Environment Agency,
Lake District National
Park Authority

Environmental Appraisal of Derwentwater Low Water Levels

Volume III: Management Options

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Derwentwater Low Water Levels

Management Options

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1. INTRODUCTION

RKL-Arup were appointed by the Environment Agency and the Lake District National Park Authority to undertake an environmental appraisal of Derwentwater Low Water Levels.

The National Park Authority produced a management plan for the lake in 1996. Public consultation for this management plan indicated that the low minimum lake level experienced in 1995 was a cause for concern for the lake users. The Lake District National Park Authority and the Environment Agency therefore commissioned this study to determine if the minimum lake level in Derwentwater was descreasing. The study was also to provide options to manage the minimum lake level and to undertake an environmental appraisal of these options. Studies were undertaken to determine how the ecology, recreational use of the lake, archaeology, agriculture, and landscape would be affected by changes to the minimum lake level.

This Environmental Appraisal was undertaken by RKL-Arup working in association with the Institute of Freshwater Ecology and the Smeeden Foreman Partnership.

The study is reported in three volumes.

Volume 1 : Hydrological and Geological Study
Volume 2 : Ecological Appraisal
Volume 3 : Management Options

This report forms Volume 3 and has been written in conjunction with Smeeden Foreman Partnership, Landscape Architects, and the Institute of Freshwater Ecology. The following minimum water level management options are developed and the impacts discussed.

Management Options:

- Do nothing
- Map and mark obstacles
- Dredge boating channels
- Permanent Weir
- Temporary Weir
- Maintain at Present Level

This report has been prepared by RKL-Arup for the use of the Environment Agency and the Lake District National Park Authority in response to their particular instructions. It is not intended for and should not be relied upon by any third party and no responsibility is undertaken to any third party.

2. THE SITE

Derwentwater is the third largest lake in Cumbria. It is situated south-west of Keswick and is in the Lake District National Park. As shown in Figure 1, Derwentwater is aligned north-south and is approximately 4.5km in length and 1.25km in width. It is centred on National Grid Reference NY260210. In normal conditions, Derwentwater has a surface area of approximately 6.7km^2. The catchment area of the lake is approximately 85km^2.

The main river feeder into Derwentwater is the River Derwent. This rises in the Borrowdale Fells and enters at the southern end of the lake. Many smaller becks enter the lake from the east and the west. The catchment is amongst the steepest and wettest in England. The lake discharges at the northern end over a natural sill barrier into a continuation of the River Derwent, which subsequently flows into Bassenthwaite lake.

The topography to the south-west falls steeply from Cat Bells at 451mOD to a general shoreline level of 75mOD. To the south-east the topography is again steep, falling from Castlerigg Fell and Bleaberry Fell to the shoreline (Figure 2). To the north and south there are significant 'wash lands' where the River Derwent enters and leaves the lake (Figure 3).

The River Greta enters into the River Derwent 400m downstream of the lake. The catchment area of the River Greta, upstream of the confluence with the River Derwent is 150km^2 as shown in Figure 1. This catchment includes tributaries from the Blencathra, Matterdale Common and Helvellyn range, together with St. Johns Beck from Thirlmere. The River Derwent then flows over the Environment Agency gauging station at Portinscale, 600m downstream of the confluence.

3. HISTORY

3.1 Issues Due to Low Water Levels

The proposals for a study into possible water level fluctuations were driven by the particularly low water levels during September 1995 when the lake level fell to the lowest ever recorded.

Commercial boat users and boat owners on the lake, including people who had to commute between Derwent Isle and Keswick, expressed concern that the low water levels caused:

- Damage to boats and their propellers
- A potential danger to life if a boat struck a rock and lost a propeller, particularly at night in strong winds
- A risk to passengers when they had to be transferred from the launches on the lake to smaller craft in order to reach landing stages
- A risk that the low water might affect the economic viability of the Launch Company and Marina business on the lake with possible unemployment consequences.

3.2 Historic Weirs

There has been heresay that there was a weir on the River Derwent at the outfall from Derwentwater. Enquiries by letters to the local press and at a public meeting held in Keswick on 26 June 1996, which was well attended by lake users, resulted in no reliable evidence of a past weir. Contradictory verbal reports indicated those who clearly remembered that a weir existed and others who clearly remember that no weir ever existed.

Historic Ordnance Survey maps, as shown in Figures 4 to 6 show no reference to a weir. Landing stages at the outfall to the lake are shown on the Ordnance Survey Maps dated 1925 to 1983. The Ordnance Survey map dated 1925, shown on Figure 4 shows the landing platform with three landing stages. To the west of the platform the lake is shown as containing reeds. No changes are shown on the 1938, 1957, or 1966 ordnance survey maps. The 1970 map, shown in Figure 5, shows the three landing stages as absent but the landing platform still as existing. The 1983 Ordnance Survey map, shown on Figure 6, shows that the area to the west is now marshy as opposed to the previously reedy area. No weirs are shown on any of the figures. Outlines of the foundations of these landing stages can still be seen at the lake outfall.

In recent years small boulder dams have occasionally been constructed at the lake outfall. As the dams did not have Planning Permission or Land Drainage Consent, they were deemed illegal and hence removed. The 'dam builders' were requested to remove the dam or, failing that, the National Rivers Authority, now the Environment Agency, removed the dams.

During the summer of 1995 an illegal dam was constructed. The lake at this time was approximately 200 mm above the lowest level ever recorded. The dam was removed by the Environment Agency on 3 August 1995. When removing the dam the Environment Agency Excavator accidently removed some shale comprising the bed. The Environment Agency report that this was replaced immediately.

It was suggested by the boat users, and reported in the media in May 1996, that when the boulder dam was removed the lake level dropped nine inches in two days. The Environment Agency investigated these water levels. Lake levels were recorded automatically every 15 minutes by the Environment Agency. The results indicated that the fall in lake level over the two days following the dam removal was approximately 3.6 cm (1.4 inches). This fall was close to the general regression of the water level during this very dry period.

