Clutha Valley Development

WATER ORIENTED RECREATION on the UPPER CLUTHA HYDRO LAKES

electricorp
ELECTRICITY CORPORATION OF NEW ZEALAND LIMITED

Ministry of Works and Development

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ELECTRICITY CORPORATION OF NEW ZEALAND LIMITED

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PREFACE

The attached report, Clutha Valley Development - Water Oriented Recreation on the Upper Clutha Hydro Lakes, is the result of research by the Ministry of Works and Development (MWD) and Dr Reiner Jaakson, a Canadian Geography Professor.

Although there is now some debate about the timing of the formation of some of these lakes, Electricorp must share a trust with other concerned agencies and bodies that resources such as these, once developed, should be managed for the greatest good. It is hoped that Dr Jaakson's report will, in this spirit, promote discussion and cooperation.

The report presents the views of the consultant and not necessarily those of Electricorp. In his introduction, Dr Jaakson explains that the report is not a plan, nor primarily even a set of final, rigid recommendations; it does suggest how desirable patterns of recreation for any water environment may be determined.

Some points made in the report merit specific comment. Water-oriented recreation on the hydro lakes is seen by Electricorp as secondary use, with primary use being the production of electricity. Such consideration must bear on, for example, Dr Jaakson's recommendations for a white-water canoeing centre below Queensberry dam. Such a centre would be dependent on Electricorp's operating rules, established within the water rights obtained for the dam's operation. Nonetheless, management of hydro resources, such as those at Karapiro, has seen the successful marriage of energy production and major recreation events (e.g. New Zealand and World rowing championships).

Dr Jaakson also refers to control of the 20 metre strip surrounding the lakes. It is Electricorp's opinion that this strip is required for electricity generation purposes. However, further discussion and clarification of governing legislation may be necessary.

The report emphasises the need to plan and manage recreational uses of the hydro lakes. There are a number of issues raised, particularly regarding Lake Dunstan, that will undoubtedly involve an integrated effort; Electricorp would be pleased to act as an advisor to a managing Joint Authority.

We commend the MWD and Dr Jaakson for producing a thoroughly readable paper which outlines some exciting possibilities for use of the Upper Clutha hydro lakes.

ELECTRICITY CORPORATION OF NZ LTD

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CLUTHA VALLEY DEVELOPMENT

WATER ORIENTED RECREATION ON THE UPPER CLUTHA HYDRO LAKES

by

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Prepared by the Ministry of Works
and Development on behalf of the
Electricity Division of the Ministry
of Energy

19 March 1987

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PREFACE

This project was undertaken in fifteen weeks during the period October 1986 to March 1987, while I was on sabbatical from the University of Toronto. I am grateful to the University for providing me the salary and the free time to enable me to come to New Zealand for the project.

The study was carried out by the Ministry of Works and Development, on behalf of the Ministry of Energy. The Ministry of Works and Development commissioned me to serve as a consultant with the responsibility to carry out all aspects of the study. I thank the Ministry of Energy for the budget made available to cover my expenses associated with the project, and for the quick and effective project reviews and feed-back. I am particularly grateful to Mr.Robert Stevens, of the Ministry of Energy, for his role in coordinating the project administration.

A key reason this study has been, I believe, a success is the assistance I have had from the Ministry of Works and Development. I have been accepted more as an employee of, than as a consultant to, the Ministry. I was provided with an excellent base of operations in the Ministry's Upper Clutha Development Project Office in Cromwell. Facilities and services were made freely available to me, including equipment, maps, reports, word-processing, photocopying, a vehicle, accommodation, and much more.

I have thoroughly enjoyed the association with my co-workers. Mr.Jim Paul of the Town and Country Planning Directorate has provided guidance throughout the project. Mr.Terry Emmitt, the Project Landscape Architect in the Ministry's Cromwell office, has helped me in numerous ways: to find information, to secure equipment, to arrange for travel. I have especially benefitted from the many discussions we have had on matters pertaining specifically to this project, as well as our debates on other tourism and recreation planning issues. Mrs.Raylee Thornton, Supervising Typist in the Cromwell office, has been invaluable in teaching me the intricacies of word-processing and assisting me in attending to the numerous details of final report preparation.

I am grateful for the comments and suggestions made by all those who read a first draft of this report.

I take with me from New Zealand a lifetime of happy memories of your lovely country.

Rainer Jaakson.

Cromwell, March 1987

EXECUTIVE SUMMARY

1. This report examines the water-oriented recreation constraints and opportunities of the Upper Clutha hydro-lakes. The potential for water-oriented recreation is considered within the framework of the main purpose of the hydro-lakes: the production of hydro-electricity.

2. The study area extends from the Clyde dam to the outlet of Lake Wanaka, and includes Lake Dunstan, Lake Queensberry, Lake Luggate, and the residual river.

3. The basic premise is that there is a limit to the amount and type of recreation use that can be made of the Upper Clutha hydro-lakes. The report estimates this limit and recommends a recreation pattern based on this estimate.

4. Potential users of the hydro-lakes are identified; priorities are defined; the market potential is assessed; and marketing strategies are discussed.

5. The future of Cromwell as a tourism, holiday-home, and retirement community is reviewed, and action to achieve this role is presented.

6. Demographic trends and their implications for future use of the hydro-lakes are considered.

7. Some of the theory behind the estimation of the capacity for water-oriented recreation is presented.

8. Legislation and organizational structures exist, with which to implement the recommendations made in this report.

The key conclusions and recommendations of the report are:

1. Cromwell has a positive future as a tourism, holiday-home, and retirement centre.

2. The Upper-Clutha hydro-lakes and Cromwell should not attempt to compete with Queenstown, and other areas, for the international tourist market, but should instead serve the domestic market.

3. Water-surface zoning should be used on the Clutha Arm to separate motorized boats from non-motorized vessels, and swimmers from boaters.

4. Water-surface zones for non-motorized boats should be established in the following locations:

   (1) the south end of the Clutha Arm of Lake Dunstan
   (2) Bannockburn Inlet
   (3) all of Lake Queensberry

5. McNulty Inlet should become a sailing and windsurfing harbour, together with back-up land facilities such as a carpark, a club house, storage facilities, etc.

6. There will be problems with the recreation use of the Kawarau Arm. The water-area is constrained and of a narrow and elongated configuration, which limits its attractiveness. As well, siltation will seriously further restrict use. This part of Lake Dunstan should be developed and used with reference to careful monitoring to prevent over-use. A major boat launching ramp should be limited to one location: at Memorial Hall; small secondary ramps should be limited to two locations: one at the Bannockburn bridge and one at the oxidation ponds. No further ramps and no marina or other public boating facility should be built in the Kawarau Arm.

7. A speed-limit of five knots on water within 200 metres of shore should be imposed on all three hydro-lakes.

8. There will be a potential for commercial boat operations on Lake Dunstan. One tour-boat route should be made available in the Clutha Arm, one in the Dunstan Arm, and one in the Kawarau Arm; the routes could be combined.

9. A white-water canoeing centre should be built below Queensberry dam, to be used for canoeing training and competitions. Road access, a carpark, and buildings will be required.

10. Boater-camping at designated sites should be encouraged on all three hydro-lakes. Toilets and garbage containers, and removal, must be included at each site.

11. The Harbours Act 1950 should be used to grant control of the water surface and of the foreshore except within a 20 m strip, generally above the maximum operating level, which remains for electricity generation purposes. A Joint Authority should be established and have representation from the Department of Conservation, Vincent County Council, and Cromwell Borough Council. By-laws to implement the recommendations of this report, and to generally supervise use of the Lakes, should be established. The Water Recreation Regulations 1979 should be used to appoint a Harbourmaster and a Beach Ranger, to enforce the by-laws.

12. Subdivision of land near the lakes, for holiday-home or other residential uses, should take place with compliance to two key policies of the Vincent County District Scheme: (1) that development should not affect adversely the visual, aesthetic quality of the landscapes around the Lakes, and (2) that in order to assure satisfactory sewage disposal, to avoid servicing problems, development should not be scattered.

INTRODUCTION

The basic premise of this report is that the Upper Clutha hydro-lakes and the residual river are finite resources with an identifiable carrying capacity for water-oriented recreation. Carrying capacity is defined as the amount and type of recreation activity that is safe and satisfying to the users, and that the area being used can accommodate, without suffering an unacceptable deterioration of the physical or social environment. Recreation carrying capacity deals with both the amount of use and the mix of different types of use; amount and mix of use are interrelated.

The report estimates the carrying capacity for water-oriented recreation between Lake Wanaka and the Clyde Dam: Lake Dunstan, Lake Luggate, Lake Queensberry, and the Clutha River between Lake Wanaka and Lake Luggate, and between the Queensberry dam and Lake Dunstan. This is a supply oriented study: demand is not projected or estimated. The aim is to identify the potentials and constraints for water-oriented recreation. The report spells out how legislation which already exists in New Zealand may serve as the basis for the implementation of the recommendations.

There is no such thing as a single, definitive carrying capacity. Instead, it should be viewed as a range of alternative amounts and types of use that can be made of an area. Carrying capacity is primarily a guide for the making of management decisions. The report identifies one desirable pattern of water-oriented recreation on the hydro-lakes and the residual river, and proposes how this pattern may be implemented.

The text is in five parts. Part 1 examines the overall tourism and water oriented recreation potential of the hydro-lakes from a marketing viewpoint. Part 2 describes the theory of carrying capacity, and boating capacity standards as one type of capacity estimation. Part 3 discusses water-oriented recreation on Lake Dunstan. Part 4 discusses water-oriented recreation on the reservoirs and river between Lake Wanaka and Lake Dunstan. Part 5 discusses aspects of management and implementation. Appendices present support material and documentation.

This report is not a plan, nor is it primarily even a set of final, rigid recommendations. The desired recreation pattern on the Upper Clutha hydro-lakes must be determined. This report suggests one such pattern, and some issues involved in implementing it. To this extent, the report does make concrete recommendations. However, the report is also designed to illustrate how desirable patterns of recreation for any water environment may be determined. Hence, the recommendations themselves may perhaps be less important than is their demonstration of how policy decisions about water-oriented recreation may be identified and implemented.

1. MARKETING OF THE UPPER CLUTHA HYDRO LAKES

1.1 Introduction

The Upper Clutha hydro-lakes will offer new tourism and recreation opportunities in a region that is already renowned for its attractions at Queenstown and Wanaka. The hydro-lakes cannot compete on an equal basis with such well-established locations. Instead they will be more competitive if they aim to serve another, possibly complementary, market which utilizes the unique qualities of the hydro lakes and which establishes its own recreation activity style.

A marketing strategy is necessary,

(1) to define the attractions of the Upper Clutha hydro-lakes and to explore how their potential can best be realized

(2) to make available a product - water-oriented recreation opportunities - in such a way that a high-quality environment is continued and the appeal of the area is sustained for future, ongoing use

(3) to identify rival areas with which the hydro-lakes have to compete, and to establish a strategy for competition

(4) to nurture an association, in the public's mind, between the hydro-lakes and the potential for recreation and tourism, in such a way that the opportunities for water-oriented recreation experiences there are seen to be different from opportunities that are available in other, rival and competing, locations

(5) over a longer term, once the Upper Clutha hydro-lakes have become established, to monitor the visitation to and use of the area, so as to be able to adapt to market changes

1.2 User-groups

1.2.1 Categories:

The market which the Upper Clutha hydro-lakes will be serving may be visualized as a series of populations or user-groups, each of which has unique needs and different ways of using the area. The hydro-lakes will not be able to serve all these user-groups equally well, nor, it could be argued, would this be desirable, even if it were to be possible. Priorities among the different market segments have to be established.

The different user-groups of the area can be visualized as forming identifiable segments of the total market, although with some overlap between the segments.

The user-groups can be defined as:

Residents: (1) permanent residents, in the workforce

(2) permanent residents, retired
(3) seasonal residents in second homes and cribs

Visitors: (1) destination visitors, for whom the Upper Clutha hydro-lakes are the primary destination

(2) stop-over visitors, for whom the hydro-lakes are a visit on the way to another, the primary, destination

The two visitor groups can also be categorized according to whether they are day visitors (duration less than 24 hours), or overnight visitors (one or more nights of accommodation in the area). Thus, the visitor category forms four sub-groups:

- destination day-use visitors
- destination overnight visitors
- stop-over day-use visitors
- stop-over overnight visitors

The total potential users thus consist of seven groups: three resident groups, and four visitor groups. Other methods of categorizing the users of the hydro-lakes could also be formulated, based, for example, on the amount of money spent or the type of activities pursued by the visitor.

Another consideration, which may be superimposed on the four visitor categories, is whether a visitor is part of a coach tour group, or is a "Free Independent Traveller" (FIT). (See Section 1.4.3 for further discussion on the FIT). Because coach tours consist of large groups, and the FIT visitors move in family or other small units, they demand different types of service, and the impact of the magnitude of this demand, imposed at any given moment on the local service industry, reflects their different size.

1.2.2 Needs:

Each of the seven user-groups will tend to use a unique combination of resources, depending on their specific needs. There are distinct advantages in planning water-oriented recreation facilities in such a way so as to minimize competition and conflict between the different user-groups. For example, large numbers of stop-over visitors as part of coach tours, may reduce the satisfaction of other, more long-term, users of the area, especially if there is direct contact or spatial overlap between their activities.

Similarly, seasonal residents in second-homes, who have a vested interest and a financial investment in the area, may resent having to compete for use of certain facilities that are also used by stop-over day visitors.

International and domestic tourists have different needs. International tourists can be expected to be largely in the stop-over category, mostly in coach tours on the way to Te Anau, Queenstown or the West Coast, making a sightseeing stop at the

hydro-lakes. Apart from scenic look-out locations (which will be used by all visitors, not just by international tourists), there does not appear to be a large potential on the hydro-lakes for large numbers of international tourists. Although shopping in Cromwell may attract some international tourists, retailers there may prefer not to compete with Queenstown, and may find it prudent to cater more to a domestic visitor market, and to avoid the price inflation that often results from catering to foreign visitors.

1.2.3 Priorities:

The planning of water-oriented recreation facilities on the hydro-lakes should reflect the relative emphasis directed to the needs of different user-groups. These emphases may be ranked from 4: primary emphasis to 1: low priority emphasis, and have been summarized in Table 1:

TABLE 1

TOURISM PRIORITIES

	TRANSIENT STOP-OVER TOURISTS	HOLIDAY MAKER IN AREA	HOLIDAY HOUSE OWNER
TOURISTS:			
DOMESTIC	3	4	4
INTERNATIONAL	2	1	-

The relative amount of use, made of the Upper Clutha hydro-lakes by different groups, can be expected to change over time. The priorities shown in Table 1 must be adapted to such changes. More emphasis may have to be directed to serve transient, stop-over, tourists in the early years, with gradually increasing emphasis in later years to cater to holiday-makers and holiday-home owners, as the entire Upper Clutha hydro-project would be completed and as the recreation pattern becomes established.

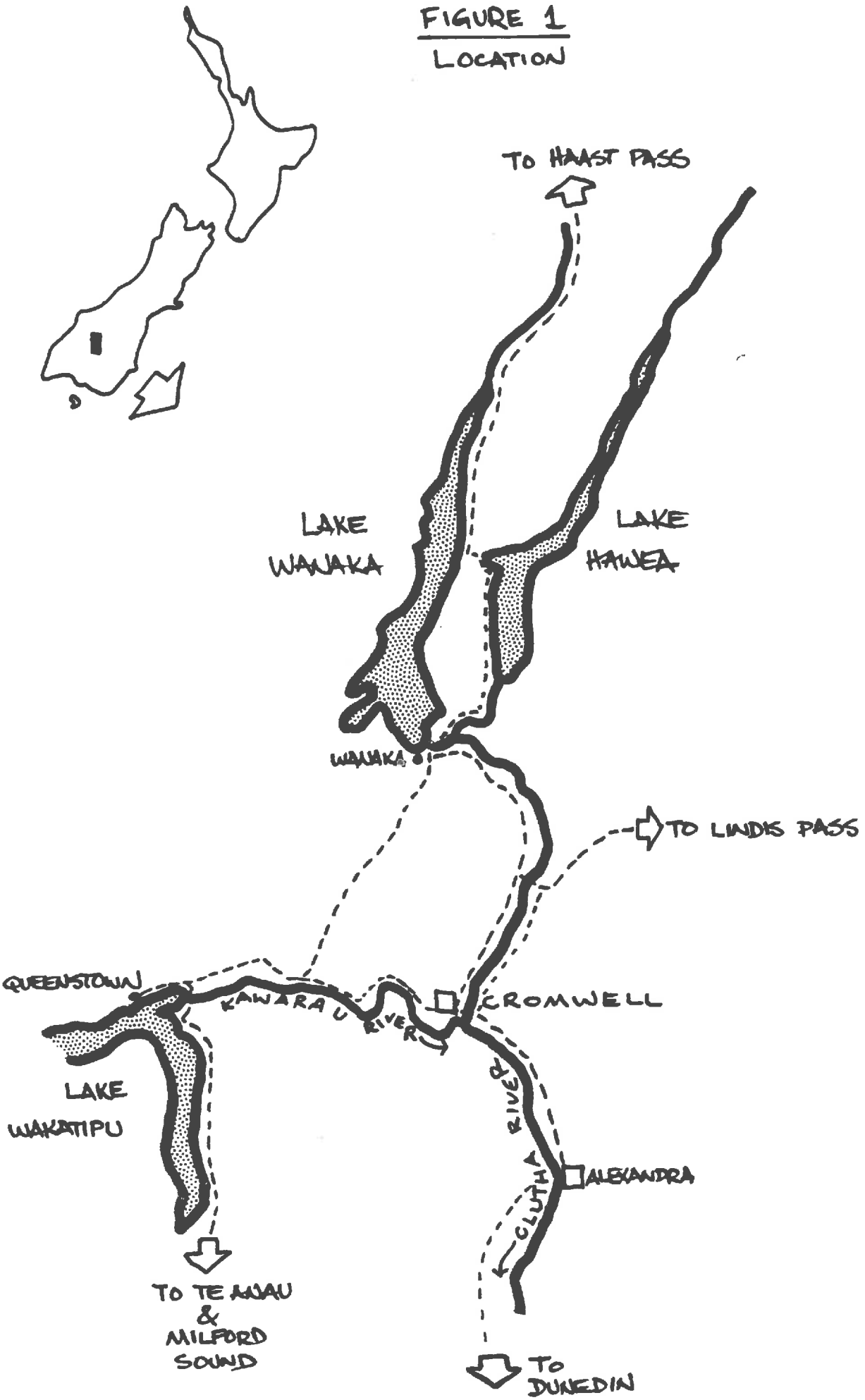
After the completion of Lake Dunstan, recreation uses will be phased-in at a time when the Luggate and Queensberry projects would be built. The full potential of Lake Dunstan may be difficult to achieve during the period of major construction upstream. Care should be taken to minimize the impact of upstream construction, on recreation use of Lake Dunstan.

During the transition period, after the Clyde dam has been completed and the Luggate and the Queensberry dams would be built, servicing the needs of holiday-home owners or of people who have taken up retirement residency in the area, will of necessity take lower priority to servicing the needs of the continued workforce involved in dam construction. Once all three hydro-lakes are completed, there would be a substantial shift in the composition of the local population, with growing emphasis on the area's role as a centre for holidaying, for holiday-home ownership, and for retirement (see Section 1.5.2 for further discussion on this theme).

1.3 Regional Market Potential

The key variables for the tourism potential of the Upper Clutha hydro-lakes are:

FIGURE 1
LOCATION



1.3.1 Location:

The hydro-lakes, with Cromwell as a central service "hub", are strategically located (Figure 1). All tourism traffic in the region passes through, or very close to, Cromwell, and the town is ideally suited to tap this travel market. Central Otago is also well located in terms of the time-distance of travel to large population centres, such as Dunedin.

The Waitaki hydro-lakes are in a more sparsely populated region; are without direct access to sizeable communities, comparable to Cromwell or Alexandra; and are not located on major highways which lead to internationally renowned tourism destinations (such as Te Anau, and Queenstown) beyond the region. The Upper Clutha hydro-lakes can therefore be expected to experience substantially higher levels of visitation and use. They will also be under considerably greater pressure for development by the private sector, because of the large number of established tourism entrepreneurs nearby, who may seek opportunities in the hydro-lakes to expand their operations.

