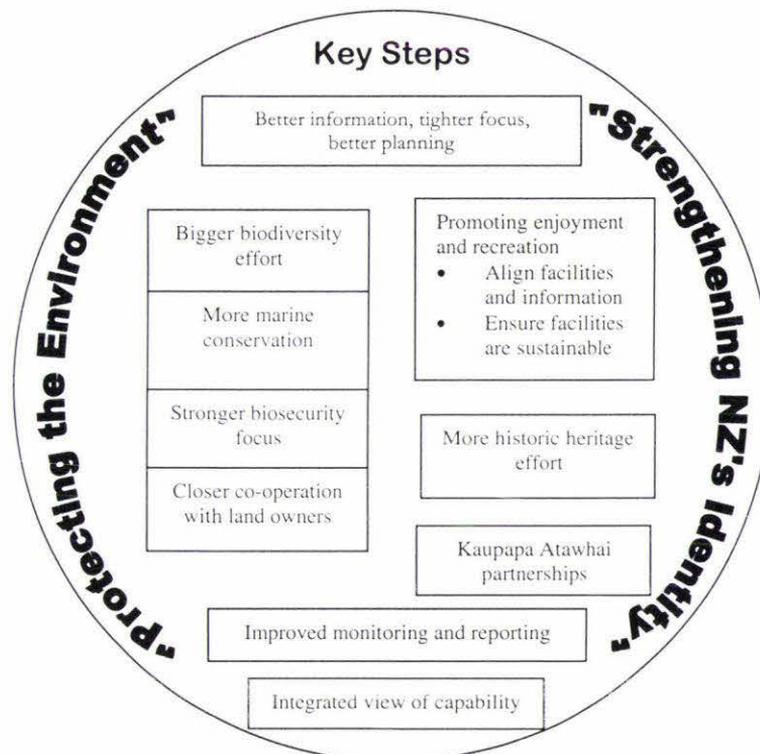


Figure 1-1: Key steps to meet the government's key goals

The three areas that I have shaded in the diagram are particularly relevant to this research.

How this thesis may help

This information and analysis is timely for the Tongariro/Taupo Conservancy of the Department of Conservation as their business plan is currently being written and my reports submitted during 2001 have heightened their awareness of several issues, as well as use-patterns. But the value of this research should go well beyond the immediacy of the business

plan—it is hoped that it will be utilised in the greater context of the information needs that have been clearly outlined by Logan (Fig 1-1).

For DoC Management this research contains:

- (i) a wide range of information relating to the Tongariro Northern Circuit, providing a picture of actual use and potential problem areas. This information has been lacking in the past.
- (ii) a raft of tables and charts to help Management identify key data that should be collected in order to help with monitoring and reporting.
- (iii) a discussion of the problems affecting congestion in huts, bringing an awareness that crowding impacts are felt well before all bunks are occupied
- (iv) the development of models identifying and quantifying the relative influences of factors affecting overnight facility use
- (v) predictions or forecasts of increased use which should help with the business plan process.

For the overnight facility users this research could help in the following ways:

- (i) DoC Management may use the information to help *align information services with the recreational opportunities provided* on the Tongariro Northern Circuit (Logan, page 6). This means that the information could be made available to the public, and overnight facility users would then be able to seek out the experiences they desire—prior knowledge of crowded facilities at certain times of the year may alter use patterns for example. To date, year after year the Easter use is excessive and many leave dissatisfied with the experience
- (ii) DoC Management may also respond to crowding issues and move to increase or modify the existing facilities
- (iii) The most-used tracks and facilities, as revealed by the research, may begin to receive more upkeep in the future thus improving the experience for the majority.

1.4 The Tongariro Northern Circuit

Location and map

The Tongariro Northern Circuit (TNC) is located in the heart of the volcanic plateau in the centre of the North Island. It lies approximately 15 kilometres southwest of the southern shoreline of Lake Taupo. The Tongariro Northern Circuit consists of four overnight facilities and tracks around Mt Ngauruhoe and across the Mt Tongariro massif.