4. GEOLOGY

The underlying geology of the Derwentwater area is defined by the Borrowdale Volcanic Series in the south and the Skiddaw Slates in the north. The Borrowdale Volcanics are harder rocks than the Skiddaw Slates and are more resistant to erosion, forming the higher fells of the Lake District.

The underlying geology is, however, covered extensively within the valley bottoms by glacial materials, deposited during the Quaternary Ice Age. The valleys themselves were formed by glacial erosion, and contain tills and moraines deposited as the glaciers retreated. A series of lakes formed behind these glacial moraines which gradually cut down through the moraines and drained. There are several former lakes within Borrowdale which are now dry land, having been filled in with sediments. Derwentwater and Bassenthwaite have not yet reached this stage and are therefore in a state of geological non-equilibrium.

Volume 1 contains a more detailed description of the geology of the area.

5. HYDROLOGY OF THE DERWENTWATER CATCHMENT

Derwentwater has a catchment area of 85 km^2, the majority of which consists of the semi-natural fells. The main river feeder into Derwentwater is the River Derwent, although many smaller becks also enter the lake from the east and the west. The River Derwent rises in the Borrowdale Fells and flows into the southern end of the lake. This catchment is amongst the steepest and wettest in England and thus catchment response may be expected to consist of fast, high flows.

Flows from the River Derwent will enter Derwentwater and become attenuated as velocities decrease and the lake level rises, storing water. This will allow all but the very finest sediment to settle out in the lake and will lead to lower discharges flowing from the lake. The lake discharges at its northern end over a natural till barrier. During normal flows the lake flows into a small channel, which is a continuation of the River Derwent, but during very high flows the entire floodplain downstream of the lake may be flooded to depths of over 6 feet.

Over the last 100 years or so it has become customary to mark very low lake levels with tablets at Friars Crag. These tablets indicate that lake levels have fallen since the late 19th century. Climate and land use within the catchment do not appear to have changed significantly over this period and thus another factor may have caused the apparent decline in lake levels.

Using Environment Agency data, lake stage-discharge curves were derived and these indicated that the level of the lake sill is falling, and thus erosion of the lake sill could have caused a fall in lake levels.

Comparison of past lake levels with critical climatic conditions over the last 134 years also indicates that lake levels are dropping, and that this is due to the sill level falling. The clearest example of this effect can be seen when comparing the 1939 and 1989 low lake levels. Despite having virtually the same climatic conditions the 1989 minimum lake level is 0.25m lower than that experienced in 1939. Given that no other significant changes have occurred within the Derwentwater catchment this can only be due to falling sill levels.

Examination of long-term records indicates that at present there is a 10% probability in any one year that the minimum lake level experienced in September 1995, or lower, will occur. The probability of this lake level occurring will increase as the sill erodes further.

Erosion of the sill is a natural process but will also be effected by human interference. Future erosion rates are likely to be variable, depending on rainfall within the Derwentwater catchment, the material exposed as the sill erodes and human influences and are therefore difficult to predict.

Volume 1 of this series of reports describes in more detail the past and current hydrological regime within the Derwentwater catchment.

6. ECOLOGY

An ecological appraisal of Derwentwater was undertaken in association with the Institute of Freshwater Ecology. The aim of the appraisal was to assess the relative ecological performance of each management option.

Derwentwater, its lakeside habitats, and the species they support collectively represent a site of both regional and international importance for nature conservation. Nationally-important statutory designations have been conferred on the lake's flora and fauna by English Nature. For example, Derwentwater is a Site of Special Scientific Interest (SSSI), and part of a candidate Special Area for Conversation (SAC), proposed under the EC Habitats and Species Directive. The lake is also part of a designated Salmonid Water under the Freshwater Fish Directive.

The bathymetric and limnological characteristics of the lake play a key role in supporting its ecological interest. For example, Derwentwater is one of the least productive (i.e. nutrient-poor) lakes in the Lake District. The physical and chemical characteristics of the lake are unique. Any irreversible decline in these physico-chemical parameters is very likely to adversely affect the ecological equilibrium.

The lake supports several nationaly rare species of flora and fauna. For example, the vendace (*Coregonus albula)* is a nationally scarce fish whose only remaining indigenious populations in the UK are found in Derwentwater and Bassenthwaite. The vendace has very specific habitat requirements, including shallow spawning areas offering a clean, exposed substrate. The Derwentwater catchment is understood to contain a breeding population of otters (*Lutra lutra).* Otter and vendace are protected under Schedule 5 of the Wildlife and Countryside Act 1981, as amended. Derwentwater and Bassenthwaite are the only known Cumbrian localities for the nationally scarce floating water plantain (*Luronium natans).* The narrow-leaved water dropwort (*Oenanthe silaifolia*) is recorded at the wetlands adjacent to the lake's outfall at North Bay. This is one of only two Cumbrian sites which support this rare species.

Derwentwater also supports some of the finest hydrosere habitats within the Derwent Catchment. There are several sites around the lake with soft shorelines and undisturbed transitions from open water to reed swamp and carr woodland. The bays and shallow margins of the lake provide important feeding and roosting habitat for bird species. Indeed, Derwentwater is acknowledged as a site of county importance for both wintering wildfowl and resident bird species. Both the north and south (Great Bay) ends of the lake are significant areas for wintering wildfowl. In addition, the bays at the Ings and Crow Park represent important locations. Calfclose and Barrow Bays on the east side can be as equally important as those at Otterbield. Kettlewell Bay is also important. These locations can be equally significant during the Summer months, because of food availability.

Volume II of the report presents a detailed summary of the lake's ecological resources, and evaluates the way in which the management options could interact with these resources.

7. RECREATION

7.1 Introduction

The following section addresses the recreation and leisure uses of Derwentwater. It aims to describe the present uses of the lake and its shoreline for recreational purposes. It also describes the problems which can arise for certain stakeholders during low water level events. Interactions between recreational activities and the nature conservation resources of the lake are also identified.