Because of the proximity to Queenstown and Wanaka, the Upper Clutha hydro-lakes will be used as a stopover for travellers through the area, as well as the main destination for other tourists and holiday-makers. This dual function of stopover and main-destination has broad policy implications for water oriented recreation development on the hydro-lakes.

Cromwell is also strategically located because access is available to all four ski-fields in the region (Table 2). By contrast, from Queenstown or Wanaka there is direct access to only two ski-fields, with longer travel required to reach the region's remaining two ski fields, especially so when the Cardrona road (S.H. 89) is closed. A visitor to Cromwell thus has almost as good a choice between travel to the four ski-fields in Central Otago, as does a visitor to either Queenstown or to Wanaka. Cheaper accommodation in Cromwell may more than compensate for the marginally longer average travel distances.

1.3.2 Climate:

The dry, sunny, continental climate of Central Otago has attracted visitors in the past and is an important motivator particularly for holiday-home owners and for those who retire to the area. In a dry, semi-arid region, the hydro-lakes will have a special appeal, and will present a visually attractive contrast to the surrounding landscape. Jordan (1980), in a survey of holidaymakers and holiday-home owners in Cromwell, discovered that a perceived good climate ranked second in a list of primary reasons for the choice of Cromwell as a destination. The climate also makes winter recreation possible, with a still unrealized growth potential for cross-country skiing.

The water in the hydro-lakes will be warmer than that in the natural lakes in the region (Wakatipu, Wanaka, Hawea). Water temperature readings taken during a study of the location of a potential fish hatchery showed summer water temperatures of generally between 10 - 15 degrees centigrade. In the shallow water of beaches, the water temperature may exceed this range. The water of the hydro-lakes

TABLE 2

CENTRAL OTAGO
TRAVEL DISTANCES TO SKI FIELDS
(In Kilometres)

From	TO								Average Distance	
	Treble Cone		Cardrona		Coronet Peak		The Remarkables			
	1	2	1	2	1	2	1	2	1	2
Queenstown	88	136	52	135	15		18		43.3	76.0
Wanaka	23		32		88	120	68	117	52.8	73.0
Cromwell	77		76		63		58		68.5	

NOTE: 1 = Via the Cardrona Road/Crown Range

2 = Via Cromwell

should therefore have a higher comfort level for swimming and waterskiing, than the natural lakes in the region.

Fog, especially in winter, together with thermal inversions, may be a problem, and may be exacerbated by Lake Dunstan.

1.3.3 Water-oriented recreation opportunities:

The hydro-lakes cannot compete on an equal level with the scenery and other attractions of natural lakes in an alpine setting. Instead, they should cater to an alternative, and to some extent complementary, market based more on domestic travellers.

From a marketing perspective, the main water-oriented recreation opportunities of the hydro lakes are:

(1) the reservoirs themselves, with their shoreline facilities for water-oriented recreation

(2) the dams, the canal, and other engineering works, all of which offer opportunities for viewing and interpretation

(3) the Clutha River between the outlet of Lake Wanaka and the head of Lake Luggate

(4) the residual river between Queensberry dam and the head of Lake Dunstan; river flows will be a critical determinant of recreation potential here; opportunity would exist for boat travel from Lake Dunstan upstream on the residual river; there is potential on the residual river, below Queebsberry dam, for a white-water canoeing training and competition course (see Section 4, for a further discussion of such a competition course)

(5) scenic landscape amenities, especially in the Kawarau Arm and the Dunstan Arm of Lake Dunstan, with a high potential for sight-seeing by boat and car

(6) tributary rivers around the hydro-lakes, with recreation opportunities in the surrounding back-country (for example, the Lindis and the Cardrona Rivers)

(7) Cromwell as a central, established community, which will be able to function as a service "hub"

(8) The waterfront of Cromwell may have a special appeal, especially when considered in conjunction with the historic precinct

1.4 Marketing Strategies

The Upper Clutha hydro-lakes would best be marketed with a multiple strategy, with different degrees of effort directed to each market sector. A multiple market strategy will reduce the impact on the

local economy of sudden downturns in any one tourism market sector. The tourism industry is extremely prone to "peaking" of visitation during certain seasons, and low visitation at other times of the year, creating problems with staff continuity, cash-flow, etc. A multiple-market strategy will assist to reduce the tendency for peaking, and help to even out visitation over the year.

Several marketing strategies have been defined:

1.4.1 Market leader:
(the strongest position)

(1) water-oriented recreation opportunities on man-made lakes

(2) specialized recreation opportunities, such as a white-water canoeing training and competition course below Queensberry Dam (see Section 4.3.2)

(3) facilities for dinghy sailing and windsurfing, including the rental of equipment, and regattas (see Section 3.3 and 4.3.3)

(4) viewing and visitor interpretation of engineering works

(5) good climate (fog in winter may be a detracting factor)

(6) attractive landscapes (see Section 5 for a discussion of how the Vincent County District Scheme can facilitate the protection of the landscape around the hydro-lakes)

(7) a lower price structure and avoidance of the negative spillover effects common to areas which cater in a major way to international tourists

1.4.2 Market challenger:
(not as strong a position as the "market leader", but one where competitors, who are already established, may be challenged to a part of their market)

(1) holiday-homes

(2) retirement living

(3) Cromwell as an alternative location for accommodation for skiers, from where choice of travel to four ski fields is possible

(4) development of cross-country skiing

1.4.3 Market follower:
(a weaker position than the "market challenger", but one where the established market has room for new members)

(1) stop-over for international tourist coach tours on their way to Te Anau-Milford, Queenstown, or the West Coast

(2) attracting the FIT (Free Independent Traveller) market, with budget accommodation and lakeside camping

The FIT market is growing, and may in time offer opportunities for the Upper Clutha hydro-lakes to advance to a "market challenger" position. Trends in the FIT market which suggest this are:

(a) the National Travel Association data indicate that now less than 33% of all tourism (domestic and international) is by coach tours

(b) in Queenstown, the number of car hire establishments has almost tripled in the past several years, suggesting rapid growth in the FIT market here

(c) the campervan fleet in New Zealand over the past five years has grown from some 500 vehicles to an estimated 1,600 vehicles today, and is continuing to expand from the current 5% of foreign tourists who travel by campervan.

(National Travel Association information).

1.4.4 Market corner:
(a small, speciality market that is created; also called "market niche")

Special events to attract visitors: dinghy sailing regattas, windsurfing competitions, waterskiing performances, activities centred on the gold-fields history or timed to coincide with special seasonal events such as the apricot spring blossom festival, or the Cromwell races. There is a potential for diving and other underwater sports. For example if there are no compelling engineering reasons for the removal of the old Cromwell bridge, serious consideration should be given to keep it in place.

1.5 Marketing actions

Market actions have to be calibrated to suit each of the four market positions discussed above. Some possible marketing actions are:

1.5.1 Image development:

The market leader role of the Upper Clutha hydro-lakes implies a position which cannot, or at least cannot easily, be challenged by competitors. Market leader action would aim to create a maximum public awareness of the availability on the hydro-lakes of a wide range of water-oriented recreation opportunities. Advertisement is essential, first to create the market, and then to maintain and expand the market.

Establishing a distinct "image" for the area would help to promote the recreation appeal of the Upper Clutha hydro-lakes. Monitoring visitor satisfaction, using techniques such as market surveys, would assist in adapting to market changes, and help to maintain the market leader position. The market leader position can all too easily result in complacency, with the result that other areas can

begin to lure away some of the visitors who otherwise may have come to the hydro-lakes. Advertisement is mandatory.

1.5.2 Holiday-homes and retirement:

Cromwell and the hydro-lakes will present an alternative for holiday-homes and retirement living, and thus could be a market challenger to established communities such as Queenstown, Arrowtown, Wanaka, Albert Town, and Hawea. But, for the hydro-lakes region to be seen by prospective property purchasers as a viable alternative, it must offer distinctly different attractions, not available in the competing areas.

Property with a wide price range is available for holiday-homes and retirement in Queenstown, Arrowtown, Wanaka, Hawea, and elsewhere. Holiday-home and retirement properties in the hydro-lakes area would not be a new commodity on the market. A marketing strategy for holiday-homes and retirement should therefore stress the distinctly different living environment that would be available in Cromwell and the environs of the hydro-lakes. Cromwell could be promoted as a holiday-home and retirement community for those who want a full range of comprehensive urban-style services, without having to live in a city. It will have a special appeal for those who may prefer an "in town" living style.

Cromwell as a planned and well serviced town should thus be in an ideal position to promote itself as a holiday-home and retirement centre. Promotion should stress that for an equivalent price to property in Queenstown, say, the purchaser in Cromwell will get "twice the house at half the price, a lake, the healthiest climate in New Zealand, and city services without the city".

Jordan (1980) found that 40% of holidaymakers in Cromwell were from Dunedin, while as many as 55% of holiday-home owners were from Dunedin; Dunedin obviously dominates the market.

There will also be opportunities for holiday-home development outside Cromwell, in a more rural, lakeside setting. This will be the responsibility of Vincent County. Such developments must be located with care, however, and with adherence to two strict policies set down by the Vincent County District Scheme: (1) not to affect the landscape aesthetics, and (2) not to create servicing problems. The District Scheme favours clusters of holiday-home developments, and an avoidance of continuous developments along the lakeshores. By far the largest proportion of the lakeshores must remain as public open space, to safeguard the appearance of the natural landscape, and to avoid the creation of servicing problems. (See Section 5 for a further discussion on this theme.)

The Town Centre in Cromwell is not well located. A location of the Town Centre on the waterfront of Lake Dunstan would have been an extraordinary opportunity to enhance the tourism potential of the community. It is questionable even whether in the short-term a highway location is to the best advantage of the Town. McElroy (1982) has documented extensively an alleged lack of planning cooperation and lack of coordination between Vincent County Council, and the Cromwell and Alexandra Borough Councils. In the future

planning for water-oriented recreation at Lake Dunstan and at the other hydro-lakes, coordination between all levels of government is imperative for success.

1.5.3 Phasing and long-range planning:

Long-range planning is essential to gradually, over the years, phase out the construction work-force use of housing in Cromwell, and to phase in holiday-homes and retirement use. Policies for future development should emphasize that eventually the purpose of the town, and the composition of its population, will become quite different from what it is today. After a community has acquired a new role, there may be substantial costs involved to retro-fit the physical infrastructure to suit new users. The situation in Cromwell has the distinct advantage that long-term changes in the role of the town can be foreseen, and can be reflected in anticipatory planning.

For long-range planning, three phases in the evolution of Cromwell, and of recreation and tourism use of the hydro lakes generally, can be visualized:

PHASE I: The completion of the Clyde dam, the inundation of Lake Dunstan, and the installation of shoreline recreation facilities. The completion date for this phase is 1988-90. Sport fishing in the new Lake Dunstan should be excellent, because of the extra nutrients in the water from submerged terrestrial vegetation and the ample fish habitat and food sources.

PHASE II: The beginning of recreation use of Lake Dunstan and increased tourism visitation to the general region, concurrently with the construction of the Luggate dam and, subsequently, the Queensberry dam. This phase will last into the 1990's. Because construction would still be ongoing, tourism visitation to the general area, and recreation specifically on Lake Dunstan, could to some extent be constrained, and possibly affected adversely. Therefore, during this phase, care must be taken that the ongoing construction will affect as little as possible the recreation use of Lake Dunstan. A negative public image, of the attractiveness of Lake Dunstan, may have lasting consequences and may detract from the realization of the full recreation potential of the entire project. The Environmental Impact Reports have examined the issue of siltation from the construction of the Queensberry dam, and likely effects on Lake Dunstan.

At the end of Phase II, the transition should be well underway from a local economy largely dependent on heavy construction and its support services, to one oriented more to tourism and recreation.

PHASE III: Completion of construction of the Luggate and Queensberry dams, and the final phasing-in of shoreline and other recreation facilities on them. (In more detail, this phase could be divided into two parts: IIIa, completion of Luggate, and IIIb, completion of Queensberry.) By the end of Phase III, there will be a full realization of the linkages and interactions of recreation on all three hydro-lakes; between the Clutha River and Lake Luggate;

between Lake Dunstan and the residual to Queensberry dam; and between Lake Dunstan and the Kawarau River.

1.5.4 Demographic trends:

A market strategy for the Upper Clutha hydro-lakes should also consider broad demographic trends in New Zealand. Perhaps a key consideration is the peristalsis effect, whereby large and then small population cohorts follow each other in successive waves.

The years following World War II, from the late 1940s to the mid or late 1960s, were a period of high birth rates and high immigration to New Zealand. The period has been dubbed the post-war baby-boom. The New Zealand fertility rate peaked in the early 1960s; today it is below replacement level, at 1.9 children per woman, in a total population of 3,307,084 in March, 1986 (Department of Statistics data). If fertility continues to decline, and if emigration continues to be larger than immigration, the population is expected to increase by only 12% over the 1986 figure, to reach about 3.7 million in 2011. The Maori component of this increase will be relatively larger, accounting for almost half (46%) of the increase.

The significance of the peristalsis effect over the next few decades, barring large scale emigration from or immigration to New Zealand, will be:

(1) an increase in the average age of the population, and in the number of elderly people

(2) fewer people under the age of 15; there will be 19% fewer teenagers by the year 2000

(3) a moderate increase of those between age 20 and 40

(4) substantial increase in those over age 70; society's resources will have to be directed, more and more, to the care of the elderly, as contrasted to the dependent young. In the Maori population, there will be an even faster increase in the number of elderly

(5) the "dependency ratio" will change dramatically. This is the ratio between those in the active labour force, and those who are not in the labour force. Generally, this is taken as the ratio between the working population contributing to public revenues, and the elderly, who depend on those revenues for pensions, health-care, and nursing homes. The dependent portion also includes the unemployed, the pre-school and school-aged population, those in hospitals, or in any other way dependent on government for their livelihood. Suffice to say that the dependent portion of the ratio will increase

(Source: Population Monitoring Group, New Zealand Planning Council, 1985 Report.)

How does the peristalsis effect affect the future market for the hydro-lakes?

Disposable income and time for leisure travel and recreation tend to be constrained during the family formation years of early adulthood. Young families faced with high mortgage payments have been referred to as the "new poor". Purchasing power tends to increase markedly after age 40 - precisely the population cohort that is becoming dominant demographically in New Zealand. Those over age 60 may have ample free time but, because they live on fixed incomes, they may have constrained disposable income for tourism travel and for recreation. Nevertheless, because senior citizens are becoming more numerous and more vocal politically, their special needs, such as housing, health care, and recreation, will grow in importance. One private sector response, following trends in North America, is the development of retirement villages. It may be prudent to examine the potential of the housing stock in Cromwell for conversion to retirement and to holiday home use. Sarkissian and Perlgut (1986) have an excellent review of retirement housing. The Ministry of Works and Development Chalets would be suitable for tourist accommodation or for retirement housing.

Planning has traditionally presumed continued growth, and plans are often based on the assumption that there will be increases in the number of people and expansion of the physical, built environment. In the post-World War II decades, the high levels of fertility and the net gain from immigration to New Zealand, provided the social, political, and economic bases for growth-founded planning policies. But the low fertility levels in the last two decades, and a net loss of population from emigration, today no longer support growth-founded planning policies. A shift of the population fulcrum to the north, together with only a slowly increasing absolute population and major changes in the composition of that population, imply that the Upper Clutha hydro-lakes will serve generally older users, and will have a major potential role as a retirement region. However, there will also be a demand for recreation by a younger population; it is the relative proportions of the various age-groups that are going to change - a change which will have implications for the type of uses that will be made of the hydro-lakes.

2. WATER-ORIENTED RECREATION CAPACITY STANDARDS

2.1 Introduction

Planning for water-oriented recreation on the Upper Clutha hydro-lakes should be a pro-active, not a reactive, process. There is a tendency, particularly in North America, for private sector recreation developments to result in a reactive planning process, whereby public agencies respond on an ad hoc basis to development proposals. The final outcome reflects less what is intended in any plan, and is instead defined more by the sequence and type of uncoordinated successive developments. Rarely does such a reactive process examine the broader question of the cumulative effects, over time, of successive individual developments, and how these may reduce the overall quality of an area.

There is a limit to the amount of development that any tourism area can withstand, without deterioration of its social and physical environment. The term carrying capacity, as defined in the Introduction to this report, has both a quantitative and a qualitative part. The quantitative part estimates the desirable maximum number of users of an area (see for example, Table 3 and Table 6). The qualitative part deals with the desirable combinations of users of different type for an area (see for example, Tables 4A and 4B). The two parts are of course inter-related (see Section 2.2).

With a small population, scenic landscapes, and high-quality services, New Zealand is in the fortunate position of being able to avoid the destruction of tourism resources, which often results from overdevelopment. Nevertheless, the pressure for development is intense, partly because the international tourist destinations in the country are highly concentrated. For example, 1984 visitor arrival figures show that some 40% of all international tourists to New Zealand visit Queenstown. Not surprisingly, tourism development there is booming. Speculative proposals have been aired to expand the airport to accommodate direct jet flights from Japan (to better tap the lucrative Japanese honeymoon tourist market); to develop a monorail along the east shore; to establish a direct road connection between Queenstown and Milford Sound; to relocate the Kingston Flyer to Queenstown; and to build a cable-car across the lake, with the cable support towers being of an estimated height of some 40 metres (to obtain the desired clearance for the cables over the water). Over 3000 hotel rooms are in various stages of either being built, being processed for approval, or being considered as part of future expansion.

Fortunately, recreation capacity standards, as a management tool to guide the rate of recreation use, are already well established in New Zealand. For example, the amount of use allowed on the Milford Track is carefully controlled, and use limits are being considered for sites in other national parks. The public sector responsibility for such areas facilitates agreement on the desirable level of use.

Regrettably, in a private sector setting, such as in some of the highly concentrated, popular destinations for foreign tourists, the institutional framework does not exist to curtail growth, even

though there may be evidence that unchecked expansion is deteriorating the very resources on which the local tourism economy is based. Relentless development may eventually change the quality of the physical and social environment to such an extent that tourist visitation drops off. Even though the increasing social and environmental costs due to incremental development may be acknowledged, the pressure for continued growth may remain unrelenting. The result, too often, is a tourism slum.

International tourism to New Zealand is a high-quality market, primarily because of the high cost of travel from the tourist generating countries. There is evidence from market surveys that the tourists are motivated by an image of New Zealand as an uncrowded country with undeveloped scenic natural areas. It is more than likely that these top-market tourists, who are highly discriminating in the countries they visit, will not tolerate intense commercial development of the destinations in New Zealand which are supposed to portray the undeveloped, scenic character of the country. They may eventually select alternative countries.

Where tourism over-development has caused an area to deteriorate, such as the Costa del Sol in Spain or southern Florida in the United States, for example, it may have been possible to replace the former upper-end market with a lower, cheaper market of tourists. But in New Zealand, because of the high cost of travel to the country, such a replacement will be very difficult, if not impossible; there is only the one, top, market.

Fortunately, the Upper Clutha hydro-lakes have a distinct marketing advantage in that they can be planned, developed, and managed so as to achieve and sustain a high-quality recreation environment. However, this achievement is contingent on defining a limit to the amount and type of use made of the lakes. In practice, this means that, after a desirable level of use has been reached, further development is curtailed, regardless of how attractive any individual additional proposal may appear to be on its own merits.

The goal for development of the Upper Clutha hydro-lakes should be to reach their fullest market potential, while at the same time respecting the limits of the lakes for the accommodation of water-oriented recreation. Boating capacity standards help to define these supply constraints, and provide a basis for the establishment of a development policy which will help to assure that a high-quality recreation environment is achieved and maintained.

The next section (2.2) outlines some of the theory behind capacity standards, and the section following it (2.3) applies the theory to the Upper Clutha hydro-lakes.

2.2 Theoretical background

Capacity standards are planning guidelines which suggest a desired level of use of a natural resource or a specific facilitiy. Here, they refer to the type and amount of boating suitable on the Upper Clutha hydro-lakes. Boating capacity standards typically are expressed as either the number of hectares of water surface per boat; the number of boats per length of river or channel; or the

number of boats launched per day per boat launching ramp. Other standards, usually in the form of government regulations, exist for safe boating speeds, for operation, for boat traffic rules, and for equipment and seaworthiness of vessels.