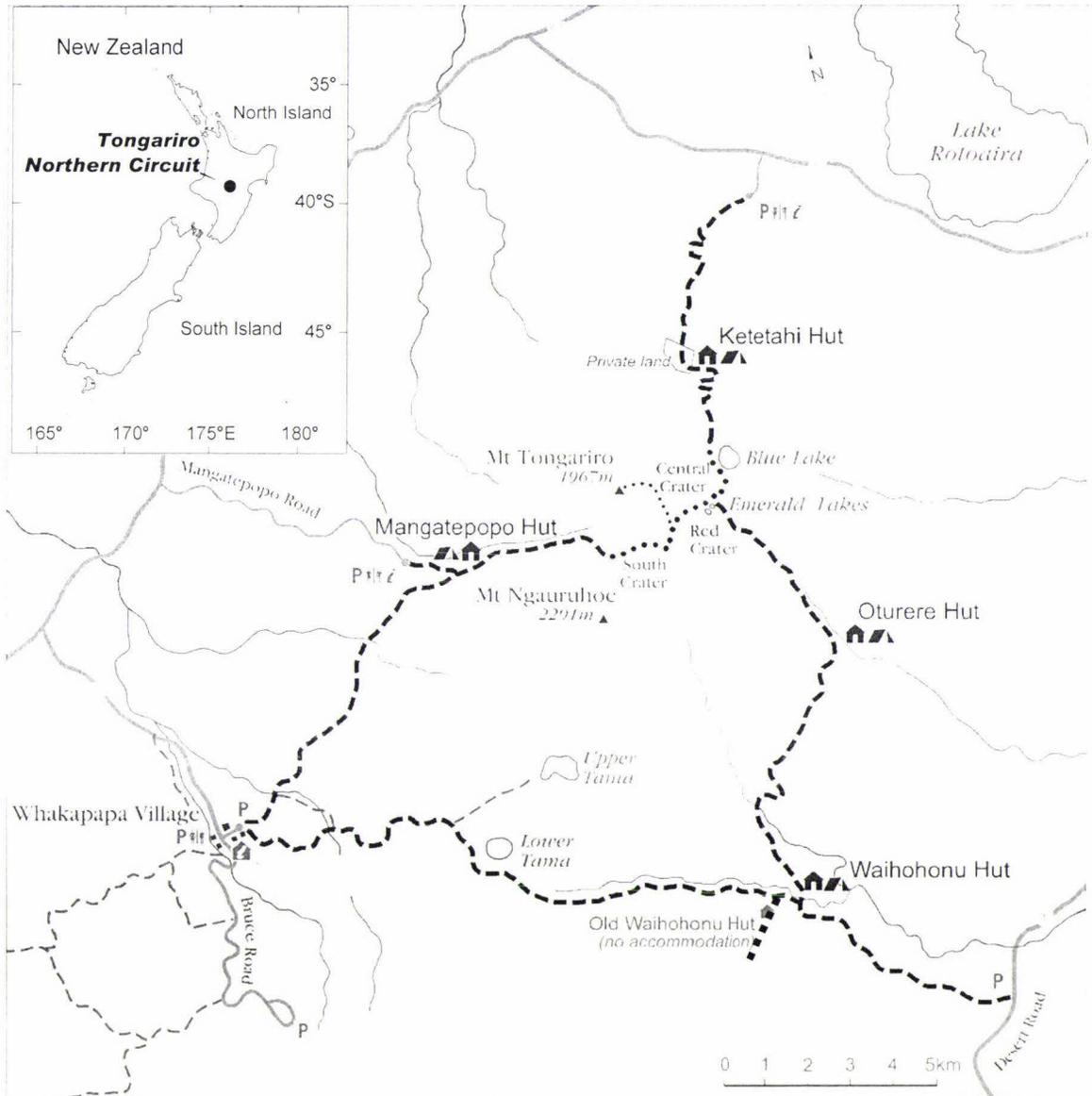


Figure 1-2: The tracks and overnight facilities on the Tongariro Northern Circuit

There are four sites with overnight facilities on the TNC. These are Mangatepopo, Oturere and Waihohonu (all located on the circular track around Mt Ngauruhoe) and Ketetahi (located on the northern slope of Mt Tongariro).

The attraction

The DoC webpage simply states:

“The Tongariro Northern Circuit winds its way over Mt Tongariro and around Mt Ngauruhoe. This walk passes through unique and stunning landforms which include volcanic craters and glacial valleys.”

The *Tongariro Crossing*, the route explained in detail in Section 5.4, is often referred to as one of the best day walks in the country. On fine, calm days during mid-summer there are frequently over one hundred day-walkers completing the seven to eight hour *Crossing*. Approximately 1,500 overnight facility users also complete the *Crossing* each season over a period of two–three days.

There is a large variety of recreational opportunities available within the Tongariro Northern Circuit with the majority of visitors only visiting by day. These include short walks to waterfalls, strolls up the Mangatepopo Valley or into Waihohonu from the Desert Road, and more energetic trips climbing to South Crater, Red Crater and/or taking in the peaks of Mt Tongariro and/or Ngauruhoe. Rock-climbing is also popular on Pukekaikiore in the Mangatepopo Valley. Schools from as far away as Wellington have annual visits for classes studying geography (land formation, regeneration on the differently aged lava flows, erosion etc) and some have annual tramping trips in the Circuit as it provides a relatively safe, accessible, backcountry experience for students in an alpine environment.

Visitors speak highly of the splendid alpine views from the exposed ridges, some even describing it as a spiritual experience in hut logbooks.