There is a public right of navigation on Derwentwater, however there is not a designated navigation authority for the lake. This means that water-borne recreational use of the lake is, and will continue to be for the foreseeable future, and important public amenity. The wooden launches operated by the Keswick on Derwentwater Launch Company Ltd ('Keswick Launch Company') are an integral part of the lake's character and heritage. Derwentwater Marina and Nichol End Marina provide moorings for private boats. In addition, there are significant numbers of visitors to the lakeshore, especially at locations easily accessible by car, for example, Lake Road car park at Keswick. Indeed, Derwentwater has one of the busiest lakeshores in the Lake District, with walking or strolling being enjoyed by just over 50% of visitors to the lake. Sitting or picnicing is the second most popular activity, enjoyed by approximately a third of visitors along the lakeshore during the Summer months.

Inevitably, recreational activities place some pressure on the environmental resources of the lake. Clearly, recreational activities are at the centre of people's decision to visit Derwentwater, and represent an important source of income for local businesses. During recent drought years, the low water levels have adversely affected the ability of the launch companies to operate their full potential as some parts of the lake are not navigable during low water events. Consideration therefore needs to be given to the ways in which the lake level management operations could interact with the recreational resources of Derwentwater, especially the ability of launch companies to navigate safely around the lake.

In preparing this summary, reference has been made to a survey of recreational use at Derwentwater undertaken by the Lake District National Park Authority (August 1994, and 1997), and the Derwentwater Management Plan (Lake District National Park Authority, January 1996).

7.2 Commercial Use of the Lake

7.2.1 Passenger Launches

The Keswick Launch Company operates passenger services around the lake using its distinctive wooden launches. There are six launches, some with a capacity of up to 120 passengers. The period between Easter and November represents the 'high season'. During the high season there is a half-hourly service around the lake. The circuit of the lake begins at the Keswick boat loadings, to Watendlath road end, down to Lodore, and back via High Brandelhow, Hawes End and Nichol End Marina. In addition to the passenger launches, the company hires out rowing boats and self-drive motor boats.

The Keswick Launch Company has advised that it requires 5ft (1,520 mm) depth for the safe passage of its boats through shallower waters, and a channel width of 65 ft (20m). During recent drought years exceptionally low lake levels have compromised the ability of the company to deliver its usual service. Access to certain parts of the lake has been restricted, and approaches to some jetties have been hindered too. Concern has been raised over the safety implications of passenger launches sailing over near-surface obstructions such as rocks.

While dredging may alleviate these problems any dredging undertaken would need to be repeated at intervals to maintain satisfactory depths. This is because at the south end of Derwentwater sediments are transported into the lake by the River Derwent. The sediments are deposited to form a 'delta' which can interfere with navigation. At the north end of the lake silts may be deposited in North Bay due to sediment dynamics.

7.2.2 Private Marinas

Boats such as sailing dinghies and sail boards can be hired from Nichol End Marina. Derwentwater boat club operates from Derwentwater Marina, where sailing craft, open 'Canadians', and kayaks can be hired. Due to sedimentation Derwentwater Marina is one of the lake-side businesses which stands to benefit the most from the control of minimum water levels. Consultations with Derwentwater Marina during the course of the study have identified several requirements for pleasure craft navigating the lake during low water levels. Derwentwater Marina has advised that if dredging were to be the preferred option, then the area at North Bay would need to be cleared for a draught of 1,200 mm at the minimum water level.

7.2.3 Outdoor Activity Centres

There are four residential outdoor activity centres which teach sailing and canoeing on the lake (Derwent Hill, Hawse End, Newlands Adventure Centre and the Isthmus Boys Club). There is also a non-residential establishment at the southern end of the lake which also teaches sailing and canoeing and in addition hires out sailing boats and canoes. All three centres place a strong emphasis on water-based instructional courses such as canoeing and sailing.

While canoeing and sailing can take place unhindered during the lowest minimum lake levels, the rescue boats can have some difficulty navigating. This can create problems if the canoes and sailing craft get into trouble in the abnormally shallow areas of the lake, not easily accessed by the rescue boats.

7.3 Visitors to the Lakeshore

Derwentwater is considered to have one of the most accessible and busiest lakeshores in the Lake District. There was an estimated 20% increase in visitors to the lakeshore in the ten years to 1993. Visitors are able to walk on footpaths around a large part of the walk without the need to use local roads. The lakeshore footpaths are used by cyclists, however, cyclists do not legally have the right to use these paths. The Derwentwater Management Plan makes reference to cycles causing footpath erosion in places.

7.4 Density and Pattern of Lake Use

7.4.1 Density of Lake Use

Lake use surveys were undertaken in 1982 as background information to the review of the Lake District National Park Plan (1986). These surveys covered all of the lakes used for recreational purposes and not Derwentwater alone. In 1993 and 1997 further recreational use surveys were undertaken on Derwentwater. Comparison of the data from the first two surveys indicates that over the 11 years to 1993, the density of pleasure craft at Derwentwater increased from 15 craft/km^2 to 24 craft/km^2. The data suggest that Derwentwater has the same density of craft as Ullswater, but half the density recorded at Coniston Water and Windermere. The data from the most recent survey (1997) are presented in Tables 7.1 and 7.2 and shows an average density of 28 craft/km^2.

Tables 7.1 and 7.2 are significant in that they illustrate the proportional use of the lake by different types of craft in 1997. For example, canoes account for 30% of all craft using the lake on a Summer Sunday. This figure can rise to 40% on a Summer weekday. On Summer Sundays the next most popular craft on the lake are rowboats (16%), small open motor boats (12%), and sailing cruisers and sailing dinghies (both 11%). Summer weekdays revealed slightly different levels of use between different craft, with sailing dinghies (but not sailing cruisers), rowboats, and 'others' accounting for between 12% and 16% of total usage. It should be noted that other boats stored and 'not in use' were not counted for the purpose of this survey.