Boating capacity standards are both prescriptive and descriptive. They are prescriptive in that they prescribe to an area a type and amount of use that the managing agency construes to be desirable. They are descriptive in that they reflect the costs inherent in the trade-offs between the quantity and quality of use made of an area. "Cost" here can be defined as, for example, social impacts, physical environmental deterioration, or maintenance and management expenses incurred by the use of an area.

Rarely is there a consensus on the acceptability of a particular cost, associated with a given level or mix of use for an area. An acceptable level of use for a wilderness area, for example, could be seen very differently by the wilderness advocate, and by the developer: the costs accepted by the one party may be rejected outright by the other. Adverse environmental impact, due to intensive use, may be seen by the wilderness advocate as being an unacceptably high cost for intensive use. Conversely, the lost opportunity costs of development that is foregone due to a low level wilderness use, may be seen by the entrepreneur as being an unacceptably high cost for the wilderness use.

A strong subjective element underlies carrying capacity standards, including the boating capacity standards. To use a contrasting example, road traffic standards rely on relatively precise measurements of the physical environment (road), traffic volume in relation to the road (number of vehicles and their speed), and even the human behavioural aspects of the driver (visibility, reaction-time to stimuli, etc.). By comparison, boating capacity standards are less precise and more judgemental.

Considerable research has been carried out, by many agencies, to improve boating capacity standards. For example, the number of boat launching ramps required for an area has, in one instance, been based on traffic counts, and in another case, on the sustained yield of a fishery, so as not to deplete the fisheries resource. Despite such studies, however, boating standards still depend on subjective decisions made by the researcher. However, even though such decisions are subjective, they do reflect an agency's familiarity with how an area is used, and may be the result of trial-and-error experimentation to find a standard that appears to work. For example, the number, type, and mix of boats allowed on a reservoir may have been varied and, based on direct observation and the reports by boaters, a standard that appears to suit the reservoir will have been established. Cross-referencing of a number of such standards available in the literature shows that they converge toward a consensus, even though there is a sizeable range between extreme values (see Section 2.3).

The transferability of standards from one location to another must be carried out with caution. Because the standards often are location-specific, they should not be applied uncritically.

A water environment for outdoor recreation does not have a single definitive limit of the amount of boating, or other recreation uses, that may be made of it. There is a wide variety of possible boating intensities and patterns on different water environments: lakes, rivers, coastal areas, and even urban canals and ponds. It is therefore more realistic to visualize capacity standards as a range of management decisions about the intensity and periodicity of boating that may be suitable in a specific water environment.

In some situations, a relatively high density of boats may be desirable and may enhance the quality of the experience of the users. For example, in rowing or pedal-boating on a small lake in an urban park, the socializing between boaters is part of the enjoyment of the activity. By contrast, in other situations, such as wilderness canoeing, a low density of boaters is expected by the users and may be the pre-requisite for a high quality experience.

Some boats compete better for use of an area than do others. Boats are sometimes considered as being of the "impacting" kind (high speed motorboats, especially with waterskiers, for example), or of the "impacted upon" kind (canoes and other slow boats of limited manoeuverability, for example). The impacting type boats use up a large water-surface and they tend to displace other boats which cannot compete, by making it difficult for them to concurrently use the same water environment.

Waterskiing is an impacting activity. The combination of a high-speed motorboat, tow-rope, and skier, performing slalom turns in a figure-of-eight shaped course, requires a large water-surface. The activity has negative externality effects in that it may render large areas of water unsuitable, even dangerous, for other boats. It also creates noise which may reduce the enjoyment of people on the shoreline. Of course, waterskiing may also have positive externality effects, in that people on shore may enjoy watching waterskiiers perform on the water.

The Ontario Waterski Association in Canada has suggested the following minimum standards for waterskiing:

(a) a minimum 60 metre "lane" of unobstructed water for safe uni-directional waterskiing, because -

- assuming a 23 metre tow-rope, a waterskier may be 23 metres on either side of the tow boat and moving parallel to it
- another 7 metres of open water on either side is desirable as a safety margin.

(b) a course 600 metres long is considered desirable

(c) backwash from an embankment or other shoreline structures, and the wakes of other motorboats, reduce both the safety and the enjoyment of waterskiing

(d) turning radius is inversely proportional to speed: as speed increases, turning radius shortens

(e) 150 metres of unobstructed water is desirable for safe execution of a U-turn by recreational waterskiers; 90 metres may be considered as a minimum for trained, competition waterskiers

Certain combinations of boats work better than others, and the circumstances of each water environment have to be considered separately, in order to establish boating capacity standards that suit local conditions. Trade-offs exist between different combinations of boats, in that the same number of total boats may have very different environmental consequences, depending on the mix of boat types that makes up that total. The degree of impacts and total number of boats do not form a strict linear relationship, but depend also on the diversity of boats, i.e., the total number of types of boats.

For example, if the number of high-speed motorboats in an area were to be reduced, enough water surface may be liberated to allow an increase in both the total number, and the diversity, of boats. With fewer motorboats, boats of another kind, say, sailboats or canoes, may be introduced. Because these are less space demanding than are motorboats, the total number of boats could be increased. Due to the new mix of boats, the quality of the social and physical boating environment may have increased, in spite of a larger total number of boats. Hence, there is a relationship between total number of boats, type of boats, and diversity (number of types) of boats.

One weakness in boating capacity standards is that they do not consider well enough the interactions between different types of boats. That is, the standards apply to discrete situations where it is assumed that a given water area is used by boats of only one type at a time. However, in most situations, several types of craft have to use the same water area concurrently. Conflict between competing boats is common, and at high densities, safety may be jeopardised.

The degree of conflict, between boats interacting on the same water-area, varies greatly, depending on the type of vessels involved. Compatibility between boats is largely determined by the following variables:

(1) speed differential: boats moving at a much slower speed are at a disadvantage, compared to faster boats

(2) means of propulsion: different means of propulsion create different operational characteristics; for example, muscle and wind powered craft are more difficult to operate and usually are slower as well

(3) seamanship: ability to operate water craft is one of the more critical causes of boating conflict. Generally, operators of powerboats and some sailboats (other than learners) are more skilled than are operators of rental craft. On the Upper Clutha hydro-lakes, boat rental, especially the rental of houseboats, may cause safety problems

(4) boat size: to some extent, smaller boats seem more vulnerable to boating conflict, particularly to the wake of larger and

faster craft; small boat operators may also be intimidated by the sheer size of larger craft

(5) directional stability and control: this varies widely with means of propulsion and boat size, and is an important factor in the potential for conflict. Powered craft generally have more control and directional stability than non-powered vessels, and it is partly for this reason that, in open water, sail has the right-of-way over powerboats. Windsurfers have relatively the least directional control since they are highly dependent on wind velocity and direction. The operators frequently lose control of their craft and swim in the water near their sailboards. Muscle-powered craft have more control, but usually are slower than motor or sail-powered craft. In channels, and elsewhere where powerboat movement may be restricted, sail does not have the right-of-way over power.

(6) waterskiers have limited control because of the large spatial requirement of the boat-tow rope-skier combination, and the large area required for turns

(7) boat density and number of manoeuvres per boat: the higher the density of boats in a given area of water, the higher will be the probability of occasions when accidents may occur. This is compounded as the number of manoeuvres per boat increases: for example, windsurfers tacking in a strong wind must carry out many more major turns than will muscle or motorized craft

The degree of compatibility between craft is shown in Tables 4A and 4B.

Because boating capacity standards do not fully account for conflicts due to competition between boats, two water management planning techniques are frequently used in conjunction with the capacity standards:

(1) Water-surface zoning:

Much as land is zoned for different uses, the water surface, too, can be designated for different purposes. However, land uses are relatively fixed, and vehicular and pedestrian movement can be channelled. On water, activity is far more difficult to separate spatially. Buoys and various navigation markers delineate boat channels, harbour entrances, and navigation hazards. But in a recreation water environment, such as the Upper Clutha hydro-lakes, rigid separation of activities on water, using a complex system of markers, is not necessary, nor desirable. An elaborate system of markers could detract from the visual appearance of a lake, and may affect the enjoyment of water users. Nevertheless, in certain locations, some separation of activities may be desirable, because it would greatly enhance the functionality of the entire water environment. (See Section 3.1.2). Fortunately, The Harbours Act 1950, and The Water Recreation Regulations 1979, provide the legislative basis for the control of water-surface activities.

TABLE 4A

LAKE BOATING COMPATIBILITY

Activity	A C T I V I T Y						Mean (See Note 4)
	A	B	C	D	E	F	
A Waterskiing	0	3	2	1	1	2	1.8
B Jet Boating	3	0	3	2	2	2	2.4
C Slow Motorboat	2	3	0	3	4	4	3.2
D Sail/Windsurf	1	2	3	0	4	3	2.6
E Canoeing	1	2	4	4	0	4	3.0
F Lake Fishing By Boat	2	2	4	3	4	0	3.0

TABLE 4B

RIVER RECREATION COMPATIBILITY

Activity	A C T I V I T Y						Mean Compatibility Index (See Note 4)
	A	B	C	D	E	F	
A River Angling	0	4	1	2	3	2	2.4
B Canoeing	4	0	1	2	4	1	2.4
C Jet Boating	1	1	0	4	1	4	2.2
D Boater Camping (Motor Boats)	2	2	4	0	3	3	2.8
E Boater Camping (Canoes)	3	4	1	3	0	1	3.2
F Rafting	2	1	4	3	1	0	2.2

Notes:

1. Motorboats include both jetboats and fast, planing-type outboard motor boats.

2. Ordinal scale: 1: Least Compatible, 4: Most Compatible.

3. Multiple compatibility indices (MC) may be computed, where 't' is boat or activity type and 'C' is the compatibility index between a pair of t boats or activities.

$$MC = \sum_{i=1}^{n} C_{t_i} / n$$

4. Ordinal values are treated as interval-ratio measurements.

(2) Time-zoning:

On very small waterbodies, where all boating cannot take place concurrently, time-zoning may be used. Different activities can be scheduled for specific periods, with other times being available for general boating. Time zoning works especially well to control the activities of organized groups (for example, the schedule for sailing regattas) or to establish hours of operation for commercial recreation operators.

2.3 Boating capacity for the Upper Clutha hydro-lakes

The Upper Clutha hydro-lakes have a wide range of possible combinations of total number and mix of boats, and where and when boating takes place. Each combination would have its own associated cost characteristics. For example, all use could be assigned to motorboats only, with no provision for other craft; or, all use could be assigned to commercial boat rental establishments, with little or no provision for the private, individual boater; or, a mixture of boating types (non-motorized craft and other boats), and a balance between the private boater and commercial operations, could be aimed for. The boating capacity standards on their own do not provide answers to these questions, but must be considered in conjunction with the marketing strategies discussed earlier, in Part 1 of the report.

As a management decision of what amount and mix of use to assign to the hydro-lakes, consideration must be given to: (1) trade-offs between level of use and costs, particularly the cumulative costs and whether users pay for these or whether the costs are, or can be, transferred to outside parties; (2) who is affected by and has to pay for negative externality effects; (3) whether the resource being used is renewable or not; and (4) whether alternative resources exist elsewhere for the same use. What would constitute the ideal amount and mix of water oriented recreation, may be seen very differently by each potential user-group.

To develop boating capacity standards for the Upper Clutha hydro-lakes, North American literature sources were reviewed, and those references which were judged to be applicable to the hydro-lakes were selected. For example, standards for recreation in urban water environments or in other unique situations, were not used. Because the standards in the literature varied greatly, extreme values were rejected. Based on the final selected standards, the mean of the capacity for each type of boating was computed.

The recommended standards are shown in Table 3 and Figure 3.

2.4 Shoreline physiography

In addition to the water requirements for water-oriented recreation, the physiography of the shoreline has to be considered. For some types of water-oriented recreation, such as swimming, the shoreline physiography is of prime importance. But even more generally, the

TABLE 3

ESTIMATED WATER AREA CONSUMED BY WATER-ORIENTED RECREATION ACTIVITIES (SEE ALSO FIGURE 3)

1. MOTORBOATING, INCLUDING JETBOATING: $\leq$ 7 Hectares/Boat
   (References: 4, 6, 8, 10, 12, 13)

2. WATERSKIING: $\leq$ 15 Hectares/Boat
   (References: 4, 6, 10, 15)

3. CANOEING, INCLUDING ROWING: .2 - .5 Hectares/Boat (5 Boats/Hectare)
   (References: 9, 10)

4. WINDSURFING: .5 - 1.0 Hectares/Boat (See Note 2)
   (Reference: 3)

5. DINGHY SAILING: .5 - 1.0 Hectares/Boat (See Note 2)
   (References: 4, 6, 8, 10, 12, 15)

6. LAKE FISHING: $\leq$ .1 Hectare/Boat (10 Boats/Hectare)
   (References: 9, 12)

7. RIVER FISHING: $\leq$ 100 metres of Shore/Fisherman
   (References: 9, 12)

NOTES:

1. The above standards refer to peak periods of use. The total water area 'A', consumed by 'b' boats of different types, 't', with each type consuming a water area 'a', can be represented as:

$$A = \sum_{i,j=1}^{n} (b_i t_j)(a)$$

2. Sailing and windsurfing are strongly wind speed (and direction) dependent. Spatial consumption increases as speed of vessel increases. In strong winds, novice sailors may avoid the water and hence the higher spatial requirement is compensated by the fewer boats on water.

3. For references, see end of report.

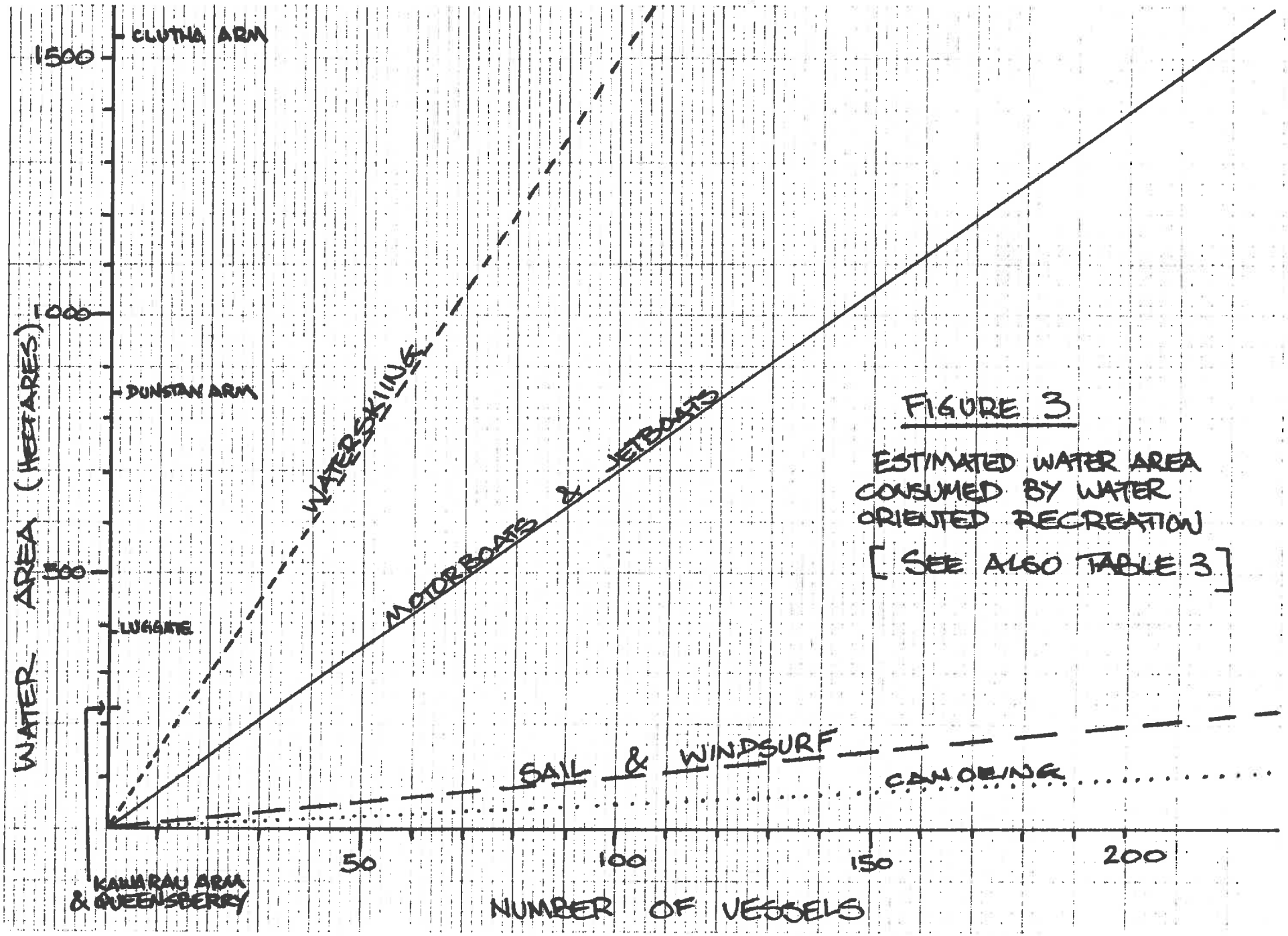


FIGURE 3

ESTIMATED WATER AREA CONSUMED BY WATER ORIENTED RECREATION

[SEE ALSO TABLE 3]

shoreline as the land base from which water is used, influences both the capacity for and the quality of water oriented recreation.

2.4.1 Beach physiographic units:

For water-oriented recreation, the shoreline may be divided into four physiographic units (See Figure 2):

(1) Wet beach: The part of the beach which extends from the water's edge to the 1.5 metre depth contour. This depth is the limit to which most people will swim from shore and thus delineates the most intensively used part of the swimming area. In North America, generally, the outer limit of a public beach is buoyed off at the 1.75 - 2.0 metre depth contour.

(2) Dry beach: The part of the beach immediately above the water's edge, which is used for sunbathing, sitting, etc., in association with actual swimming in the water itself. The extent inland of the dry beach is defined either by a change of slope, a change of beach material, the start of different, less littoral-oriented, vegetation, or a distinct change of land use.

(3) Backshore: The part of the shoreline inland of the dry beach. This is commonly not directly used for activities immediately associated with water-oriented recreation, such as, say, swimming, but is important nevertheless, because it provides the site for the back-up land infrastructure required to use the water: buildings, access, carparks, etc. Where the dry beach is absent or inadequate, the backshore may have to serve the function of the dry beach: for example, sunbathing on the backshore, instead of on the sand of a dry-beach.