The Tongariro Northern Circuit entity

The Tongariro Northern Circuit was given **Great Walk** status within the Department of Conservation when the concept was first introduced in 1992. This status recognised the relative importance, high use and high profile of the tracks and overnight facilities. Two significant changes came with the Great Walk status:

- (i) It allowed for the introduction of its own overnight pass system. The Great Walks pass system ensured that money could be collected locally for the overnight use of facilities and these funds could be utilised immediately for the maintenance of those facilities.

- (ii) Central funding was provided for the employment of a limited number of hut wardens during the summer season. These then became the first paid hut wardens on the Tongariro Northern Circuit with responsibilities which included compliance (checking passes to ensure users have paid), general public relations, and public safety.

The more expensive Great Walks pass charges of the high-use summer season can be seen by the users to finance the increased number of facilities and services (cooking rings/burners, flush toilets and hut-wardens). During the off-season the additional facilities and services are removed and the charges for the overnight facilities revert back to the previous national backcountry pass system.

Prior to 1992 there were no DoC staff assigned specifically to the Tongariro Northern Circuit. The development and maintenance of facilities on the Tongariro Northern Circuit was, and still remains, under the care of two Field Centres—Turangi and Whakapapa—and the Tongariro Northern Circuit represents only a small part of their overall responsibilities. The Whakapapa Field Centre, located primarily in the Whakapapa Visitor Centre, is responsible for the maintenance of the Mangatepopo facilities and westernmost tracks from the Tama Lakes to Red Crater, with the Turangi Field Centre being responsible for the rest. During the 1992/3 summer season the Field Centres selected and employed their own hut wardens. In 1993/4 the senior hut warden position was introduced and since then has been based in the Turangi Field Centre which has responsibility for three of the four overnight facilities. The senior hut warden became responsible for the selection, training and placement of all hut wardens on the Tongariro Northern Circuit during the summer season. The Field Centres continue to assign the local day-to-day tasks performed by the hut wardens on tracks and facilities, though site-specific training usually rests with the senior hut warden.

The Tongariro Northern Circuit Management Team consists of staff from three entities: area planning and maintenance staff from the two Field Centres, and staff with regional planning and financial responsibilities from the Tongariro/Taupo Conservancy Office (based in Turangi alongside the Turangi Field Centre).

1.5 Primary sources of data for this thesis

This section gives a brief introduction to the primary sources of data analysed in this thesis. The specific content of each data source is described in more detail in various Parts, Chapters and Sections of this thesis, the references for which are provided here. There are three main sources of overnight facility-use data and three sources of weather data.

The 2000/1 Summer Survey

This survey (Appendix A) was created as part of my Masters research and thesis to provide DoC Tongariro Northern Circuit Management with current overnight use information and to identify how use has changed from seven years ago. As well as user information the survey has also gathered information on the movement of overnight facility users within the TNC. The setting up of the survey is covered in Chapter 2, data entry in Chapter 3, survey results in Part II, and comparisons with seven years ago in Part IV.

Great Walk pass butts

These pass butts are filled in when the Great Walks passes are purchased. They are used in this thesis primarily to provide a picture of the seasonal use of facilities and different use patterns of nationalities and youth use (Chapter 9). They also provide an annual breakdown of total use by nationality.

Hut warden observations of use

The hut wardens provide the numbers of those using hut and camp facilities at each location. These are used to show the fluctuating use of individual facilities and the pressure that users place on facilities (Chapter 10). These observations, dating back to 1993/4, also provide the base information for modelling seasonal use (Chapter 15).

Weather forecasts and other weather records

There are three sources of data in this area (Chapter 14):

- (a) NIWA has provided historical weather records from Whakapapa and Turangi (Section 14.2). These are used to determine whether climatic variables have played a part in overall TNC use.

- (b) Hut wardens have recorded local weather observations from Ketetahi and Mangatepopo through most of the last summer season. This has provided more accurate weather details for modelling purposes (Section 14.3).
- (c) DoC Turangi has gathered the Mountain Weather Forecasts for 2000/1 summer season from the MetService in Wellington. The morning forecasts have been collected to determine whether they can be used to improve models of overnight facility use (Section 14.4).

1.6 The structure of this thesis

It is divided into six parts:

I Preliminaries

This introduces the thesis, providing the rationale for the research and an overview of the process required to set up and run the 2000/1 summer survey, then enter the results.

II Survey Results

This presents the findings of the 2000/1 summer survey providing an analysis of the user groups, arrival and departure modes of transport and user movements within the Tongariro Northern Circuit.

III Times of Overnight Facility Use

This contains the analysis of the two other sources of use information—the Great Walks pass butts and the hut wardens' observations of use—and discusses crowding and congestion issues.

IV Comparisons Between Data Sets

Sources of Bias

This discusses the changes in the user group and facility use compared with seven years ago. It also suggests explanations for the differences evident between data sets that have collected the same information. Sources of bias are discussed.

V Model Development

This outlines the weather data sources that have been obtained to improve models of overnight facility use, and then develops models of use.

VI Summary, Conclusions and Recommendations