TABLE 7.1 Boat Counts at Derwentwater, Summer Sundays 1997

Date	Rescue Boat	Motor Cruiser	Small Open Motor Boat	Sailing Cruiser	Sailing Dinghy	Sail Board	Canoe	Steam Boat	Passenger Boat	Rowboat	Other	Total
25 May	6 (6%)	7 (7%)	23 (23%)	9 (9%)	11 (11%)	8 (8%)	13 (13%)	0 (0%)	3 (3%)	21 (21%)	1 (1%)	102 (100%)
6 July	7 (6%)	5 (4%)	9 (6%)	20 (17%)	11 (9%)	6 (5%)	36 (31%)	0 (0%)	3 (3%)	21 (16%)	0 (0%)	118 (100%)
20 July	5 (2%)	4 (2%)	16 (8%)	24 (12%)	20 (10%)	9 (4%)	70 (34%)	0 (0%)	4 (2%)	28 (14%)	27 (13%)	207 (100%)
24 Aug	9 (5%)	5 (3%)	22 (13%)	15 (9%)	24 (14%)	6 (3%)	60 (34%)	) (0%)	2 (1%)	27 (15%)	6 (3%)	176 (100%)
Average % age	7 4%	5 3%	18 12%	17 11%	17 11%	7 5%	45 30%	0 0%	3 2%	24 16%	9 6%	151 100%

TABLE 7.2 Boat Counts at Derwent, Summer Weekdays 1997

Date	Rescue Boat	Motor Cruiser	Small Open Motor Boat	Sailing Cruiser	Sailing Dinghy	Sail Board	Canoe	Steam Boat	Passenger Boat	Rowboat	Other	Total
6 July	2 (3%)	3 (4%)	1 (1%)	1 (1%)	18 (28%)	5 (7%)	28 (40%)	0 (0%)	3 (4%)	9 (13%)	0 (0%)	70 (100%
24 Aug	8 (4%)	1 (0%)	21 (9%)	6 (3%)	28 (12%)	3 (1%)	90 (40%)	0 (0%)	3 (1%)	29 (13%)	38 (13%)	225 (100%)
Average % age	5 3%	2 1%	11 7%	4 2%	23 16%	4 3%	59 40%	0 0%	3 2%	19 13%	18 12%	148 100%

On both Summer weekdays and Sundays passenger-boats account for only 2 % of total pleasure craft on Derwentwater. Sailing cruisers account for no more than 11 % of observations. This might suggest that the stakeholders potentially most affected by low water levels account for no more than 13 % of craft using the lake. This figure masks, however, the number of people occupying these craft. Passenger launches, whilst relatively few in number, may carry over 100 people at once, while a canoe may carry up to 3. Sailing cruisers vary in size from 2-berth to over 6-berth. No details are available about the actual occupancy rates for each craft observed in the lake use surveys, but it should be noted that the number of craft observed does not directly equate to the number of lake users.

Potential occupancy figures should therefore be considered when identifying those lake users potentially benefitting most from the proposed water level management options.

7.4.2 Pattern of Lake Use

Formal surveys and casual observations of craft at Derwentwater reveal that there is not an even distribution of boats around the lake. During the 1993 survey, 43 % of all craft were recorded near Nichol End / Derwentwater Marina, with a further 24 % of craft around the islands just to the south. This bias of use towards the Keswick end of the lake contributes towards the marked difference in character between North Bay and the area near Great Bay. The southern end of the lake has a much quieter and tranquil atmosphere, while the northern end is generally more busy.

7.4.3 Access Points for Craft

The distribution of boats around the lake can be accounted for in part by the distribution of access points around the shoreline. Larger craft (i.e. those that cannot be carried by hand into the water) can be launched only at northern end of the lake at:

- Derwentwater Marina
- Nichol End Marina
- The Allerdale Borough Campsite
- Lakeside Caravan Site
- The public landing stages at Lake Road.

Smaller craft such as canoes, sailboards, and some sailing dinghies can be launched at the southern end of the lake at Kettlewell and near Low Manesty Caravan Site. Kettlewell is in effect the only 'free' public launching point by the lakeshore. The Kettlewell location is primarily a car park and so it is not always possible to get boats to the shoreline. Great Wood car park can provide an alternative to Kettlewell during busy periods, but only if users can carry their craft and are prepared to cross the B5289.

7.5 Environmental Significance of Recreational Activities

The preceding sections have highlighted some of the more popular recreational activities pursued by visitors to the lake. The following section examines some environmental pressures inadvertently created by visitors. It is intended that this section should highlight what, if any, additional pressures the management options could exert on recreation-related environmental issues.

7.5.1 Recreational Disturbance of Wintering Wildfowl and Breeding Birds

Derwentwater is acknowledged by both statutory and non-statutory agencies as a site of county importance for wintering wildfowl (refer to Volume II, Section 4.6). The lake provides important feeding areas within the bays and along its shallow margins. The more significant wildfowl sites include the north end of the lake, which is in relative proximity to the lake outfall. Any option entailing dredging could interact with other areas of the lake, which also support significant wintering wildfowl populations.

It should be borne in mind that there has been a decline in recent years in numbers of coot, goldeneye, tufted duck and pochard on Bassenthwaite. The Derwentwater numbers have on the whole increased and may well have absorbed some of the Bassenthwaite birds. This puts a greater emphasis on the welfare of wintering birds at Derwentwater which must be taken into account (P. Barron, 1998 pers. comm.)

Figure 6, Volume II indicates the location of important areas for wintering wildfowl. The figure reveals that both the north and south (Great Bay) ends of the lake are significant areas for wintering wildfowl. In addition, the bays at The Ings and Crow Park represent important locations. Calfclose and Barrow Bays on the east side can be as equally important as those at Otterbield and Derwent Bays on the west. Finally, Kettlewell Bay is regarded as a very important location for wintering wildfowl (P. Barron, Lake District National Park Authority (1998) pers. comm.). All these areas can be equally important during the Summer, because of food availability.

There is anecdotal evidence that recreational users of the lake and shoreline cause disturbance to wintering wildfowl and breeding birds. Disturbance may take the form of people accessing on foot sensitive roosting or nesting areas along the shoreline, or through people sailing close to waterfowl on the lake itself or sheltering in reed beds. Disturbance is regarded as a problem because it displaces birds from their preferred roost. For example, Great Bay, Kettlewell and North Bay are crucial for wintering wildfowl. When disturbed, birds at Kettlewell are known to fly to Great Bay, thereby expending energy and losing access to a preferential feeding site.