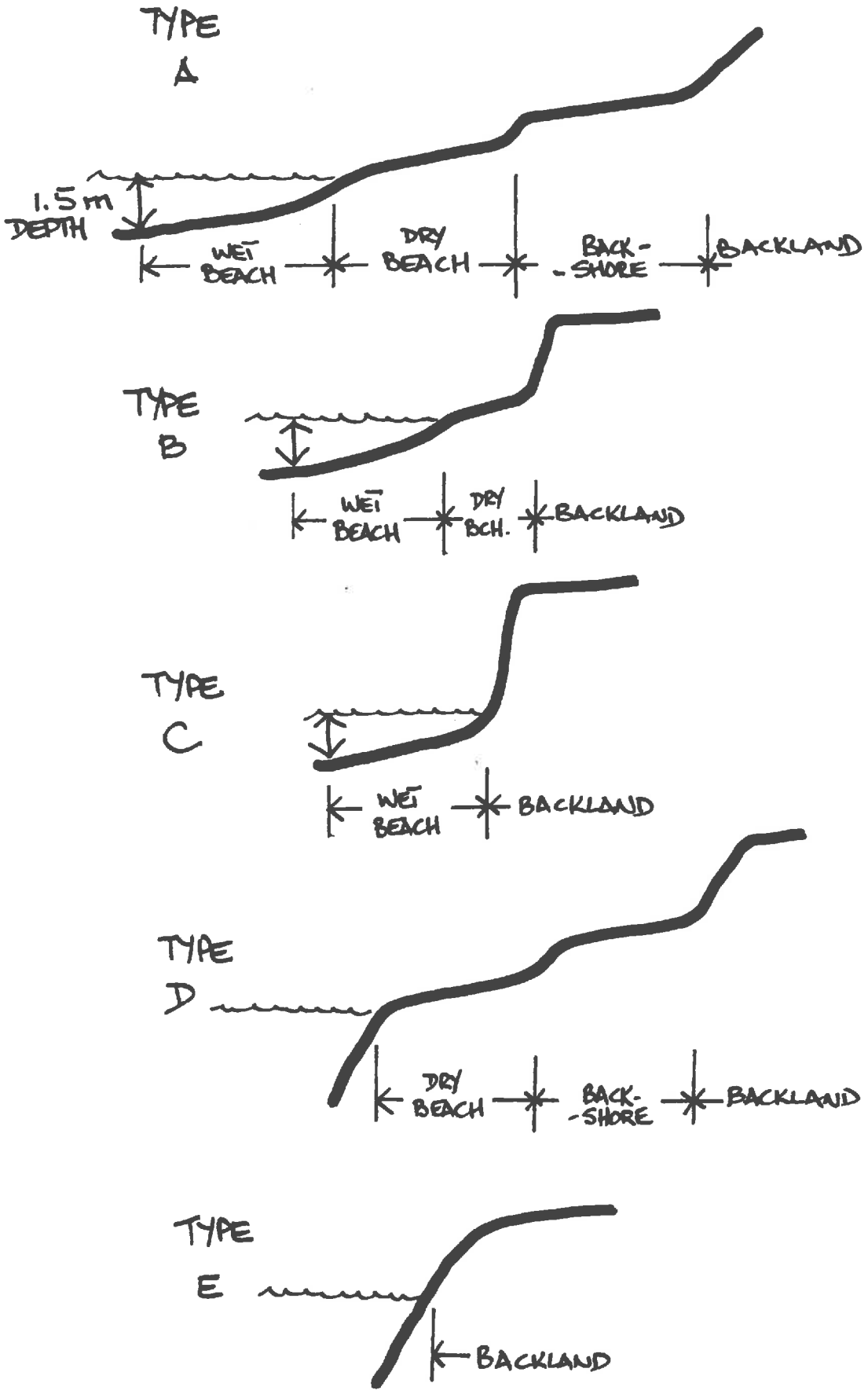
(4) Backland: This part of the shoreline extends from the backshore inland for some distance, as determined, for example, by landforms, land use, or other local circumstances. The backland can be viewed as the land, surrounding a water area, that is not directly used in conjunction with the water or the shoreline, but forms the visual backdrop to the shoreline. By contrast, the backshore still has a direct functional relationship with the water. On the Upper Clutha hydro-lakes, there are many shorelines where there is no beach or backshore to speak of, but where the backland, as steep bluffs, sometimes part of a river terrace, front immediately into the water. Depending on the height above water, the top of the bluff could, in some cases, be considered as a backshore.

2.4.2 Shoreline types:

Based on the above physiographic units, shoreline types have been defined for Lake Luggate and Lake Queensberry, in order to better assess their potential for water-oriented recreation. (Shoreline types on Lake Dunstan were not examined because the location and design for recreation facilities has already been completed by the Ministry of Works and Development.) Marine coastal, or other

FIGURE 2

SHORELINE TYPES



shoreline, environments would have to be considered separately from the present discussion.

The shorelines found on the Upper Clutha hydro-lakes may be divided into five shoreline or beach types (Figure 2):

Type A : all four beach units exist

Type B : backshore absent

Type C : dry beach and backshore absent

Type D : wet beach absent

Type E : wet beach, dry beach, and backshore absent

Additional shoreline types may occur, depending on combinations of the beach physiographic units (wet beach, dry beach, backshore, and backland):

Type F : wet beach, backshore, and backland (this could in effect be a Type A shoreline with a higher water-level).

Type G : dry beach and backland (this could be similar to a Type C shoreline with a lowered water-level).

Type H : backshore and backland.

The F and H shoreline types may leave a potential for passive recreation use, such as viewing the water, as contrasted to active beach-oriented activities, where a dry and wet beach is required.

In addition to the A-E shoreline types shown in Figures 7 and 8, the F to H shoreline alternatives, depending on water-level fluctuation, should also be included.

Water-level fluctuation influences the beach types. For example, higher water-levels cculd change a Type B shoreline into a Type C shoreline, or a Type D shoreline into a Type B or Type A shoreline. Lower water-levels could change a Type C shoreline into a Type B shoreline. Type E shorelines can be expected to be more erosion susceptible than other shorelines. In Type E shorelines, the water-level also determines the height of the bluff - an important consideration in the recreation usability of this type of shoreline. Over long time periods, erosion would change a Type E shoreline into a Type C shoreline and, eventually, even a Type A shoreline. Thus, shoreline types are not permanent, but are part of a dynamic process guided by water-level changes, shoreline erosion, and transportation and deposition of material.

Generally, a Type A shoreline has a higher recreation potential than do other shorelines. However, the type of water recreation also has to be considered, when judging the quality of a shoreline. If the water is unsuitable for swimming, say, because it is cold, physically unsafe, or polluted, the beach may be used only for sun-bathing, sitting, and picnicking, and not for actual swimming. In this case, a wet beach may be less essential, and a Type D

shoreline with an attractive backshore, for example, may be as useful as a Type A shoreline with a dry beach. For viewing water, Type C and Type E shorelines with a high bluff may offer the best vistas over the waterscape.

Beach material also influences the recreation suitability of a shoreline. The material of the dry beach and the wet beach is of key importance for swimming. Beach material may be ranked into broad categories, depending on the type and range of local materials. For example, wet and dry beach material could be classified for recreation, as follows:

Material Class 1: sand
Material Class 2: material coarser than sand, but finer than stones 2.5 centimetres in diameter
Material Class 3: 2.5 cm diameter to 5 cm diameter
Material Class 4: coarser than Class 3

The above serves as an example only. In actual fact, combinations of the above and other material types can be expected to occur. The same material may not occur consistently across a beach, and therefore the detail of the mapping would vary widely, depending on the purpose of the inventory. Local conditions must define the categories and the range of the scale.

The wet and dry beach may have different materials, due in most cases to beach processes (erosion, transportation, deposition of material,etc.). Thus a Type B shoreline may have a Class 1 material wet beach, but a Class 2 material dry beach.

The material of the backshore may also, influence the recreation suitability of a beach.

The capacity of a shoreline (as contrasted to suitability discussed above) is a factor more of the beach dimensions than of beach material, although material can influence capacity. The beach capacity is determined by the beach area, as defined by the width and length of a beach:

(1) beach width: for the wet beach, this is the distance from the water's edge to the 1.5 metre depth contour. For the dry beach, it is the distance from the water's edge to the backshore (the boundary between dry beach and backshore may sometimes be difficult to determine, and may have to be set arbitrarily, wherever a clear delineation is absent).

(2) beach length: the extent of a beach of consistent (as far as this is possible) type, width, and material, along (parallel to) the the water's edge.

The area of a wet or dry beach is determined by beach width times beach length. Beach usability increases with area and the quality of the beach material. For example, of two beaches of identical type and area, a beach with Class 1 material could accommodate more people than a beach with Class 2 material. The quality of the recreation experience on the Class 1 material beach would also be higher, provided that crowding can be avoided.

Beach width is a function of beach slope, as determined by the location from shore of the 1.5 metre depth contour. In a similar way to the ranking of beach material, beach slope may also be ranked. For the Upper Clutha hydro-lakes, three slope classes have tentatively been defined:

Slope class 1:	10:1	8:1
Slope class 2:	8:1	3:1
Slope class 3:	=3:1	

Combining the variables beach (1) type, (2) material class, (3) slope class, and (4) area, a general shoreline index could be established, ranging from high suitability/high capacity shoreline, to low suitability/low capacity shorelines, with intermediate types defined by the cells in the matrix formed by the variables.

3. WATER ORIENTED RECREATION CAPACITY OF LAKE DUNSTAN

3.1 Morphology of Lake Dunstan

The shoreline length, water area, and shape (lake morphology) of Lake Dunstan are shown in Table 5. The lake has been divided into four parts (Figure 4):

(1) Dunstan Arm: from the confluence of the Clutha Arm and the Kawarau River, to the Clyde Dam.

(2) Clutha Arm: from the confluence of the Clutha River and the Kawarau River, to the head of lake

(3) Kawarau Arm

(4) Bannockburn Inlet

Over half (58.3%) of the water area of Lake Dunstan is in the Clutha Arm, and one-third (32.0%) in the Dunstan Arm. Although both of these parts of the Lake have aproximately the same length of shoreline (37.7% and 36.6% respectively), the Clutha Arm has substantially more water area per kilometre of shoreline, than does the Dunstan Arm (38.9 hectares and 21.5 hectares respectively). The Clutha Arm is the more "lake like" part, i.e., approximating the shape of a circle, whereas the Dunstan Arm and the Kawarau Arm resemble a river more than a lake.

Some of the key boating attractions on Lake Dunstan are:

(a) boating along the Cromwell Borough waterfront

(b) boat touring and scenic viewing along the Kawarau Arm, the Dunstan Arm touring, and scenic viewing and boat travel downstream on the Dunstan Arm to the Clyde Dam

(c) boat touring from Lake Dunstan upstream on the Kawarau River and the Clutha River

(d) windsurfing and dinghy sailing on the southern part of the Clutha Arm

(e) water-skiing on the open water of the Clutha Arm

(f) "boater camping" in more secluded locations throughout the Lake

3.2 Water surface zones

Four water surface zones are recommended for Lake Dunstan (Figure 5; see also the discussion in Section 2.2):

FIGURE 4

LAKE DUNSTAN
SUB-AREAS

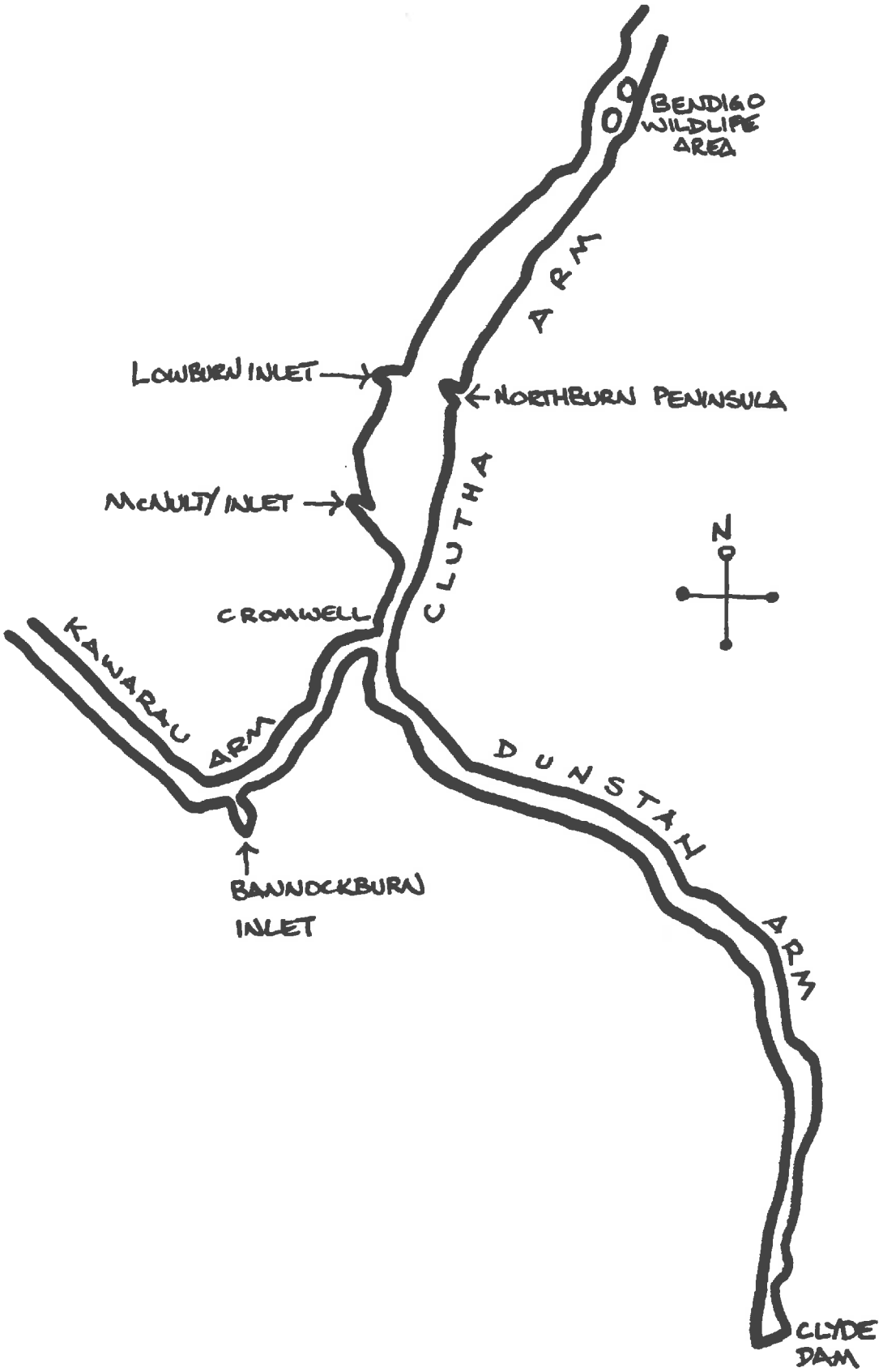


TABLE 5

LAKE DUNSTAN
WATER AREAS AND WATER ZONING

Lake Dunstan Areas	Total Water Area (ha)	% Total	Shore-Line (km) 1	% Total	Water Area (ha) Per km Shore	Shoreline Zone (ha) 2	General Boating Zone (ha) 2	Non-Motorised Boating Zone (ha) 2
1 Dunstan Arm	844	32.0	39.3	36.6	21.5	118	726	0
2 Kawarau Arm	237	8.9	24.9	23.2	9.5	75	162	0
3 Bannockburn Inlet	20	.8	2.7	2.5	7.4	Note 3	0	20
4 Clutha Arm	1,541	58.3	40.5	37.7	38.0	121	1,127	293
Total or Average for Lake	2,642	100%	107.4	100%	24.6	314	2,015	313

NOTES

1. The shoreline can be further broken down, as follows:

   (1) Dunstan Arm : W Side 19.5 km
   E Side 19.8 km

   (2) Kawarau Arm : Cromwell Borough 2.4 km
   North Shore 9.9 km
   South Shore (excluding Bannockburn Inlet) 12.6 km

   (3) Clutha Arm : Cromwell Borough 3.9 km
   McNulty Inlet to Lowburn Inlet 5.1 km
   Lowburn Inlet to Tailrace 13.2 km
   East Shore 18.3 km

2. See text for definitions of these terms (Section 3.1).

3. Bannockburn Inlet is entirely a non-motorised boating zone and therefore cannot be treated in the same way as the other parts of Lake Dunstan.

(1) Shoreline Zone

As part of a water-management scheme, a common practice is to delineate a Shoreline Zone. The Shoreline Zone for Lake Dunstan is shown in Table 5, and is conservatively calculated on the basis of a width of 30 metres, times the length of the shoreline. Section 7 of The Water Recreation Regulations, 1979, states that "(1) No person shall propel or navigate a small craft at a proper speed exceeding 5 knots - (b) within 200 metres of the shore or of any structure." In the Dunstan Arm and the Kawarau Arm, the 200 metre limit from both shores would either meet in the centre of the narrow water, or would leave a laneway of approximately 100 metres, or less, in the centre. (The situation on the upper parts of both Lake Luggate and Lake Queensberry is even worse, because the entire width of these parts of the two reservoirs is less than 200 metres.) Applying the 200 metre limit would mean that there could be no waterskiing anywhere in the Kawarau Arm or the Dunstan Arm (or in the narrow portions of Lake Luggate and Lake Queensberry). It is for this reason that a Motorized Boating Zone, for waterskiing on the the Clutha Arm of Lake Dunstan and on lower Lake Luggate is recommended, in order to accommodate this activity.

The Shoreline Zone serves two additional functions:

(a) Protection of lake ecology

The shallow water close to shore forms part of the littoral zone of a lake ecology, where plant and animal life thrives. The littoral is of prime importance to the entire ecosystem of a lake. Fish nest and spawn here, and aquatic vegetation grows in the shallow water where sunlight penetrates for photosynthesis of plants. The littoral is an ecotone where the land and water ecosystems overlap; ecotones tend to be particularly prone to adverse environmental impacts.

Unfortunately, the littoral is also where man's water oriented activities are concentrated: boating facilities, swimming beaches, docks, jetties, and harbours are all located in the littoral zone. Water turbulence created by motorboats and their propellers may uproot aquatic plants, disturb fish habitats, increase the suspended solids in the water, and introduce into the water oil and petrol from leaking motors.

In contrast to the ecology of a natural lake, water-level fluctuation on reservoirs may prevent a littoral zone from becoming established. Changing water levels hinder the rooting of aquatic plants and, without plants, precludes the establishment of adequate habitat for fish and other wildlife. A Shoreline Zone as a means to protect lake ecology is therefore less effective on a reservoir, than on a lake. A more effective means to protect reservoir ecology would be to eliminate water-level fluctuation, a goal that usually is inherently contradictory to the very purpose of a reservoir and how its water is to be used.

(b) Protection of lake users

On reservoirs, the Shoreline Zone serves more to protect lake users, than lake ecology. The band of water close to shore may be unsuitable to boaters, and may possibly even be hazardous. The juvenile shoreline of a reservoir often tends to be geologically active, with wave undercutting, slumping, and erosion on steep slopes, and deposition of material by longshore currents in shallow-water shoals. The wake and turbulence from high speed motorboating, close to shore, may accelerate this process. Water-level fluctuation may render the depth and location of shallow underwater shoals along the shore highly unpredictable. At some locations, there may be short and steep waves close to shore, and certain winds may create sudden down-drafts by ricocheting off a steep shoreline cliff.

On Lake Dunstan, there will be a long fetch of wind on the Clutha Arm, with a potential for high waves from northerly winds. The Kawarau Arm and the Dunstan Arm are more sheltered, but may have precarious aircurrents and waves when winds are funnelled directly down the gorge. Therefore, it seems prudent to apply the 200 metre shoreline water speed limit spelled out in The Water Recreation Regulations 1979, as a zone which boaters in general should not use, and in most cases would not use, because they may find it unattractive. Boaters will prefer the open water away from shore, and may venture close to shore only for the purpose of beaching a boat.

At some locations on all three of the Upper Clutha hydro-lakes, there may be deep water, or "underwater cliffs", directly off the shoreline. Where there is access to such locations, and where it emerges that informal swimming takes place there, a sign should be used to warn the unwary of the potential of danger.

Warning signs and a safety boom should be used on water near a dam, to keep boaters away from the spillway and the dam area.

(2) General Boating Zone

Most of the water surface of Lake Dunstan (76%) (Table 5) has been delineated as a General Boating Zone - the area where the majority of boating activities of various types will take place. Within this zone, there would be no general controls or restrictions, other than those of The Water Recreation Regulations 1979. However, special restrictions would still have to be applied to specific types of boats, such as houseboats.

(3) Non-motorized Boating Zone

Under Section 18 of The Water Recreation Regulations, 1979,a "reserved area" can be set aside for a specific type of boating. Using this provision in the Regulations, part of Lake Dunstan should be set aside as a Non-motorized Boating Zone.

From a marketing viewpoint, the motorboating demand for Lake Dunstan will be more than adequately supplied: over 2,000 hectares of water, or 76% of the total Lake area, is designated as a General Boating Zone, with opportunities for many kinds of motorboating (waterskiing, touring, etc.) and alternative locations to visit.

But, a marketing strategy, directed to achieve the optimum use of Lake Dunstan, must also consider diversification of demand. If only one type of lake-user is being catered to, overdependence on that market sector may have negative economic consequences locally, should there be a down-turn in that demand. A comprehensive marketing strategy for Lake Dunstan must therefore attempt to diversify demand for use of the Lake. Access to a diverse market will help to assure that the local economy will be more resilient and less vulnerable to the uncertainties which often plague the tourism industry.

One way to diversify the demand for Lake Dunstan, is to consider the non-motorboating lake users. For example, windsurfing is growing rapidly in popularity in New Zealand, following strong growth trends in North America, Europe, and Australia. Windsurfing is cheap and appeals to a wide spectrum of people. Personal capital outlay for equipment is low, compared to other forms of boating, and there is minimal dependence on support infrastructure, such as the docks, launching ramps, mechanical and other services, etc., required by motorboats.