There is much variation in the amount of human recreational disturbance between different wildfowl sites. It is considered likely that locations such as North Bay could support larger numbers in the Summer if there was less disturbance. However, this may be limited by the territorial behaviour of some species.

The northern end of the lake supports significant numbers of fowl, especially in Winter, and could probably hold larger numbers in the Summer months except for disturbance. The Great Bay voluntary *no boating* zone is very important because it is a significant day time roost site for a variety of species, especially in Summer.

Other sensitive areas for non-wildfowl species include Lodore marsh, Kettlewell reeds, Stable Hills, Ings Wood, Portinscale and the North Bay reed fringe. Shingle areas provide valuable habitat for Sandpiper and Little Ringed Plover. Islands provide refuges for oystercatcher, gulls, sandpipers, mallards, merganser, heron and geese.

The ecological significance of the management options in relation to disturbance of wildfowl and breeding birds has been examined in Volume II.

7.5.2 Erosion of Shoreline Habitats

At certain points where the public can gain access to the lakeshore, erosion and trampling of vegetation can take place. The trampling of shorelines can transform the rich habitat of a lake shore hydrosere to a gravel beach and even lead to the loss of attractive belts of fringing trees. Trampling by stock can cause similar problems. There are many examples around Derwentwater where complete vegetation cover has been lost through trampling, creating an extensive eroded beach fringed by trees. During naturally-occurring low water events (for example, during the Summer months), submerged areas of emergent vegetation not ordinarily accessible to walkers become exposed as 'dry' land. Under normal circumstances, shoreline vegetation is often able to survive the stresses of exposure to the air. However, when this naturally-occurring stress is exacerbated by trampling, the vegetation is frequently unable to survive before the next inundation and is eroded away. Low water levels also mean that areas of lakeshore usually too wet to make walking comfortable, for example reed beds, dry out and become passable, encouraging paths to develop. If this continues for long periods the vegetation is lost, creating virtually impassable quagmires.

Walkers usually choose to walk along the water edge which means once the vegetation is lost it is unlikely to be re-established unless access is denied through fencing.

Damage which may occur through trampling must be taken into account when considering the management options for the lake level, as this will affect both the ecological and landscape value of the lakeshore.

7.5.3 Scouring by Moorings

Apart from the general problems of the impact of recreation the impact of moorings is a specific concern, although limited in extent. Moorings can cause 'scouring' of the lake bed and hence damage to underwater aquatic vegetation at sensitive locations. Movement of the chain which attaches the moorings to the concrete block can scour the lake bed clean of vegetation. This is due to boats swinging freely on a fixed mooring in response to changing wind directions and lake levels. The ecological significance of this problem cannot be quantified, partly because there is incomplete survey data on aquatic macrophytes within the mooring zones. The Lake District National Park Authority has historically encouraged the use of non-scouring moorings to protect sensitive areas supporting aquatic vegetation. This type of mooring makes use of a second bouy to retract the chain to the required length, thereby removing any 'slack' that might otherwise cause scouring. It is therefore essential that if the map and mark hazards option is pursued and bouys are used to mark hazards the aquatic plants and design of the mooring are taken into account.

7.6 Recreation Summary

Derwentwater is an undoubtedly important recreational resource within the Lake District, enhanced by the public right of navigation across the lake. A broad range of craft make use of this right of navigation, and they form an integral part of the lake's character. This review has highlighted a series of points which relate directly to the Low Water Level study, as well as some factors which, although important in recreational terms, are less relevant to the current decision-making process. These concluding points are summarised in Table 7.3.

Recreational Issue	Summary
Commercial use of the lake	
Low water events affecting passenger launch services	The Keswick Launch Company constitutes, along with the private marinas, the most adversely affected stakeholder during exceptional low water events. During low water events, the ability of the company to operate a normal service is compromised, and concerns have been expressed over the safety aspects of near-surface obstructions. In conjunction with the two marinas (see box below), the launch company stands to gain most from a minimum water level management solution. This benefit would not be accrued year-on-year, however, because the extreme low water events in question currently have a 1 in 10 chance of occurring in any one year. If the minimum lake level continues to fall this may create a demand to extend the jetties which will have an adverse landscape impact on the lake.
Private marinas	In conjunction with the Keswick Launch Company, Derwentwater Marina and Nichol End Marina stand to gain most from any minimum water level management solution. Extreme low water events can place constraints on the ability of keel boats to navigate around shallower parts of the lake.
Outdoor activity centres	The nature of the craft used by the outdoor activity centres (for example, canoes and dinghies) mean low water levels will not compromise waterborne activites using these craft on the lake. However at low water levels the safety boat has navigation problems.
Visitors to the lakeshore	Neither the 'do nothing' option or any of the 'do something' options will affect people's ability to gain access to the lakeshore, or to enjoy any of the activites presently pursued along the lakeshore. None of the footpaths around the lake will be affected by any of the proposals.

Recreational Issue	Summary
Density and pattern of lake use	Presently, small craft such as canoes, row boats and small open motor boats account for a significant proportion (in the order of 60 %) of craft occupying the lake at any one time. The five passenger boats account for a relatively small proportion of the total number of boats using the lake. However, the passenger boats do account for a significant proportion of overall lake users which can represent 50% of all lake users. The pattern of lake use is strongly biased towards the northern end of the lake. In contrast, the southern part of the lake is quieter environment with fewer craft venturing into this area. The distribution of craft around the lake is in part a function of the location of access points for craft. None of the proposed water level management options would influence either the density or pattern of lake use. This is because the overall proportion of vessels standing to gain from minimum water level controls (passenger boats and keel boats) is relatively small. The pattern of lake use would not change because none of the options involves an alteration to any of the lake's access points.
Access points for craft	Under the normal range of naturally-occurring water levels at Derwentwater, none of the existing access points for craft would be affected by either the 'do nothing' or 'do something' scenarios. This is because none of the options would interfere directly with any public or private access point. Under the 'do nothing' scenario, there is a risk that the frequency of low water events adversely affecting access points for passenger craft and keel boats could increase if absolute minimum water levels continue to fall.
Environmental significance of recreational activities	
Disturbance of wintering wildfowl and breeding birds	There is anecdotal evidence that recreational users of the lake and shoreline cause disturbance to wintering wildfowl and breeding birds. Disturbance may take the form of people accessing on foot sensitive roosting or nesting areas along the shoreline, or through people sailing close to waterfowl on the lake itself or sheltering in reed beds. Disturbance is regarded as a problem because it displaces birds from their preferred roost. It is considered that the seasonal timing of extreme water level events (Summer months, *versus* an over-wintering period for wildfowl), in conjunction with the marginal effect of the management options on lakeshore nesting habitat, will not lead to an increase in disturbance of birdlife. This is not to say that disturbance is not an issue for the Park Authority, rather that there is little if any potential for the lake level management solutions to interact with the existing problem.