Dinghy sailing is more expensive than windsurfing, and requires more back-up services. However, sailing has a long-established following by enthusiasts who have a strong peer-group identity, and who differentiate themselves, sometimes vehemently, from motorboaters. Competition for space and conflict on water between motorboaters and sailors is common, and may explain the periodic animosity between them.

The southern part of the Clutha Arm of Lake Dunstan is a highly suitable area for windsurfing and dinghy-sailing.There is sufficient open water and a good fetch of wind;a sheltered harbour for dinghies is available in McNulty Inlet; and a shoreline suitable for windsurfers to gain access to the water is available on the north shore of the peninsula at McNulty Inlet (See Figure 5). But, to create an attractive and safe water area for dinghy sailors and windsurfers, spatial separation of this area from motorboats is essential.

The southern part of the Clutha Arm should therefore be zoned, and physically delineated on water, as a Non-motorized Boating Zone. This zone is 293 hectares in area, or 11.0% of the total surface of Lake Dunstan. Key advantages of this zone are:

(a) separation of motorboating from non-motorized activity

(b) distancing motorboats further away from the swimming beach along the north waterfront of Cromwell (see Figure 5 and Figure 6)

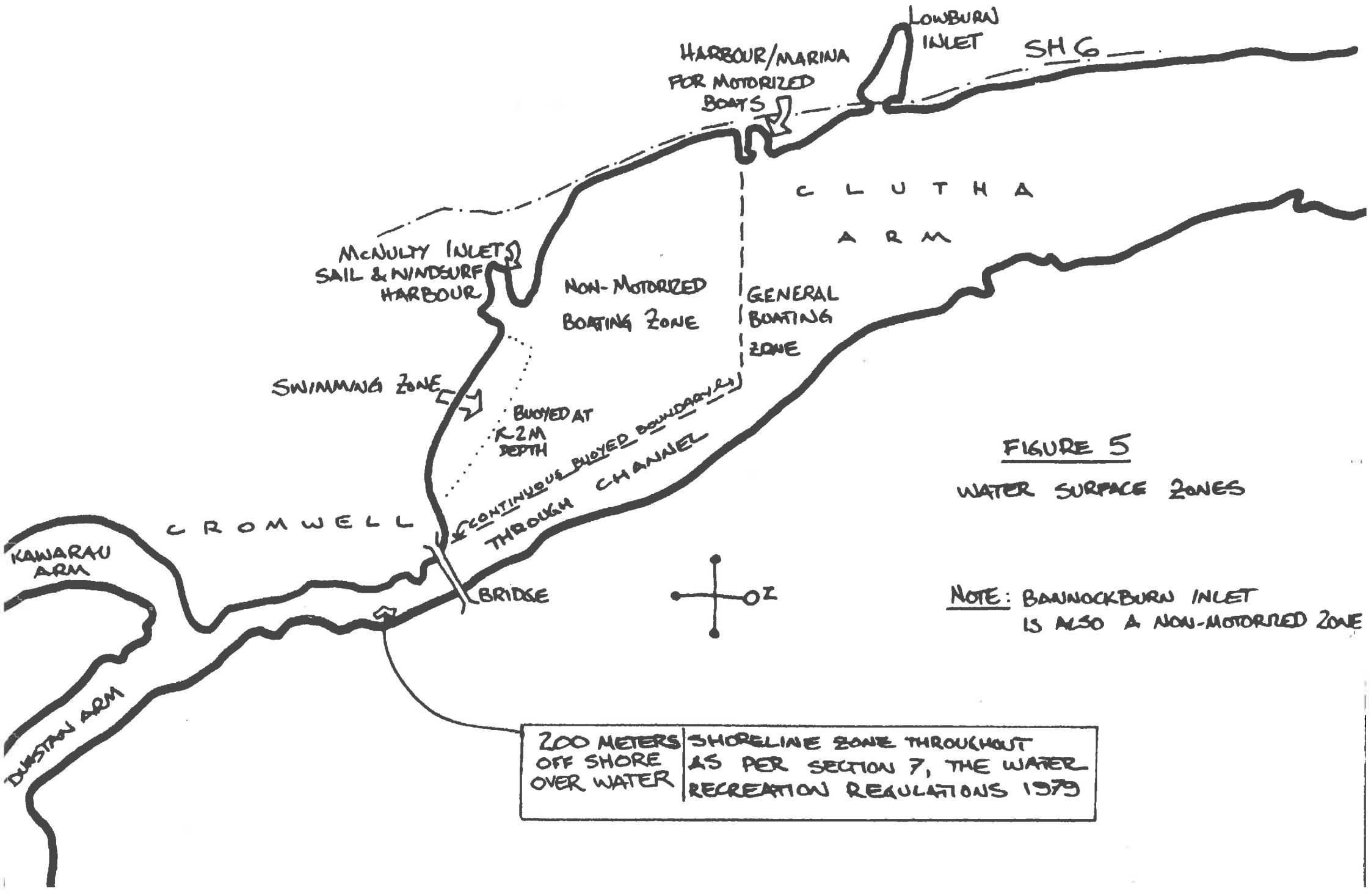


FIGURE 5

WATER SURFACE ZONES

NOTE: BANNOCKBURN INLET IS ALSO A NON-MOTORISED ZONE

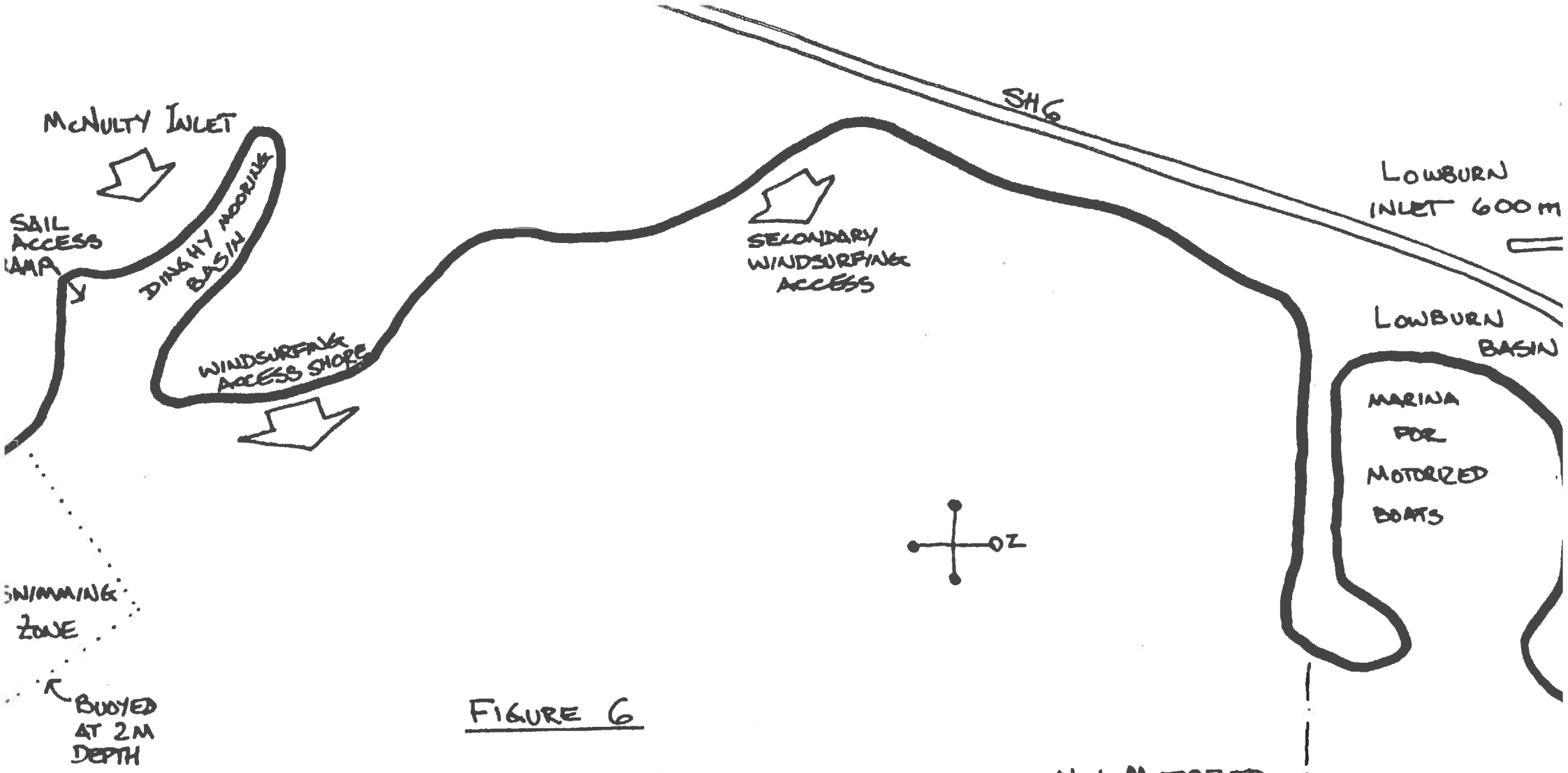


FIGURE 6

CONCEPT SCHEME FOR GENERAL & NON-MOTORIZED BOATING ZONES ON THE CLUTHA ARM, LAKE DUNSTAN

(SEE ALSO FIG. 5)

(c) providing a designated area where sailing and wind-surfing may take place unhindered by other activity

(d) presenting a high-quality opportunity which would attract a distinct, additional user-group to Lake Dunstan and thereby broaden the market potential

(4) Swimming Zone (buoyed at a depth contour of 2 metres); the buoyed demarcation may have to be moved, to adjust to water-level changes

By authority of Section 18 of The Water Recreation Regulations, 1979, a reserved area for swimming should be established in Lake Dunstan (see Figure 5 and Figure 6).

The swimming beach located within the Non-Motorized Boating Zone should be buoyed off, both to prevent swimmers from venturing too far into the lake, and to prevent sailing dinghies or windsurfers from entering the area. Accidents may occur if dinghies or windsurfers were to enter the swimming area. A continuous floating line or boom, joined by brightly coloured floaters, should be used to delineate the Swimming Zone. The swimming season tends to be shorter than the dinghy sailing and windsurfing seasons. Therefore, before and after the swimming season, when the beach is not used, the floating line or boom delineating the area could be removed, to liberate extra water surface for sailing.

It is imperative that the buoyed boundary markers be established right at the outset when the lake first becomes established, so that users are conditioned to accept the demarcations from the very beginning.

3.3 Planning and design for sailing and windsurfing

McNulty Inlet should be designated as a reserve area, under Section 18 of The Water Recreation Regulations 1979, and under Section 15, be assigned for the purpose of mooring of sailing dinghies.

The Alpha Street Inlet should also be designated as a Swimming Area within a Non-Motorized Boating Zone.

The shoreline facilities in McNulty Inlet should be designed to provide the land back-up required by sailing dinghies and windsurfers. For dinghies, some of the requirements are:

(a) a launch ramp

(b) a jetty for temporary docking of boats

(c) moorings in the Inlet for up to 15 sailing dinghies

(d) car park, with provision for parking of cars with boat trailers

(e) a clubhouse and training facility would greatly assist to popularise sailing and create interest and generate demand;

Cromwell College may be encouraged to become involved, and possibly to take on a leading role.

For windsurfing, there are relatively fewer land back-up facilities that would be required:

(a) car park, shared with dinghy sailors

(b) access track from the car-park to the shoreline on the north side of McNulty Inlet facing the open water; the track should be as short as possible, to minimize the distance that boards have to be carried

(c) a gradually sloping beach with an underwater slope of not steeper than 1:6, to facilitate mounting and dismounting the boards as the windsurfers leave and return to shore.

Provision should be made for the rental of equipment. This would have the advantage of allowing, at minimum expense, novices to experiment with sailing and windsurfing, to test the appeal of the sport to them. New recruits may be won this way, and - as is common in much of recreation - the available opportunitites will create its own, new demand.

Storage of trailers for longer periods may become a problem. A car park cluttered with trailers is both unsightly and wasteful of space. There is some legitimate need by dinghy sailors for temporary storage on site of material and equipment with their boats and trailers. However, for long-term storage of trailers, boats, and attendant equipment, a small storage depot, perhaps run commercially, may have to be provided, but this should definitely not be on the site. Marinas and even small boating facilities can quickly acquire an industrial appearance that is incongruous in a parkland setting.

Youth-oriented events, such as training classes, clubs, and coordinated activities by the local schools, should be encouraged. An organized club could well be successful, and would assist in monitoring activities, initiating events, and generating general interest in sailing and windsurfing. However, care should be taken that such a private club does not usurp the opportunities by the general public to use the area. Lake Dunstan as a public water-body should not become a private domain for a select group of users, even if in time these users become quite numerous and are protective of their interests.

Scheduling may have to be used to reserve the Non-motorized Boating Zone for special events, such as regattas, competitions, or training sessions, if it is found that such activities make it difficult for the general public to use the area concurrently. Special events could be scheduled to coincide with periods of low use by the general public.

To be effective, the Non-motorized Boating Zone would have to be physically delineated on water, to make it visually distinct and to prevent motorboats from, intentionally or unintentionally, entering the area. Buoys should be evenly spaced along the perimeter of the Non-motorized Boating Zone. In several places signs should also be

used to alert motorboaters to the existence of the Zone. Public awareness is essential. At visitor centres, scenic look-outs, and all boat-launching ramps, harbours, and jetties, there should be a graphically clear map showing: the various visitor attractions; water access points; main shoreline facilities; and the location of the Non-motorized Boating Zone, and its purpose.

3.4 Boating capacity of the General Boating Zone

The two right-hand columns in Table 5 show the water-surface areas on Lake Dunstan, and indicate their separation into the General Boating Zone and the Non-motorized Boating Zone (the area of the Swimming Zone is included in the Non-motorized Boating Zone, because its size depends on the final configuration of the beach).

The capacity for each type of boating can be estimated by applying the figures in Table 3, to the water surface areas for each part of Lake Dunstan, shown in Table 5. The boating capacity standards show clearly that the spatial requirements for different types of boats vary greatly. The capacity estimates suggest that on the relatively large water-surface of the Dunstan Arm and the Clutha Arm, there is ample area available for boating. However, the situation of the Kawarau Arm is quite different (see the discussion below).

3.5 Boat launching ramps

Table 6 estimates the total number of boats that may be expected to be launched per day from each boat launch, and the number of boats launched during a peak hour. By applying the space standards in Table 3 to Table 6, a total of 158 hectares of water-surface is estimated to be consumed during one peak hour, by vessels from boat-launching ramps.

In the Clutha Arm and the Dunstan Arm, somewhat over half of the available capacity for boating is estimated to potentially be consumed by boats from launching ramps. This leaves about half of the capacity available for all other boats. However, this does not mean that pressure for over-use at certain locations may not occur. The estimates in Table 7 assume that all boats during a peak hour are evenly distributed on the water. But because different parts of the Lake are joined, boaters will move from one part of the Lake to another. Furthermore, because at the upstream end the Kawarau Arm and the Clutha Arm are both open to the river, boat travel to and from Lake Dunstan can be expected.

Crowding may occur because certain areas are more attractive than others and boats will congregate there; because boat movement will follow definite routes of travel; and because boats leave and return to specific locations, such as ramps, which can become nodes of denser activity.

In contrast to the Dunstan Arm, the situation on the Kawarau Arm is of concern. With Ministry of Works and Development plans show that there may be a possible total of three boat launching ramps for the Kawarau Arm, and with a comparatively restricted water area (see Table 5), peak-period over-use here is likely. This prediction remains valid even when it is assumed (see Note 3 in Table 7) that a

TABLE 6

ESTIMATED BOAT RAMP DAILY USE PATTERN AND WATER AREA CONSUMPTION

1. Daily use period 0800 - 2100 (13 hours).

2. Estimated total boats launched per ramp, per peak day = 37 boats (references: 1, 2, 3, 4, 7, 8, 9, 11, 13, 15).

3. 75% of boats launched per day are estimated to be launched during the period 12 noon to 1700 hours.

4. During this period (3, above) an average of 6 boats per peak period hour (1200 to 1700 hours) [(.75)(37)/5] can be expected to be launched. Each boat can be expected to be on the water for 3 hours (reference 2). During a peak hour, therefore a maximum of 12 boats can be expected at a ramp: 6 being launched, and 6 being hauled out.

5. Assume that 100% of launched vessels are motorboats and that a maximum of 20% will waterski. (This will vary from one part of Lake Dunstan to another: more waterskiing may be expected on the Clutha Arm, than on either the Dunstan Arm or the Kawarau Arm).

6. During a peak hour, an estimated 18 boats from each ramp can be expected to be on the water. Of these, 4 can be expected to be waterskiers and 14, other motor boats.

7. The water surface used by boats, per ramp, per peak period hour can be estimated to be 158 hectares [(14 motorboats)(7 ha) + (4 waterskiers)(15 ha)]. See Table 3.

TABLE 7

LAKE DUNSTAN : ESTIMATED WATER AREA CONSUMED BY BOATS FROM LAUNCHING RAMPS

Lake Dunstan Area	General Boating Zone Area (ha)	Consumed by (1) Boats from Ramps		Boating Facilities			Total
		Water Area (ha)(2)	% Total	Boat Launches	Harbours	Jetties	
1. Dunstan Arm	726	419	58%	2	0	0	2
2. Kawarau(3) Arm	162	269	166%	3	2	1	6
3. Bannockburn Inlet	0	0	0	0	1	0	1
4. Clutha Arm	1,127	577	51%	4(4)	3	2	9
Total or Average	2,015	1,265	63%	9	6	3	18

NOTES:

1. The above estimates do not consider boats on the water from jetties, harbours, or those which gain access to the water from undesignated locations.

2. See Table 6.

3. Boats launched in the Kawarau Arm can be expected to travel to other parts of Lake Dunstan. Assume that from each of the three boat ramps in the Kawarau Arm boats remaining in the Kawarau Arm are (as a % total per ramp): west ramp 100%; middle ramp 50%; east ramp 20%. These % allow for water area consumed in the Kawarau by departing boats on their way elsewhere. Boats leaving the Kawarau are assumed to distribute equally to the Clutha Arm and to the Dunstan Arm.

4. The fourth boat launching ramp in the Clutha Arm is in what this report recommends should be a non-motorised boating zone, and thus would not have any motorboats launched from it.

large proportion of the boats launched in the Kawarau Arm may not stay there, but may instead move into other parts of Lake Dunstan. Even by allowing for an exit of between 50% and 80% of the boats launched in the Kawarau Arm, its capacity still appears to be exceeded by over 50% .

While an assumption has been made in the estimates in Table 7 that a large proportion of boats launched in the Kawarau Arm will leave the area, the converse is also true, that some boats will enter the Kawarau Arm from other parts of Lake Dunstan, or from the Kawarau River, compounding the potential for over-use. The operators of river-rafting and other commercial enterprises upstream on the Kawarau River, although generally these activities are located closer to Queenstown than to Cromwell, may find it profitable to extend their activities into Lake Dunstan, and possibly even as far as the Clyde Dam.

The number of boat-launching ramps in the Kawarau Arm should be limited. The ramp planned by the Ministry of Works and Development at the Bannockburn bridge and the one to be located at the oxidation ponds are both of limited capacity; the one at the Memorial Hall would have a larger capacity. Certainly no more ramps seem to be required in the Kawarau Arm. An additional ramp at Wisharts is not recommended, since it may eventually create over-use of this part of Lake Dunstan. A marina in the Kawarau Arm is also definitely not desirable. Furthermore, the Kawarau Arm may prove to be unpopular with boaters, because sediment in the Lake will form bars and shallow underwater areas. An appearance similar to the Roxburgh reservoir is expected to result. This, and the restricted water area and long narrow configuration, suggests that the Kawarau Arm has a limited capacity for water-oriented recreation.

3.6 Boat speed limits

Section 7 (1) of The Water Recreation Regulations 1979, state that no person shall propel or navigate a small craft at a proper speed exceeding 5 knots - (b) within 200 metres of the shore or of any structure". Sub-section (2) of Section 7 states that "Every person who propels or navigates a small craft shall, as far as is practicable, do so at such speed so that waves caused by the movement of the craft through the water do not break against the shore or against any structure". This legislative (regulatory) basis should be used to enforce a "no wake" speed limit for the entire shoreline of Lake Dunstan. However, the success of such regulations is entirely in their enforcement.