Recreational Issue	Summary
Scouring of lake bed by moorings	The scouring of the lake bed and macrophytes by chains is a recreation-related lake management issue that occurs because of the normal fluction in lake levels found on Derwentwater. If the minimum lake level continues to fall there may be a demand to move the moorings into deeper water, which could lead to the area of scouring being extended. The Park Authority's steps towards encouraging the use of non-scouring moorings will assist in redressing this problem. This would result in the proposed water level management solutions exerterting a neutral effect.
Erosion of shoreline habitats	At certain points, where the public can gain access to the lakeshore, additional erosion and trampling of shoreline habitats takes place during extreme low water events. Members of the public can stray into reed beds which are usually inaccessible. The proposed water level management solutions are unlikely to have any discernable impact on lakeshore erosion or access to (ordinarily) submerged areas of the lake. This is because exposed and unvegetated areas of shoreline result from trampling and naturally-occurring fluctuations in water level, rather than the more extreme 1 in 10 year events. When extreme low water events do occur, the management solutions would serve to reduce the maximum amount of exposed shoreline. This may represent a beneficial effect in landscape quality terms, but is small in relation to the area normally exposed.

Table 7.3

8. ARCHAEOLOGY

The main archaeological features that are associated with the lakeshore of Derwentwater are shown in Figure 7. These were obtained from Cumbria County Council's database containing the Sites and Monuments record and the positions of Listed Buildings from the database held by the Lake District National Park Authority. This map indicates that the main areas of archaeological interest are confined to the Islands and two areas within Brandelhow Bay and Great Bay towards the southern end of the lake. These are summarised in Tables 8.1 and 8.2.

Site	Number	Comments
St Herbert's Island	1102	Summer House remains
Lord's Island	1105	Earthworks
Lord's Island	1107	Manor House
Rampsholme Island	1108	
Fawe Park	1111	
Rampsholme Island	4462	
Derwent Isle	4904	
Brandelhow Bay	12039	Shown as to lake edge
Great Bay	12133	Shown as close to lake edge

Table 8.1: Sites and Monuments Register

Site	Number	Comments
Derwent Isle	238/2/12	Boat House
Derwent Isle	238/2/13	

Table 8.2: Listed Buildings

The majority of these sites are within the higher central areas of the Island, presumably built in such a location to minimise the risk of flooding, with the obvious exceptions being the Boat House on Derwent Isle and the Brandelhow Bay site.

The book 'Landscape and Society in Medieval Cumbria' indicates that there was a weir on the River Derwent at Portinscale, at the foot of Derwentwater. This is apparent as the field name Fisgardheved (fish-garth head) was recorded around 1210 AD. A 'Fishgarth', or fish weir, was a wooden structure across the water in the centre of which was a basket or net to trap fish. Placing such a structure at the point where water flowed from the lake into a river was a common fishing method in medieval Cumbria. Figure 26 in the book indicates, however, that by the 15th Century this fish trap was not being used to provide fish for the Honour of Cockermouth, consistent with the decline of other fisheries in the area.

Discussions with the book's author, an archaeologist at Lancaster University, revealed that the deed indicated that the "Fishgarth" was in fact downstream of the confluence of the River Derwent and River Greta. It is thought highly unlikely that any of the Fishgarth structure would have survived as these structures were typically made of wicker.

There is a possibility that unlisted industrial archaeological remains may be present at Copperheap Bay, as this area was formerly used to load boats with quarried materials, although this has not been confirmed.

9. AGRICULTURE

On the basis of a visual assessment, agricultural activity on the shores of Derwentwater generally comprises of rough grazing and semi-improved permanent pasture. The pasture is likely to comprise meadows used for growing hay or silage and then aftergrazed by livestock. The distribution of land use reflects the soil conditions, with the more intensively managed pasture occupying areas of relatively fertile soils that are also free draining. In some areas of the valley floor poor natural drainage may inhibit the productivity of what is otherwise likely to be relatively fertile alluvium.

Low lying agricultural land that is affected by variations in the lake level is mainly concentrated on the valley floor at the southern end of the lake. The land on the delta created by gravels and sediments deposited by the River Derwent at the lake inlet (Cannon Dub) is flat. Groundwater levels in this region are likely to be influenced by the lake level. The high water table is apparent in the preponderance of fen and wet grassland habitats in this area.

Open drainage channels have been created at Cannon Dub in an attempt to lower groundwater levels and improve the quality of the grazing. However the available falls for drains in this area are minimal and frequent flooding in the winter months leaves little scope for more intensive farming activity.

10. LANDSCAPE APPRAISAL

The national importance of Derwentwater and surrounding area in terms of its intrinsic natural beauty, wildlife and cultural heritage is recognised by its inclusion within the Lake District National Park. The area is of outstanding scenic beauty, hence the landscape of Derwentwater and any proposed changes to the landscape are important. The Lake District National Park Authority is governed by specific policies and legislative framework. These are described in Appendix A. A brief summary of the main aims is given below.