3.7 Commercial boat operations

The ratio of commercial boat rental establishments and general, non-commercial public use, is a policy decision that will affect the general quality of the Lake. There should be provision for some commercial boat operations (rentals and boat tours, for example), but within the overall capacity limits of the Lake. Of the total capacity for boating of all types, on all parts of the lake, a ratio of 80% general public use, by private individuals, and 20% by commercial operations (rental boats, tour-boats, etc) may be considered as a guiding policy for Lake Dunstan.

However, the boating capacity standards in Table 3 may not in all cases apply equally well to the commercial sector. For example, houseboats and tour-boats, although both are motorized craft, would require relatively less water surface than a recreational motorboat such as a waterskier, but may have more intensive requirements for the back-up facilities on land: access and parking, buildings for office, washrooms and toilets, storage of equipment and servicing, etc.

A related policy decision is the extent to which the size of the commercial fleet on Lake Dunstan is allowed to stabilize at a size as determined by free market forces, as contrasted to a size limitation set by government. For example, on the Kawarau river, the number of rafting operations increased to a level which the market could not sustain; after several operators had left, the number of rafting establishments stabilized to a level more appropriate to the demand. The problem of a similar, market-force based plan for the size of the commercial fleet at Lake Dunstan, is that very likely the commercial fleet will become established more quickly than private use by individual visitors to the lake. The danger is that, by the time private individual use of the lake begins to be established, commercial use of the lake may in the interim have established a use-pattern whereby a large amount of water-area is consumed by commercial operators.

Commercial boating should not be allowed to usurp the potential of use of the lake by the general public as individual users, who gain access to the lake from reserves and public boat launches (unless government policy is specifically to favour commercial boating operations on the lake). A Joint Authority established under The Harbours Act 1950 (see Section 5) should control the number of commercial boat operators, and the size of their fleet, on Lake Dunstan.

Clayton (1979) found that there was a tendency for commercial water oriented recreation enterprises to increase beyond what the market could bear and then to contract and stabilize at a level closer to the demand. However, in the process of expansion to over-supply, and subsequent contraction, the public as individual users may be left at a competitive disadvantage.

Of the total capacity for boating of all types on the Lake, a ratio of 80% general public use by private individuals, and 20% by commercial boat operators (boat rentals and boat tours) may form the basis on which to deal with private sector proposals. The 20% capacity allocated to commercial operations cannot be estimated on the basis of boating standards, such as those in Table 3: commercial operations would involve different types of boats with different types of impacts. For example, tour-boats should have set routes and landing locations and set schedules, which can be contractually agreed on, with provision to change the agreement, if necessary. The impact of commercial boat operations therefore is more predictable and can be controlled.

A maximum of three commercial tour-boat routes should be made available on Lake Dunstan. Each of the three routes could be tendered to a separate operator, or one operator may be in a

position to run more than one of the three routes. One of the routes could link to commercial boat operators on the Kawarau River. The three proposed boat-routes are (with the approximate travel times for a return trip shown):

(1) Kawarau Arm-Cromwell (1 hr 45 mins)
(2) Clutha Arm-Cromwell (2 hrs 25 mins)
(3) Cromwell-Clyde Dam (2 hrs)

Although the Kawarau Arm-Cromwell route may link with other boat operations upstream on the Kawarau River, Lake Dunstan should not be opened up for access by any and all commercial boat operators from the Kawarau River. From a strict commercial viewpoint, extension of boat operations all the way to the Clyde Dam could be seen to be lucrative. However, the boating capacity estimates suggest that the Kawarau Arm may be prone to over-use and siltation. Commercial boat operations on the Kawarau Arm should therefore be considered with prudent reference to the potential for crowding.

A location on the waterfront of Cromwell would be suitable as a tour-boat terminus. The town could provide the back-up services required, and there would be a close connection between the activities available in the town, along the waterfront, and those offered by commercial boat operators. Docking for tour-boats would also have to be available at the Clyde Dam, to facilitate visits by tour-boat patrons to the dam and the interpretation centre.

4. WATER ORIENTED RECREATION BETWEEN LAKE WANAKA AND LAKE DUNSTAN

4.1 Overview

This section of the report looks at the recreation potential of the Upper Clutha hydro-lakes above Lake Dunstan. The emphasis in Part 3 was on estimating the recreation capacity of Lake Dunstan, and on ways to diversify boating opportunities and minimizing boating conflicts. The aim of the present section is to examine the constraints and opportunities for recreation on Lake Luggate and Lake Queensberry, and the remaining Clutha River sections, above Lake Luggate and below Queensberry dam. The emphasis is more on identifying the general potential for water-oriented recreation, and less on the estimation of capacity as such, except the extent to which capacity considerations influence general recreation potential.

The Upper Clutha hydro-lakes are an interconnected stretch of water. The term "reach" is used here to designate a linear unit of water, which includes both flowing and still water. The reach between Lake Wanaka and Lake Dunstan may be represented as a matrix, with the rows showing sub-areas within the reach, and the columns showing the various possible water-oriented recreation activities. The area-activity matrix is shown in Table 8. The interconnections exist because:

(1) use of one area may have spillover effects on another area, especially where the areas are connected in the sense that users can travel by boat between them

(2) accommodating use in one area may mean that in another area other uses may be introduced: the mix of activities and their spatial distribution are interactive

(3) within each area there are different physical capacity constraints, and some areas can physically accommodate certain uses better than can other areas

(4) from a marketing viewpoint, there are distinct advantages to diversify the range of activities that are made possible; market diversification translates to a spatial diversification.

4.2 Spatial description

The Lake Wanaka to Lake Dunstan reach of the Upper Clutha consists of five sections or sub-areas. Table 8 and Table 9 describe the dimensions of these sub-areas of the reach. Comments on each sub-area are listed below:

4.2.1 Lake Wanaka to Lake Luggate:

- total river distance: 6.5 kilometres
- 21.7% of the total river distance of the reach
- 8.0% of the total distance of lake shorelines and river length

TABLE 8

LAKE LUGGATE AND LAKE QUEENSBERRY
WATER AREAS AND SHORELINE LENGTHS

Sub Area	AREA			SHORELINE								
				EAST			WEST			TOTAL		
	ha	%	%	km	%	%	km	%	%	km	%	%
1. Upper Lake Luggate	46	11.8	7.45	4.9	32.2	21.6	4.9	24.6	17.3	9.8	27.9	19.2
2. Lower Lake Luggate	344	88.2	55.5	10.3	67.8	45.4	15.0	75.4	53.0	25.3	72.1	49.6
3. Total Lake Luggate	390	100%	(62.9)	15.2	100%	(67.0)	19.9	100%	(70.3)	35.1	100%	(68.8)
4. Lake Queens-berry	230	-	37.1	7.5	-	33.0	8.4	-	29.7	15.9	-	31.2
Total Luggate & Queensberry	620	-	100%	22.7	-	100%	28.3	-	100%	51.0	-	100%

TABLE 9

LAKE WANAKA TO LAKE LUGGATE
AND QUEENSBERRY DAM TO LAKE DUNSTAN:
RIVER LENGTHS

River Sub Area	Shoreline Length		
	km	% (2)	% (3)
1 Lake Wanaka to Lake Luggate (Note 1)	6.5	21.7	8.0
2 Queensberry dam to Lake Dunstan (Note 1)	23.4	78.3	28.9
Total River Length (Note 1)	29.9	100%	(36.9)
1 Upper Lake Luggate	9.8	27.9	12.1
2 Lower Lake Luggate	25.3	72.1	31.3
Lake Luggate Total	35.1	100%	(43.4)
3 Lake Queensberry	15.9	-	19.7
Total Lake Shorelines	51.0	-	(63.0)
Total Lake Shorelines & River Length	80.9	-	100%

Note 1: River distances are given for the linear length of the river. The shoreline length, of left and right banks, would be approximately double the linear length.

Note 2: Top 3 rows: river
Next 3 rows: Lake Luggate

Note 3: Figures in brackets show subtotal %'s.

(Table 9).

4.2.2 Upper Lake Luggate (above MWD river kilometre 272)

- total linear distance: 9.8 kilometres
- 27.9% of Lake Luggate, and 19.2% of the total reach
- the 46 hectare water area is essentially a widening and heightening of the river: a river-like water area, without flowing water
- steep valley walls, with a predominance of Type E and Type C beaches (see Figure 7)
- the width of the water is generally between 100-150 metres, shore to shore
- there is 4.6 hectares of water, per kilometre of shoreline on Upper Lake Luggate - far less, by comparison, than on the narrow Kawarau Arm and Dunstan Arm parts of Lake Dunstan.

4.2.3 Lower Lake Luggate (between MWD river kilometre 272 and Luggate dam)

- total water area: 344 hectares, 88.2% of the total area of Lake Luggate, 55.5% of the area of Lake Luggate and Lake Queensberry combined. This is the only "lake like" open water within the reach, together with the mid-section of Lake Queensberry which abuts State Highway 6, at river kilometre 241.
- there is 13.6 hectares of water per kilometre of shoreline of lower Lake Luggate. Although this is the widest part of the Lake, the ratio is comparable to that on the Kawarau Arm of Lake Dunstan (9.5 hectares per kilometre of shoreline, see Table 5). In other words, the widest part of Lake Luggate compares to the narrowest part of Lake Dunstan.
- there is a total of 15.0 kilometres of shoreline on the west (left) bank, and 10.3 kilometres on the east (right) bank, for a combined 72.1% of the total shoreline of Lake Luggate.
- the 62 hectares of open water upstream of the Luggate Bridge and the 70 hectares below the bridge location, have a high recreation potential: there is a relatively large water area, and there is a Type A shoreline on the east (left) side of the reservoir.
- the 34 hectares of water in Luggate Inlet presents an area of relatively high potential for swimming and boat access to the water

4.2.4 Lake Queensberry:

- 230 hectares of total water surface, or 37.1% of the combined Lake Luggate and Lake Queensberry area

- Lake Queensberry in total has 14.5 hectares of water per kilometre of shoreline, compared to Lake Luggate's 11.1 hectares of water per kilometre of shoreline

- however, using the index of hectares of water per kilometre of shoreline to compare the two lakes, is misleading. The disproportionately long, river-like upper section of Lake Luggate skews the index for Lake Luggate; more important here is the fact that Lake Luggate has more open water in its lower section (344 hectares), than the entire area of Lake Queensberry (230 hectares).

4.2.5 Queensberry Dam to Lake Dunstan

- total linear distance along the river: 23.4 kilometres, or 28.9% of the total river distance from Lake Wanaka outlet to Lake Dunstan

- as the remaining, natural or residual river, this section of the reach is of key importance. It will offer recreation opportunities not available on the reservoirs, and will constitute almost the last remaining natural river landscape on the Upper Clutha.

4.2.6 Shoreline types:

The shorelines of Lake Luggate and Lake Queensberry have been divided into different shoreline types (see Section 2.4.2). Table 11 shows the length of each shoreline type on Lake Luggate and Lake Queensberry. Figure 7 and Figure 8 show the distribution of these shoreline types on the two lakes.

The shoreline types on the two reservoirs were interpreted from air photographs with superimposed contour lines. Accuracy was not available for exact measurements. The data in Table 11 should therefore be viewed with caution. More accurate contour analysis would have to be carried out, including the extrapolation of cross sections and further field checks. Beach material should also be considered. The shoreline types may be weighted according to area, material, aspect, and access, to provide a more comprehensive shoreline recreation capability scale.

A total of 58.9% of the shorelines of the two reservoirs is of Type E, i.e. steep cliffs, of no or very low recreation usability, other than for scenic viewing of the water from high vantage points. There is relatively more Type E shoreline on Lake Luggate (60%) than on Lake Queensberry (57%).

There is approximately the same combined length of Type A and Type B shorelines on Lake Luggate (6.0 kilometres) and on Lake Queensberry (5.5 kilometres). However, relatively more of Lake Queensberry consists of Type A and Type B shorelines (34.4%), than on Lake Luggate (17.2%).

On Lake Queensberry, the Type A shoreline fortunately is located on the west (right) bank at river km 241, where the reservoir would abut State Highway 6. The Type A shoreline continues upstream from

FIGURE 7

SHORELINE TYPES: LAKE LUGGATE
(SEE ALSO FIG. 2)

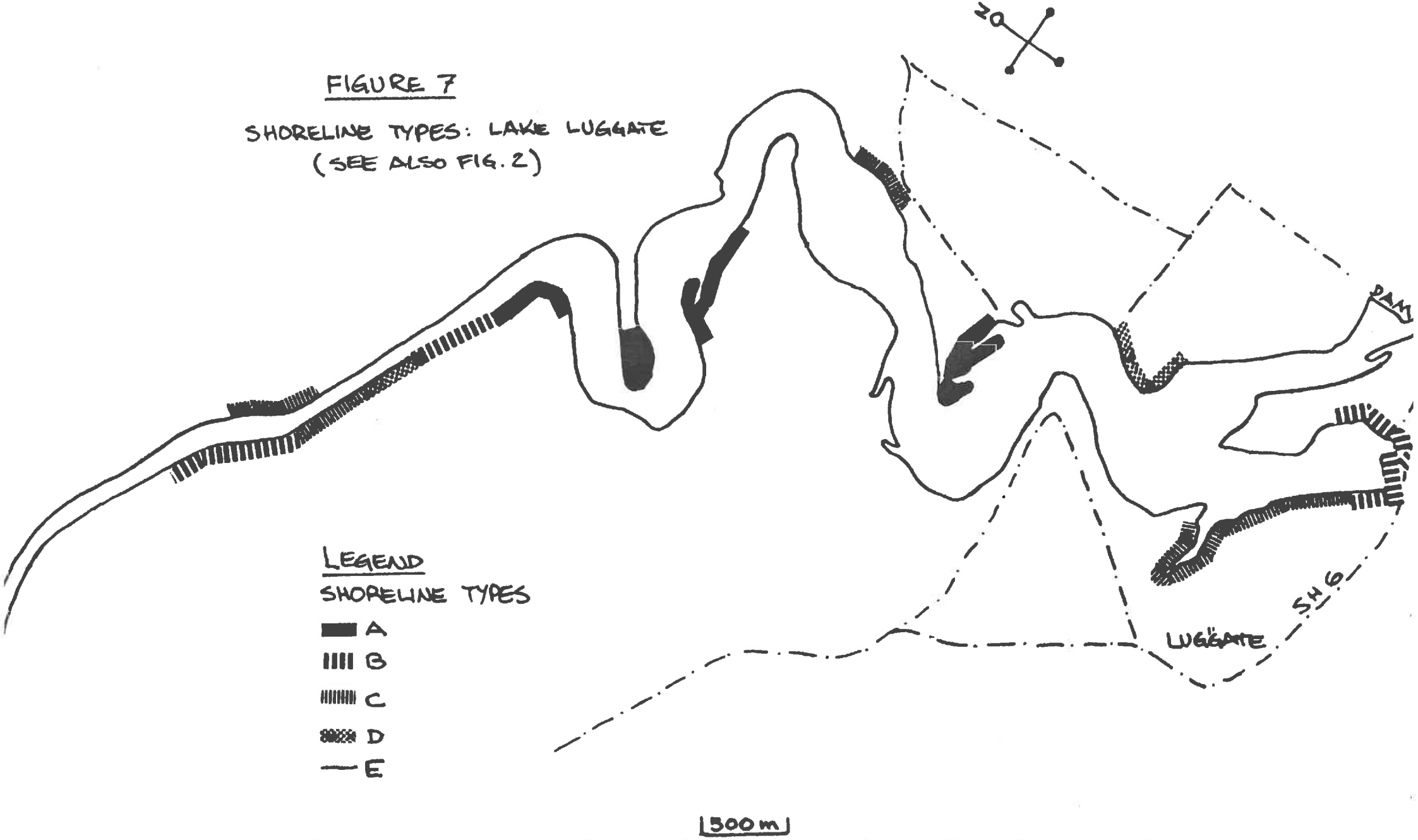


FIGURE 8

SHORELINE TYPES: LAKE QUEENSBERRY
(SEE ALSO FIG. 2)

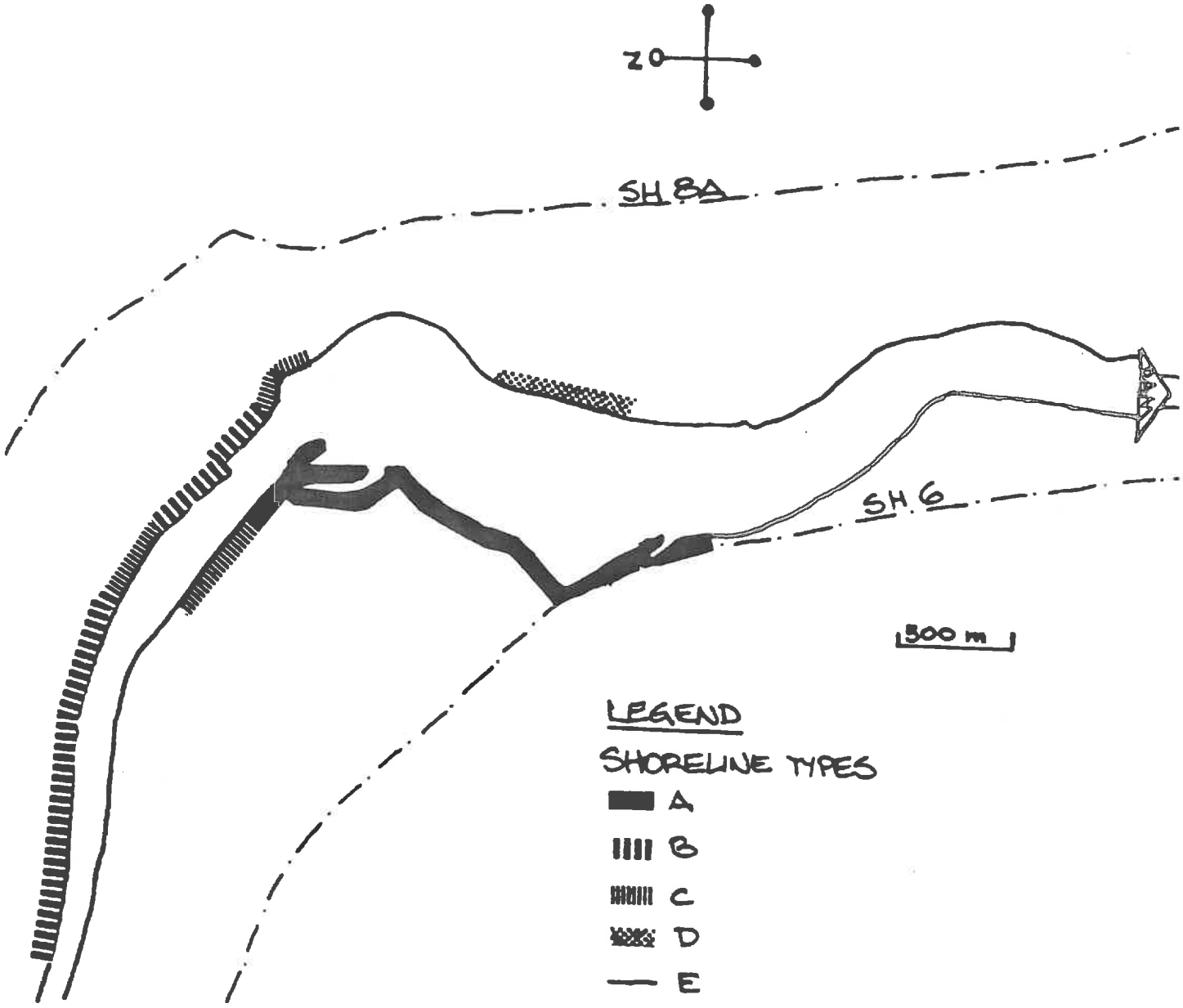


TABLE 11

LAKE LUGGATE AND LAKE QUEENSBERRY : PRELIMINARY SHORELINE TYPES

Shoreline Type	Luggate		Queensberry		Total	% Total
	km	%	km	%		
Type A	3.0	8.6	2.5	15.6	5.5	10.8
Type B	3.0	8.6	3.0	18.8	6.0	11.8
Type C	6.0	17.0	1.0	6.2	7.0	13.8
Type D	2.0	6.0	.4	2.4	2.4	4.7
Type E	21.0	60.0	9.0	57.0	30.0	58.9
Total	35.0	100.0%	15.9	100.0%	50.9	100.0%

NOTES:

1. Shoreline types are shown in figure 2.

2. Measurement of the length of each type of shoreline is rough, since it was extrapolated from contours superimposed on air photographs. This table should be used as preliminary data only. More accurate contour interpretations would have to be made, including drawing of cross sections and field checks.

3. The shoreline contours used were: Lake Luggate, 271 metres; Lake Queensberry, 245 metres.

4. The unformed shoreline was measured on Lake Luggate. Landscaping plans entail forming the shoreline in a number of places where recreation uses are designed. Thus, the total of type E shorelines on Lake Luggate will be less than shown in the table.

this location for more than a kilometre. However, the terrain here is quite undulating in places, and would have to be formed to render it more suitable for recreation. On Lake Luggate, Type B and Type C shorelines exist in Luggate inlet, close to State Highway 6, offering a high physical potential for water oriented recreation.

4.3 Activity spectrum

This section discusses the potential for water-oriented recreation in the reach between Lake Wanaka and Lake Dunstan. In table 10, each column represents a different water-oriented recreation activity, and each row, a sub-area in the reach. The discussion which follows focuses on the cells in Table 10, i.e., the potential for different recreation activities in the sub-areas of the reach.

Estimates of the capacity for different activities can be extrapolated by applying the capacity indices in Table 3 to the water-areas for each sub-area of the reach shown in Table 8 and Table 9.

4.3.1 River angling and lake fishing:

The environmental assessment of Lakes Luggate and Queensberry identified river-angling as a recreation opportunity loss resultant from the construction of Lake Luggate and Lake Queensberry ("Environmental Impact Report: Luggate and Queensberry Hydro Power Stations, Ministry of Works and Development, April, 1982.)

Lake fishing would not substitute for this loss, because of the relatively different user-populations. For example, of all people who fish:

10.9% prefer lakes
15.5% fish in rivers only
30.0% have no preference between lakes or rivers
43.6% prefer rivers but do fish in lakes as well

Thus, between one-third and one-half of the fishing population can be expected to use the hydro-lakes for fishing - an encouraging estimate, given the substantial loss of a favoured river angling resource. This estimate is based on the total of the 10.9% who prefer lakes, plus 50% of the 30.0% who have no preference, plus 33% of the 43.6% who prefer rivers but do fish in lakes as well.

Forrest (1977) found that on the Waitaki hydro-lakes, for over 50% of the holidaying households from Otematata, fishing from shore was one of the three most important recreation activities reported in a survey.

There is potential for conflict between anglers and jet boat operators and waterskiers (see Tables 4A and 4B). The narrow configuration of much of the reach between Lake Wanaka and Lake Dunstan makes such conflict highly likely, if jetboats and waterskiers were to use this area.

TABLE 10

RANKING OF WATER-ORIENTED RECREATION POTENTIAL BETWEEN LAKE WANAKA AND LAKE DUNSTAN

Sub-Area	1. River Angling	2. Lake Fishing	3. Lake Canoeing	4. River Canoeing	5. Sailing and Windsurfing	6. Boater Camping	7. Jet Boating	8. Water-Skiing
(Compatibility Rank)	2	3	3	1	3	3	1	1
1. Outlet to Lake Luggate	3	0	0	2	0	2	3	0
2. Upper Lake Luggate	0	2	2	0	1	2	3	1
3. Lower Lake Luggate	0	3	3	0	3	2	3	3
4. Lake Queensberry	0	3	1	0	2	2	3	1
5. Residual River	3	0	0	3	0	3	3	0

NOTES:

1. Use Potential Ranks:

   0 None
   1 Low Potential
   2 Moderate Potential
   3 High Potential

2. Compatibility Ranks:

   (Mean compatibility by rank order, from Tables 4A, 4B)

		Lake	River
1	Low Compatibility	$1.8 \leq 2.2$	$2.2 \leq 2.5$
2	Moderate Compatibility	$2.2 \leq 2.6$	$2.5 \leq 2.9$
3	High Compatibility	$2.6 \leq 3.0$	$2.9 \leq 3.2$

4.3.2 Canoeing:

Because canoeing opportunities on the Waitaki River have been lost to hydro-schemes, the upper Clutha River and - more importantly - the Shotover River and the Kawarau River, present important remaining regional white-water canoeing resources. In a survey of 64 New Zealand rivers, (Egarr, Egarr, and Mackay, 1979) the overall quality of these rivers was ranked as follows:

Clutha River:

Lake Wanaka - Lindis River:	11
Lindis River - Deadman's Point:	13
Cromwell Gap and Dunstan Gorge:	14
Kawarau River:	16
Shotover River:	17

In the above ranking, weighted factors were used, such as scenic quality, vegetation, banks and riverbed, landscape, wilderness potential, water quality, and water movement; the final ranking scale was: dull (0-3); ordinary (4-6); interesting (7-9); impressive (10-15); and exceptional (16 and over).

The river from Lake Wanaka outlet to Albert Town provides water for skilled canoeists, while the section below Queensberry dam is challenging more to novice paddlers.

Because overall there is going to be a loss of canoeing opportunities, to compensate for this loss, serious consideration should be given to building a major white-water canoeing facility below Queensberry dam.

Such a facility could form a key attraction for canoeing training and competitions. The ability to control the flow of water through the dam would mean that specific water conditions can be created in the course, for various types of paddling (assuming,of course, that adequate flows are available). A 'canoeing camp' here, with facilities for hostel-type accommodation, storage of equipment, meeting rooms, etc., could become a nucleus in Central Otago, from where canoeists may also use the other rivers in the region. Opportunities for boater-camping in the Upper Clutha system could form another attraction, to complement the more serious activities of training and competitions.

In Canada, such a white-water canoeing centre was built on the Gull River below the Horseshoe Lake dam, in Haliburton County, Ontario. The water flow through the Horseshoe Dam ranges from a flood level of 46 cumecs, to a low of 11 cumecs. Summer average flows are approximately 14 cumecs. For recreation white water canoeing, a minimum passage of a depth of 60 centimetres of water throughout the course is required. During competitions, the flow is increased to as much as 27 cumecs, to increase the depth throughout the course to 76-91 centimetres. The course is widely used for training, competition, and for special activities, such as Pan American Games, and county or other public events. A canoe museum, operated as a separate facility nearby, and many rivers and lakes in the region suitable for recreation canoeing and canoe camping, form

complementary resources, which together constitute a cohesive "package" of attractions.

The potential for canoeing on the Upper Clutha River above Lake Dunstan appears to be highest from Lake Wanaka to Lake Luggate, and below Queensberry dam. Because well over 75% of both Lake Luggate and Lake Queensberry consists of a Type E shoreline, there is at best limited physical suitability for canoeing. The key limiting factors for canoeing on the two reservoirs are:

(1) the long and narrow configuration of flat water confined within steep valley walls

(2) the predominance of Type E shorelines

(3) unsuitable wave conditions for recreational canoeing: with the raising of the river to form a reservoir, the vertical distance from the water to the top of the bank will be greatly reduced, with increased exposure to wind; together with (1) and (2), above, water conditions generally could be treacherous.

(4) the tendency for strong winds in Central Otago in summer and the lack of shoreline vegetation to shield the water from strong winds (generally, the summer has the lowest frequency of calm days of any of the four seasons).

Canoeing and motorized boating would be particularly incompatible on Lake Queensberry and on the narrow upper parts of Lake Luggate.

4.3.3 Sailing and windsurfing:

The emphasis here is on dinghy sailing and windsurfing. There does not appear to be much potential for sailing of larger craft on the two Lakes, given especially that large lakes, suitable for keel-boat sailing, are available nearby. The potential locations for dinghy sailing and windsurfing are on the open water of the lower portions of Lake Luggate and Lake Queensberry, where sufficient water area and accessible shoreline for facilities are available. In the narrow upper portions of Lake Luggate and Lake Queensberry, sailboats and windsurfers would have to tack across the water, and thus would have to intersect the linear traffic by other boats moving up or down these river-like parts of the reservoirs.

Lake Queensberry has a high suitability for dinghy sailing and windsurfing. The open water and Type A shoreline on the west side, provides a good recreation setting of land and water. Informal access to the water is easily available from State Highway 6. This shoreline in most places,appears to be suitable for beaching of small boats, and the wet-beach slope appears to be suitable for launching and beaching of windsurfing boards.

If all three of the Upper Clutha hydro-lakes were to be built, Lake Queensberry in its entirety should be designated as a Non-motorized Boating Zone. The total area of Lake Queensberry (230 hectares) is about the same as of the Kawarau Arm (273 hectares) of Lake Dunstan. Both water-areas have but a limited capacity to accommodate high

spatially-consuming boating, such as jetboating and waterskiing. Section 3.5 of this report has discussed how the limited water-oriented recreation capacity of the Kawarau Arm should be dealt with. In a similar way, the water oriented recreation potential of Lake Queensberrry would be better realized, if the lake in its entirety were to be designated as a Non-Motorized Boating Zone. By separating otherwise incompatible recreation activities to two different, but adjoining, waterbodies (Luggate and Queensberry), the capacity of each is used more efficiently, and the potential for conflict and competition between incompatible boating is reduced.

4.3.4 Boater camping:

Boater-camping refers to setting up camp on shore, where access to the shore has been gained by boat. In some cases, canoeists may carry their equipment over a track, to gain access to the shore. Boater camping sites are expensive to service, because they tend to be scattered and very likely may have to be serviced by boat.

Informal camping can be expected to take place anywhere on the shorelines of the Upper Clutha hydro-lakes. Camping will take place where access to the shore can be gained from land, by road or track, or where the shoreline is suitable for beaching of a boat and setting up camp. Even where the shoreline is inadequate, say without a dry-beach, boats may be tied to shore or anchored for a night's camping. Thus it is reasonable to expect camping not only in designated campsites, but potentially in many areas on all three reservoirs.

Although informal camping has the appeal of freedom and independence, and often provides a chance to get away from crowds, it also results in problems: garbage, lack of toilet facilities, trespass on private land, and potential for conflict with other users.

The provision of toilet facilities should be given the highest priority. One of the key complaints of foreign tourists who have visited New Zealand reserves and campsites is the lack of adequate toilet facilities. Vincent County Council has already recognized the importance of adequate toilets and other sanitary facilities such as water and garbage containers and garbage collection and removal.

The long, narrow and linear nature of Lake Luggate and Lake Queensberry (and of the Kawarau Arm and the Dunstan Arm of Lake Dunstan), presents opportunities for boater camping. One main constraint is the lack of suitable shoreline (dry-beach and backshore) where to land a boat. Consideration should therefore be given to locate small sites for boater-camping, at various locations of suitable shoreline on all three reservoirs. Type A shorelines would be the best, but Type B and C shorelines would also be suitable. In fact, the Type B shorelines on Lake Luggate and Lake Queensberry are well removed from the lower, more intensively used, portions of the two lakes, and may form good sites for boater-camping. A phased program should be considered, whereby one boater camping site on each Lake is established first, to test the

demand. For example, on Lake Dunstan, Lowburn Inlet may serve as a test site for boater-camping.

A dock, garbage containers, toilets, and picnic tables should be provided at each site. Shade-trees may have to be planted. Fees should be collected from the users.

If boater-camping becomes popular, preference in expansion should be to develop several small sites, rather than to enlarge existing ones. Boater-campers tend to favour a degree of seclusion, although socializing in small groups also takes place and is part of the appeal of this pursuit. Depending on the success of boater-camping, it may be desirable, or necessary, to provide for separate campsites for canoeists and motorboat-campers. Motorboat-campers can be expected to demand a higher level of facilities, than do canoeists. In fact, for canoeists, seclusion and being able to rough it may be the primary appeal of this type of camping. The capacity for boater camping as a whole is not so much water area, but more the availability of suitable shoreline locations.

4.3.5 Jet boating and waterskiing:

These forms of high-speed boating are "impacting", rather than "impacted upon", activities (see Section 2.2), are not compatible with other forms of water-oriented recreation (Table 4A and 4B), and consume a large water area (Table 3). Yet, they are popular, and provision must be made to accommodate them.

However, the upper portions of both Lake Luggate and Lake Queensberry are physically unsuitable for jetboating, and waterskiing because they are generally less than 400 metres in width. Thus, boating at speeds greater than 5 knots, i.e. jetboating and waterskiing, cannot be accommodated there. Section 7 of The Water Recreation Regulations 1979, states that:

"(1) No person shall propel or navigate a small craft at a proper speed exceeding 5 knots - (b) within 200 metres of the shore or of any structure;" (except when reserved under Section 18)

The narrow, upper portions of both lakes are particularly unsuitable for water-skiing, because insufficient water area is available for u-turns (see Section 2.2) Section 7 of The Water Recreation Regulations 1979, would in effect eliminate the possibility for waterskiing in all but three locations of the Upper Clutha hydro-lakes: the Clutha Arm of Lake Dunstan, the lower portion of Lake Luggate, and the lower portion of Lake Queensberry (were Lake Queensberry not to be designated as a Non-Motorized Zone). In fact, water skiing on the restricted and narrow upper portions of Lake Luggate and Lake Queensberry would be hazardous. For public safety, it is essential that waterskiing be prevented from taking place there.

4.3.6 Activity summary:

The activity patterns discussed in Section 4.4, above, can be summarized as follows:

Lake Wanaka to Lake Luggate:	1. canoeing 2. fishing 3. boater camping
Upper Lake Luggate:	1. boater camping 2. lake fishing 3. picnicking
Lower Lake Luggate:	1. jet boating 2. waterskiing 3. swimming 4. fishing 5. picnicking
Lake Queensberry:	1. sailing and windsurfing 2. swimming 3. canoeing 4. picnicking
Residual river:	1. competition white-water canoe course 2. canoeing 3. fishing 4. boater camping 5. picnicking

5. IMPLEMENTATION AND MANAGEMENT

5.1 Electricity Division - Primary User

The Electricity Division of the Ministry of Energy (as at the time of this writing) will have full control over the operation of the water of the Upper Clutha hydro-lakes. A fundamental principle is that recreation uses of the hydro-lakes must not be allowed to prejudice the operation of the lakes for the generation of hydro-electricity.

Although the control of the operation of the water in the lakes to generate hydro-electricity will be in a separate body from the control of on-water and shoreline uses, the two - operation of the water in the Lakes, and use of the water surface and shoreline of the Lakes - are closely related. However, use of the water in the Lakes to generate hydro-electricity has an undisputed primacy, apart from irrigation, over all other uses. Thus, on-water and shoreline uses for recreation, will have to accommodate to water-level fluctuations due to reservoir operation.

Because reservoir operation for hydro-electricity will affect on-water and shoreline users of the Lakes, it is desirable that the Electricity Division be available as an advisor to the Joint Authority which is to administer use of the water-surface (see Section 5.2).

"Waters control" as used in the Act refers to control of the uses of the water surface; use of the water in the Lakes for the generation of hydro-electricity remains a separate power, fully vested in the Electricity Division of The Ministry of Energy (as at the time of this writing).

5.1.1 Foreshore control:

The 20 metre foreshore is where water-oriented recreation activity, and its support infrastructure, are concentrated. The controlling authority would be responsible for licencing any shoreline structure built on the foreshore. Any licence to be issued by the controlling authority must first be approved by the Ministry of Transport.

Control over the foreshore includes:

(1) any structure or building

(2) vehicular or pedestrian movement, or any activity by people

(3) jetties, docks, or other harbour installations

(4) any structure that extends over the water but is attached to the lake bottom

5.1.2 Waters control:

The authority granted a foreshore control may also be granted a Waters Control. It is highly desirable that the same authority be in charge of both the foreshore and of the waters, even though the

actual transfer of a grant of control has to take place under separate provisions of The Harbours Act 1950. Once a waters control has been granted, the authority then has the legislative basis for the enforcement of The Water Recreation Regulations 1979.

Control over the waters includes:

(1) all forms of boating

(2) all water-oriented recreation (swimming, surfing,etc.)

(3) control of mooring of boats, and anchorages

(4) establishing water-skiing lanes

(5) licencing structures, such as for boats and other shoreline facilities, and their location and use

5.1.3 By-laws:

An authority that has received a grant of control over the foreshore or the waters - and in most cases over both - must institute by-laws to administer the areas under its control. The by-laws may include:

(1) provisions for the control over the location and extent of water-oriented activities (recreation, and other)

(2) provisions for policing

(3) enforcement penalties

(4) under The Water Recreation Regulations 1979: appointment of an Honorary Beach Ranger, for the enforcement of the Foreshore Controls

(5) under The Water Recreation Regulations 1979: appointment of an Honorary Harbourmaster and/or honorary launch wardens, for the enforcement of the Waters Controls. The powers of an Honorary Harbourmaster are spelled out in Regulation 50 of the General Harbour Regulations 1968.

5.2 Powers Under The Harbours Act 1950

The Ministry of Transport under The Harbours Act 1950, will control the use of the water surface and of a 20 metre strip of land on shore, generally above the maximum operating level. The Harbours Act 1950, provides for the transfer to an authority or authorities of a "grant of control". A grant of control can be made for foreshore control, and for waters control.

The recommendations which are made in this section are based on the following sections of The Harbours Act 1950:

(1) Section 8A has a provision to grant authority to one or more public bodies jointly, for a period not to exceed 21 years.

(2) Section 8A(6) enables a joint authority to make joint by-laws, to be approved by the Minister of Transport, before coming into force.

(3) Section 8A(10A) makes provisions for inclusion in the joint authority of any incorporation that is not a public body.

(4) Section 8A(11A) provides for renewal of the grant of control.

5.2.1 A Lake Dunstan Joint Authority:

A Joint Authority should be established for Lake Dunstan. The spatial extent of the Joint Authority should include:

(1) the foreshore control to the 20 metre mark as measured from 194.5 m maximum operating level, depending on topography and geological conditions.

(2) the waters control over the water of the Lake

(3) the water control 3 kilometres upstream from Lake Dunstan on the Kawarau River, and on the Clutha River

(4) the foreshore control 20 metres from the banks of the Kawarau River, and the Clutha River within the 3 kilometre distance on each River.

The Joint Authority should have representation from:

(1) Vincent County Council

(2) Cromwell Borough Council

(3) Department of Conservation, as to be constituted on April 1, 1987.

The Joint Authority should have a grant of control of both the foreshore and of the waters.

Even though the Cromwell Borough Council boundary includes only a small part of Lake Dunstan, this is the central, key location on the Lake: Cromwell and Lake Dunstan are functionally inseparable. Cromwell should have full participation and decision-power on the Joint Authority dealing with any foreshore or the water of the total area under the Joint Authority's jurisdiction. By extension, however, this also means that Cromwell should share fully in meeting the Joint Authority's costs, even though some of these costs may be incurred on the foreshore or the water outside Cromwell's boundaries.

5.2.2 An expanded administration for Lake Luggate and Lake Queensberry:

If Lake Luggate and Lake Queensberry were to proceed, there are several options of how they could be administered:

OPTION 1: three separate Joint Authorities:

- a Lake Dunstan Joint Authority, with Vincent County, Cromwell, and DOC representation

- a Lake Luggate Joint Authority, with Vincent County, and DOC representation

- a Lake Queensberry Joint Authority, with Vincent County, and DOC representation

OPTION 2: two separate Joint Authorities:

- a Lake Dunstan Joint Authority, with Vincent County, Cromwell, and DOC representation

- a Lake Luggate-Lake Queensberry Joint Authority, with Vincent County, and DOC representation

OPTION 3: one Joint Authority:

- an Upper Clutha Joint Authority, covering the reach between Lake Wanaka and the Clyde Dam.

- representation from Cromwell, Vincent County, DOC, and the Albert Town Ratepayers Association. Section 8A(12) (a) (vi) of The Harbours Act 1950, includes in the definition of a public body "any other administering body within the meaning of the Reserves Act 1977", the Albert Town Ratepayers Association may be included in the Joint Authority, or alternatively, it could have observer status on the Joint Authority.

The Upper Clutha hydro-lakes would not only be a hydrologically joined system, but would also be linked functionally - in terms of how they will be used, and how use of one part affects other parts of the system. The reach between Lake Wanaka and the Clyde Dam should be administered as one integral unit, consisting of five sub-areas: (1) Lake Wanaka to Lake Luggate; (2) Lake Luggate; (3) Lake Queensberry; (4) the residual River between the Queensberry dam and Lake Dunstan; and (5) Lake Dunstan. The reach is an intergral unit in how it will be operated hydrologically, and how it should be marketed for tourism and for recreation.