The National Park designation was first established under the National Parks and Access to the Countryside Act 1949, and subsequently amended by the Environment Act 1995. These acts set out the purpose of the National Parks as follows:-

1. To conserve and enhance the natural beauty, wildlife and cultural heritage
2. To promote opportunities for the understanding and enjoyment of the special qualities (of the Parks) by the public

The Lake District has particular renown for being at the forefront of the campaign which lead to the act and was subsequently one of the first National Parks to be designated in 1951.

The two purposes of the Parks are not necessarily mutually supportive such that conflicts could arise between them. The potential conflict between these two purposes was clarified by the 1974 Sandford Committee which stated that:-

> '..... *if it appears that there is a conflict between those (National Park) purposes, greater weight shall be attached to the purpose of conserving and enhancing the natural beauty, wildlife and cultural heritage of the National Park area'.*

This ensures that the quality of the landscape is maintained as a priority where the possibility of over-demand for use may otherwise lead to a decline.

Derwentwater is an area of outstanding scenic beauty.This beauty is derived from a combination of elements which create the unique character of the area including lakes, woodlands, traditional agriculture, settlements and open fells. The unique character is derived from a combination of geology, topography, climate, wildlife and the activities of man which have formed the landscape which we value today.

Derwentwater is situated within the north-west section of the Lake District, running along an approximate north-south orientation with the fells of Bleabury Fell and High Seat to the east and Cat Bells to the west. To the north a gently undulating open valley leads into Bassenthwaite with the Skiddaw group of fells behind. The valley is an open pastoral landscape with abundant trees and hedgerows. To the south lies the narrow, enclosed valley of Borrowdale, a steep sided valley of predominantly semi-natural woodland with rock outcrops.

The character of the hills reflects the geology which is split between the Skiddaw Slates (north /west) and the Borrowdale Volcanic Series (south / east). Bleabury Fell, High Seat and Borrowdale consist of high mountains and crags due to the erosion resistance of the volcanic material. The side slopes are steep and heavily wooded with rocky crag outcrops. Cat Bells and Skiddaw have a more rounded, softer appearance due to the greater susceptibility to erosion of the softer rocks. This results in gently sloping sides which are wooded to the bottom levels and sheep grazed grassland and bracken higher up.

The character of Derwentwater itself is quite varied. Some areas have been developed with the Derwentwater Boat Club and Keswick Landing stages forming artificial areas of lake edge. Other areas retain natural edges including reed beds and marsh at the inflow and outflow areas

whilst rocky banks and gently sloping shingle beaches occur along the sides. The edges of the lake are well wooded with trees coming down to the lake side throughout the majority of its length. In some areas it consists of a thin tree belt backed by pasture whilst elsewhere there is continuous woodland. The in and out flows areas are dominated by reedbed and marsh vegetation with some willow scrub. These areas are backed by the flatter ground of the valley floor forming open pasture.

Overall the lake has a very natural appearance. Although used by boats the appearance is not dominated by associated buildings, structures or navigational aids. The landing stages and boat houses are generally unobtrusive and constructed in a way which is in keeping with the character of the area. The town of Keswick is not visible from the lake, being hidden behind a rise in the landform such that the marina is the main area of development on the lake edge. Additionally the well wooded edges screen the road when viewed from the lake and shore such that any visual intrusion of vehicles is also low.

The area thus has a very high value in terms of its scenic beauty. The elements forming its character include the naturalness of the lake edges, woodlands, traditional buildings, hedgerows, stone walls and a backdrop of the high fells giving a distinctive landscape. This is therefore a very high value landscape which is potentially very sensitive to change.

11. WATER LEVEL MANAGEMENT OPTIONS

The lake level of Derwentwater varies, generally in response to rainfall conditions, with the extremes being flooding with heavy winter rainfall and exposed shoreline and lake bed in drought conditions.

The Environment Agency's level recorder data shows the variability of the lake level. The data shows a maximum of 77.01m AOD and a minimum of 74.38m AOD. This gives a range of 2.69m (almost 9 feet) and an average of 74.90m AOD. The normal summer water level is 74.76m AOD.

The Hydrological and Geological Report, Volume 1, identified that the lake level on Derwentwater is falling due to erosion of the lake sill. Although erosion of the lake sill would occur naturally, it has probably been increased by human influences.

Users of the lake have been adversely affected by the falling lake levels. One of the purposes of this study was to determine if the ecology and landscape had also been effected. The following management options have been investigated as a means of managing the minimum lake level.

11.1 Do Nothing

This entails allowing the sill at the mouth of Derwentwater to continue eroding. In turn, this will cause minimum lake levels to decline through time.

11.2 Map and Mark Obstacles

The introduction of warning buoys at strategic locations would allow limited navigation of the lake to continue under low water level conditions. Certain lakeshore access points may still be unusable for large craft. Maps could be made of the hazard areas and navigable channels at certain low water levels.

11.3 Dredge Boating Channels

Periodic dredging of specific channels would allow limited navigation of the lake to continue under low water level conditions. Dredging would entail a dredger being permanently located at Derwentwater, or being brought to Derwentwater as required. A dredging route would need to be agreed between the Lake District National Park Authority, the Environment Agency and the lake bed owners. For the commercial boat users the main areas of concern that may require dredging are the area near Derwentwater Marina and to the east of Derwent Isle and the landing stages at Nichol End Marine, Crow Park, Lodore, High Brandelhow and Hawes End. A dredged route would entail a route in and a route out of the landing stages. Once dredged the sediment would need to be disposed of. Three methods are available for this. The dredged sediment would have to be deposited in another part of the lake, spread on land or transported to a waste disposal site.

For land based disposal methods the water content of the dredgings needs to be reduced. This is generally done by stock piling on shoreline areas. The Environment Agency would also need to be consulted with regard to exemption certificates for spreading on land and for disposal at waste sites. Transport would need to be undertaken by registered carriers and chemical testing would generally be required on the dredgings before disposal.

11.4 Permanent Weir

Two options have been considered for the silting of a weir, shown on Figure 8. The first option is at the river mouth and the other just downstream from the lake outfall. This option would aim to maintain minimum lake levels at 74.61m AOD. This level is close to the minimum lake level recorded in 1893 (74.65m AOD) but greater than the 1995 minimum lake level of 74.38m AOD. Under ordinary lake levels and flow conditions in the River Derwent, the weir would be submerged. Naturally-occurring fluctuations in lake level would remain unchanged, apart from the extent of the extreme minimum water levels. In effect, the absolute minimum water level in the lake would be increased by 0.23m when compared to the 1995 minimum lake level. An access point for construction and maintenance of the weir would be required.