Cromwell will serve a central role in the marketing of the Upper Clutha hydro-lakes. The future of Cromwell itself depends critically on the success of tourism to, and recreation use of, the hydro-lakes. After the termination of local large-scale construction projects, Cromwell must find a new economic base, in order to remain a socially and economically viable community.

Its future success has already in large part been assured, through direct and indirect government investments, through the development of a high-quality physical environment, and through the commitments made by its full-time residents. Cromwell must not be administratively severed from the region on which its future

depends. Nor should the provisions of The Harbours Act 1950 be used to administer the hydro-lakes as a dismembered region.

There are distinct fiscal advantages of one Upper Clutha Joint Authority. Provision will have to be made by a Joint Authority for raising revenue, as, for example, from fees levied at boat launches, jetties, and from commercial operators. Pursuant to The Harbours Act 1950, a suggested schedule of fees exists. Substantial expenses for maintenance will occur throughout the system. Revenue-raising potential will vary on different parts of the Upper Clutha system, as will the spatial distribution of costs of maintenance and policing. The two will not always be correlated: sites with high maintenance costs may not necessarily have high potential for raising revenue, whereas other locations (where fees can be levied, for example) may generate a surplus of revenue. One Joint Authority for the Upper Clutha would have the advantage of being able to better minimize the imbalance in the distribution of revenue and expenses. Similarly, one Joint Authority would have savings from administrative economies of scale. Any one reservoir may not justify full time appointments for a Harbourmaster or a Beach Ranger, but a Joint Authority which includes the entire reach from Lake Wanaka to the Clyde Dam, would justify full-time appointments. There would be similar savings from the more efficient use of personnel, equipment, and administration.

5.2.3 Phasing:

If the decision is to proceed with Lake Luggate, a Joint Authority for Lake Dunstan should be established, for a five year interim term, with provision for renewal (Section 8A-(1) of The Harbours Act 1950). At the time of renewal, renewal should be made for a one year period, or longer, to coincide with the anticipated completion of Lake Luggate. When Lake Luggate is completed, the Lake Dunstan Joint Authority should be enlarged to form an Upper Clutha Joint Authority. The spatial extent of this Joint Authority should extend from Lake Wanaka, to the Clyde Dam. If Lake Queensberry is to be built, it would already be spatially covered by the Joint Authority. The composition of the phased-in Upper Clutha Joint Authority would be as outlined in 5.2.2 (3), above.

5.3 Local Authority District Schemes

The Clutha Central Otago United Council policies for waterfronts are spelled out as follows (in part):

"TO PARTICIPATE FULLY IN THE PLANNING FOR THE MAINTENANCE AND FUTURE DEVELOPMENT OF THE MARGINS OF LAKES CREATED BY HYDRO DEVELOPMENT SCHEMES.

Implementation

The United Council will participate fully in all discussions and planning forums relating to the development of the new lakeshores and considers that such development will be totally Crown funded.

Explanation

The lakes which will be created by proposed hydro schemes within the region and in particular Lake Dunstan behind the Clyde Dam will have considerable lengths of shoreline potentially available for public use. These margins are considered to be of regional significance because of their considerable potential for water based recreation which will serve to increase the range of recreational opportunities available to holiday makers and residents within the region. These areas are being created by the Crown and the cost of their orderly maintenance and future development must be met by that agency as part of the total cost of development. The United Council will work in conjunction with the Lakeshore Reserves Management Sub-Committee which has been established to participate in the planning for hydro lakes."

The lakeshore plans of the Ministry of Works and Development will affect the local authority district schemes. Inland of the 20 metre foreshore, the district schemes of Vincent County and Cromwell Borough will form the legal and administrative basis for the control of development. Within Cromwell Borough, the land use zoning designations have for some time incorporated the various shoreline land uses and other facilities that have been planned by the Ministry of Works and Development.However, outside Cromwell Borough, the predominant land use designation under the Vincent County District Scheme is Rul, Rural 1.

The District Scheme makes two particularly significant policy statements that have direct relevance to the future development around the Upper Clutha hydro-lakes:

"4.2 (e) The landscape amenities of Central Otago are widely recognized as a resource of national and regional importance. Besides the intrinsic merits in conserving such amenities in the face of various changes taking place within the County, they constitute a major basis of tourism and associated recreational activities in Central Otago.

(f) The trend towards increased demand for rural residential living in the County has been apparent for a number of years. This constitutes a legitimate use of rural land under certain situations, provided it does not compromise the agricultural, irrigation or landscape potential of the district." (emphasis ours)

The District Scheme appears to support the notion of curtailing development in rural areas, where it can be shown that such development would adversely affect the landscape aesthetics.

This goal is further elaborated on in Section 4.2.2(b)(3), "Landscape Protection Policies", of the District Scheme: "The Council will encourage development of land and buildings so that it is environmentally sensitive and in keeping with the existing natural and cultural characteristics of the site and its locality".

Shoreline sub-division of land for second homes, and other residences, should take place with reference to the site design guidelines described in the report "Coastal Development: Policy Issues and Planning Techniques" (Ministry of Works, 1972). Although the report pre-dates the (new) Town and Country Planning Act 1977, the design principles remain valid today.

The recommendation is made here that the shorelands of the Upper Clutha hydro-lakes be retained as much as possible in their current states of natural scenic landscape, and rural land use. The reasons are:

(1) to protect the visual landscape amenities of the hydro-lakes, and to avoid a situation where over time the land surrounding the Lakes aquires a suburban appearance

(2) to maximize use of the Lakes by the general, holidaying public, and to prevent a situation developing whereby riparian or other private property owners gain de facto pre-emptive use of the Lakes, to the detriment of the general public

(3) to minimize the possibility of a situation whereby private development around the Lakes generates a level of use which the lakes cannot accommodate, without experiencing stress

(4) to prevent a situation whereby rural subdivision of land for residential purposes, in the areas surrounding the hydro-lakes, will require increased levels of urban-type services

On this point, the District Scheme is quite specific:

"4.2.3(b)(4)(d) To ensure that the density of residential uses in rural zones does not reach a level where the Council could be involved in the provision of reticulated services or upgraded roads."

Furthermore, the District Scheme has several specific policies, as statements of the responsibility of Council to support the preservation of the open spaces and landscape values around the hydro-lakes; for example:

"4.2.3(b)(1) It is the responsibility of the Council to weigh the need for rural residential development against other competing objectives and priorities: to sustain and promote agricultural and horticultural uses that will ensure optimum utilisation of the productive potential of land and existing and potential irrigation resources, and to protect the amenities of scenic and very sensitive landscapes.

The District Scheme in Section 4.2.3.(b)(4) lists the objective and criterion for the evaluation of planning applications; statement (h) is particularly noteworthy:

> "(h) To ensure that buildings do not intrude into panoramas of bare open landscape which form such a distinctive part of the character and attractions of the district. To this end dwellings may be erected only on sites where they can be situated on valley floors or on sloping hillsides below the crests of hills or terraces so that they do not intrude into such landscapes as seen from (emphasis ours) public highways or vantage points and will be appropriately landscaped".

The above policy of the District Scheme should be applied to protect the views on the hydro-lakes: views anywhere from water to land, and views from one shore to the opposite shore. Any development on the shoreline, or on land behind it, should be located such that it is minimally visible anywhere from the water, or from the opposite shore. Because of the openness of the landscape and the long views, this could ultimately exclude many areas from being considered for development.

With reference to possible rural residential subdivision around the Upper Clutha hydro-lakes, the District Scheme states:

> "4.2.3.(b)(6) The Council has considered the feasibility of establishing a limited scale rural-residential zone(s) on land that has low actual or potential soil productivity or irrigation potential. There are a number of points supporting such a proposal: for example, it would cater to the continuing demand for residential living in a rural setting in Central Otago; it would enhance the tourism and recreation potential of Lake Dunstan; (emphasis ours) it would help to counter, to some degree, the decline of rural population, assist with maintenance of rural services and facilities and provide greater rural diversity.
>
> Because of the uncertainties over the extent of the Manuherikia irrigation scheme, irrigation proposals for the Cromwell basin and Dunstan flats, and the final completion date of the Clyde hydro-works, the Council has decided against zoning for such proposals for the time being. Instead, it may be prepared to consider, by way of a scheme change, the feasibility of limited scale rural-residential type developments.

Of the existing land use zoning designations used in the District Scheme, it appears that the Ru3, Rural 3 Tourist Service, zone is of particular use for the guiding of recreation-oriented development, other than for residential subdivision, around the hydro-lakes.

The recommendation is that the Ru1, Rural 1, zone be retained where it now exists, with the following exceptions (See Figure 9):

(1) A re-zoning to a Ru3, Rural 3 Tourist Service, zone is recommended;

(a) Lowburn Inlet: hotel site

(b) Lowburn Inlet: campsite

(c) Bannockburn Inlet: campsite

(d) Rocky Point (Bendigo wildlife area, east of SH 8)

(e) (with the development of Lake Luggate) on Lake Luggate, on the south and west side of Luggate Inlet

(f) (with the development of Lake Luggate) on Lake Luggate, on the east shoreline north (upstream) of the road which now crosses the Luggate Bridge over the Clutha River

(g) (with the development of Lake Queensberry) on Lake Queensberry, on the west shore where the reservoir abuts State Highway, and extending north, upstream, for about 800 metres.

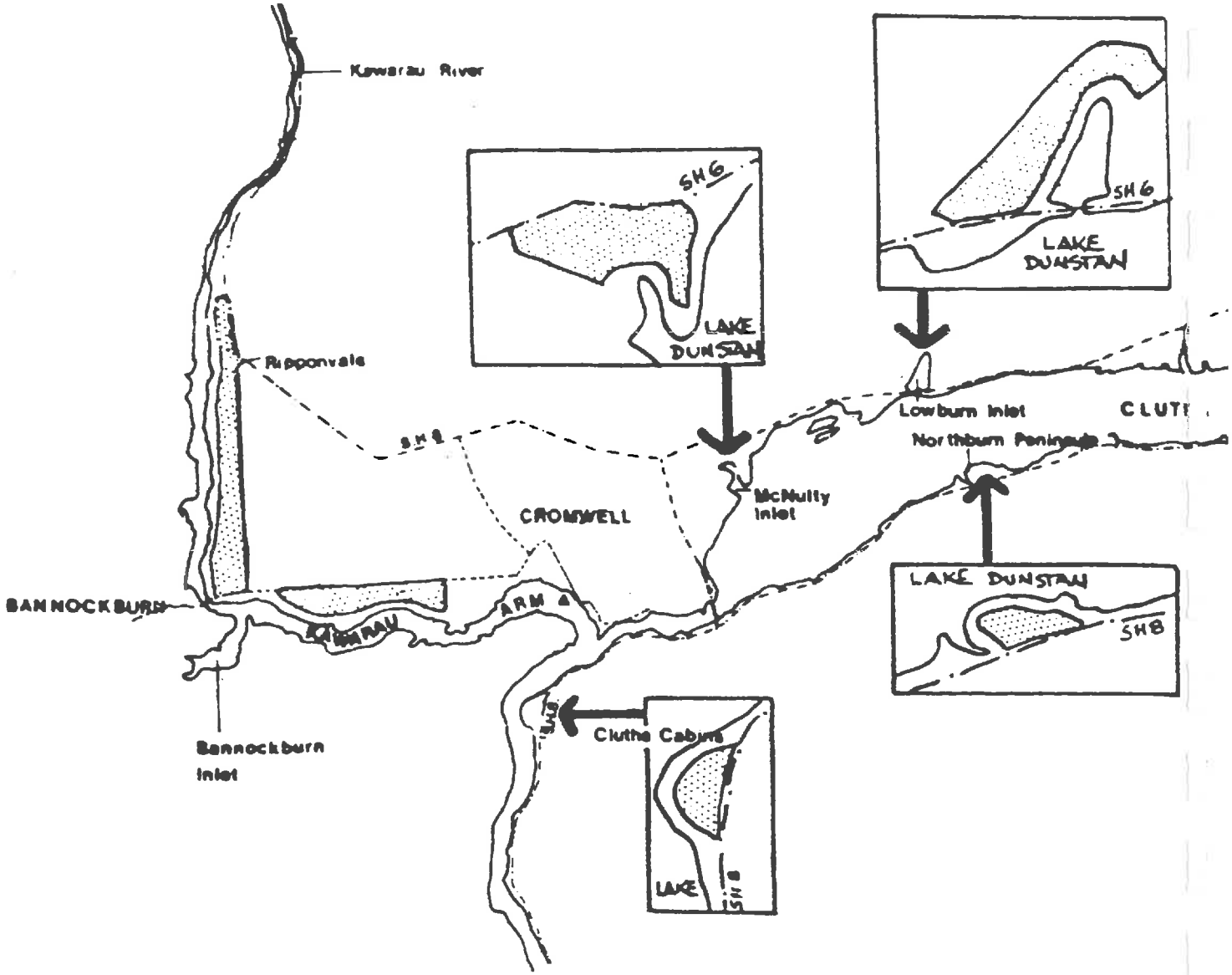
2) a re-zoning to a Residential Zone as in the Bannockburn Residential Zone in the following locations:

(a) McNulty Inlet (Fernbrook)
(b) Lowburn Inlet
(c) Northburn Peninsula
(d) Brewery Creek area (Clutha Cabins)
(e) between Pearson Road and the Lake
(f) between Bannockburn Road and the Lake

FIGURE 9

SUGGESTED SITES FOR SECOND-HOMES

POTENTIAL RESIDENTIAL ZONE AS IN BANNOCKBURN RESIDENTIAL ZONE



APPENDIX A: American and Canadian experiences in large water-resource projects.

The period from the 1930's to the 1960's was the era of large dam construction in the United States and Canada. Perhaps the "New Deal" and the Tennessee Valley Authority projects symbolize best such large, complex projects with wide-ranging social, economic, and other aims. The era spans the period from the Great Depression of the 1930's, to the beginning of the "environmental movement" of the late 1960's. But today, with the notable exception of the James Bay project in Northern Quebec, Canada (far bigger than any previous project, including even the Columbia River Treaty in British Columbia and Washington state), large engineering water-resource developments have all but ceased. Policy has been, for better or for worse - and for worse, in the opinion of this writer - to generate more electricity by means of fission and fusion nuclear power plants. In the United States, coal-fired thermal power plants have also been resurrected to generate electricity.

This appendix describes some of the experiences with dams and reservoirs built in Canada and the United States during the past half-century. The discussion is organized along several themes:

(1) Cost sharing:

Canadian large dam and reservoir projects have traditionally followed American models; this is especially true of projects, which are closely modelled on the U.S. Army Corps of Engineers, on the Canadian prairies. Both countries are federated states, with a central, federal government and state or provincial governments. However, there is one significant difference. In Canada, the British North America Act,1867, divided political power in such a way that the ten Canadian provinces are quite strong, relative to a much weaker federal government. The exceptions are the Yukon and the Northwest Territories - broadly speaking, the Canadian Arctic - where the federal government is all-powerful and performs the functions of a provincial government. New powers since 1867 have tended to accrue to the provinces, not to the federal government. By contrast, in the United States, the Constitution has given rise to a much stronger federal government, with relatively weaker state governments. At almost every level of (political) life in the United States, the federal government has a stronger presence than it would in a comparable situation in Canada.

Nevertheless, the experience in both countries has been for many large projects to be jointly funded by the federal and state or provincial governments. In Canada, especially, there is a strong tradition of joint federal-provincial funding. For example, the South Saskatchewan River Project was based on an agreement that the Province of Saskatchewan would share with the federal government 25% of the project costs, up to a maximum of $25 million. In fact, the project greatly exceeded its original cost estimate, with both the federal government's and the province's share increasing well beyond what was originally estimated.

In addition to cost sharing, there is also a tradition of sharing of project responsibilities. One typical pattern is where the senior, federal, government undertakes the design and construction of the dam, and the province is responsible for land assembly, relocation of roads and

railways, and the work necessary for the realization of project benefits, such as irrigation schemes, hydroelectricity transmission lines, and shoreline recreation facilities. Sharing can become complex when a project overlaps state or provincial boundaries, or the international boundary between Canada and the United States, or - in some cases - all three types of boundaries! One response has been to establish an international joint authority, or a federal-provincial or federal-state project authority. "Basin Boards" have also been established in some parts of Canada, delineated along watershed boundaries, and with representation from the federal government and the provinces within the basin.

A strong federal presence is sometimes resented by the state or province. Yet,in the past, such federal involvement may have been essential to survival. For example, during the Great Depression of the 1930s, the three Canadian prairie provinces of Alberta, Saskatchewan, and Manitoba, had to be sustained financially by the federal government. Starting with many small schemes, such as for irrigation and conservation, the stage was set for much larger joint federal-provincial projects. In the United States, on the other hand, relatively more projects have been developed exclusively by federal agencies, such as the Army Corps of Engineers.

(2) Social catalyst:

Large dam projects have often been justified by their assumed social benefits. In the case of the Tennessee Valley Authority, this may have been the key reason for the scheme - to improve the standard of living in the depressed Appalachian region of the American South. In Canada, too, various schemes in the prairies and British Columbia have been defended on the basis of their social benefits. In some cases, a Royal Commission may have concluded from cost-benefit studies that on strict economic grounds, a project could not be justified, but has nevertheless recommended that, based on social benefits, the project should proceed. Yet, what exactly is meant by "social benefits", and how these differ from economic benefits, has been quite ambiguous.

(3) Multiple objectives:

Government policy, often as legislation, has been to fund large water resource projects only if they can be demonstrated to have multiple benefits. The term "multiple-purpose project" is common. Single-purpose projects have rarely been funded, and have met with considerable political opposition. However, even though most large projects have to demonstrate multiple benefits, invariably one of these tends to outweigh the others in importance. Sometimes one project purpose may even be quite pre-eminent, in which case it would be more correct to refer to a "primary-purpose project with secondary benefits". Perhaps because there is a need to demonstrate multiple benefits, some projects may have exaggerated the potential of the (admittedly) secondary benefits.

Nevertheless, the multiple-purpose principle is well entrenched. It adheres closely to a philosophy of resources management which recognizes that many uses exist for a resource, such as water or forests. There may even be a symbolic meaning: the US Forest Service has a logo which includes, as segments of an equally divided circle, the various forest resource uses, such as logging, wildlife, recreation and water conservation. It is arguable, however, how closely this admirable philosophy is adhered to in practice. Certainly, there are many cases

where one use - usually logging - appears to be given unreasonable precedence over other uses.

(4) Riparian land control:

The general practice in Canada has been to purchase all land that is to be flooded by a reservoir, and land up to a defined contour elevation above the maximum storage water-level. In the United States, the practice is more often to purchase flood-easements: land may remain in private ownership (even if it is under water!), with the owner being compensated for up to 80% or even 90% of the value of the land. Some project authorities see it as an advantage when land both under and around the reservoir is in private ownership and does not encumber the reservoir agency.

Terms frequently used in conjunction with riparian land administration are:

F.S.L: full Supply Level, the elevation of maximum water that can be stored in the reservoir

Take-line: literally, the line to which land is "taken", i.e purchased. The take-line is usually first defined as a contour elevation above the FSL, and is then either related as closely as possible to existing property boundaries, or - where these are unsuitable - a new property boundary is surveyed along the take-line. The practice is to purchase or expropriate if necessary, land parcels in such a way that the agricultural holdings, which remain, are viable

Restricted Building Zone: defined as a contour elevation above the FSL, it delineates the shoreland where only non-habitable structures may be erected

Safe Building Elevation: defined as a contour elevation above the Restricted Building Zone, it delineates the shoreland where habitable buildings may be erected

RDA: The Reservoir Development Area, an administrative boundary within which the project authority has control over, for example, land use zoning and building permits. Within the RDA, local borough or county district schemes have to conform to guidelines set down by the project authority.

The location of the Restricted Building Zone and the Safe Building Elevation depend on the geological stability of the shoreline of a reservoir. Depending on undercutting and slumping, periodically these boundaries may have to be adjusted.

Practices vary as to whether the Restricted Building Zone and the Safe Building Elevation are included in the Take-line. Perhaps the more common practice is for the Take-line to include at least all the land in the Restricted Building Zone.

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