An alternative option for the design of the weir would be a shallow 'V'. This would be totally submerged during normal flow conditions. However, under low flows, the water would be concentrated in the lower central section and the edges may be exposed.

11.5 Temporary Weir

The temporary weir would be located near the outfall of the lake, as shown on Figure 8. This location allows access for the construction and removal of the weir. The outfall of the lake is the most suitable position for a temporary weir. The water is relatively shallow at this location, which would allow easier access for installation and removal of the stop logs. it would also require less stop logs than the location further downstream, hence maintenance would be easier and storage requirements would be less. The positioning of the boards would be implemented when low water level events are predicted in order to maintain lake levels to a minimum of 74.61m AOD. Once low lake level conditions are over the weir would be removed and stored for the next event. A nearby storage location would be required and a system set up to determine who would be responsible for the temporary weir and when it would be installed.

11.6 Maintain Present Minimum Water Level

This may be achieved by either constructing a weir or by protecting the sill.

For the weir option a temporary or permanent weir could be constructed as described above. However, the weir would be designed to maintain a lower minimum lake level, possibly the 1995 minimum lake level and would thus require a relatively smaller construction.

Protection of the sill may be achieved by placing suitable sized protective gravel or cobbles (rock armour) over the sill.

Further work would need to be undertaken to determine the feasibility of this option. This would include, determining the extent and ground conditions of the sill.

By visual inspection and hydraulic models, and by using the knowledge of the ground conditions, the size and exent of the rock 'armour' to be placed may be determined. A source of rock armour would need to be located. Construction access and the method of placing the rock armour would also need to be determined.

12. POTENTIAL IMPACTS OF VARIOUS WATER LEVEL MANAGEMENT OPTIONS

The potential impacts of the various options are discussed below. The methodology for the landscape and visual impacts is described in Appendix A. The methodology and details for the ecological impacts are discussed in more detail in Volume II, the Ecological Appraisal.

The impacts of each option are discussed with reference to the following, lake level/hydrology, ecology, recreation, archaeology, agriculture, landscape and maintenance.

12.1 Do Nothing

If nothing is done the degree of the potential impact depends upon the rate of erosion of the lake sill. Erosion of the sill is a natural process which will continue to occur, however as discussed in the hydrological and geological study (Volume 1) it appears that the sill erosion has been occurring in "fits and starts" with periods of slow, gradual erosion being separated by periods of increased erosion. This is likely to be a consequence of both natural and human influenced factors and is difficult to attribute to any one factor or to predict future rates.

12.1.1 Lake Level/Hydrology

Continued erosion of the sill, at any rate, will result in increasing incidences of low water even if climatic factors do not change. Some measure of the degree to which this may occur with increasing frequency can be gained by comparing the recorded lowest lake level (74.38m AOD in 1995), with that experienced in 1893 (74.65 m AOD).

12.1.2 Ecology

The do nothing strategy could have several potential ecological impacts. Marginal vegetation and riparian habitats could be adversely affected if they are unable to adjust to lower water levels, or if freshly-exposed riparian habitat were unsuitable for colonisation. The biological consequences of a do-nothing scenario are very dependent on the rate of change brought about by declining water levels, and the capacity of flora and fauna to respond to this change. From an ecological management viewpoint, the main concern is that it is difficult to predict long-term future changes in the physical environment of the lake brought about by erosion of the glacial sill. In turn, it is not possible to determine the impacts, both positive and negative, that may arise. Conversely, from a positive viewpoint, a do-nothing scenario will lead to no interference in what is a semi-natural aquatic system.

12.1.3 Recreation

As the sill erodes and the frequency of low lake levels increases, the frequency of the navigational problems of the commerical boat users will increase. Near surface obstructions and restricted access to landing stages can be hazardous.

Constraints are also placed on the ability of keel boats and the safety boat from an outdoor activity centre to navigate around shallower parts of the lake. The increasing frequency of low water events with the associated navigational problems may incur reduced revenue and additional costs for the commercial boat users.

12.1.4 Archaeology

Under the do nothing option a decline in lake levels would be expected, although the rate of fall is difficult to predict. The majority of sites would be unaffected by this, although the listed boat house on Derwent Isle could be adversely affected if lake levels continue falling.

As lake levels fall access to Lord's Island by foot will become possible, leading to an increased risk of disturbance to the archaeological sites on this island.

12.1.5 Agriculture

If minimum water levels continued to get lower this is likely to cause an increase in the periods during which these areas are relatively dry. A marginally increased use of the area could therefore be made for grazing animals, although this would be for relatively short periods at intermittent intervals that would be very unlikely to have a lasting impact on the agricultural value of the land.

12.1.6 Landscape

The potential impact of such a water level on the exposed shoreline of Derwentwater varies depending on the steepness of the shoreline. The estimated exposed shore for the 1995, 74.38m AOD level and the proposed weir water level of 74.61m are shown on Figure 9. The exposed shoreline has been determined from a bathymetric chart, while the notes are visual observations of the 1995 minimum lake level, as reported by the Lake District National Park Authority and the Environment Agency. In steep areas the difference is insignificant. However, where the shoreline is shallow and gently shelving, particularly at the in/out flow areas, the difference may be between 74m and 140m (Figure 10). Figure 11 indicates the further minimum level exposed shoreline if the sill continued to erode by approximately 0.5m. This figure is based on bathymetric chart information and are indicative only.

The impact thus varies with the gradient of the shoreline with gently shelving shingle beaches being more sensitive to a specific level decrease than a steep rock face. The overall effect would be an exaggeration of the current indents to the lake margin including the potential reattachment of some islands to the mainland during low water level periods.

In time this effect will be detrimental to the views of the lake, the degree and time scale involved depending on the actual rate of erosion and incidences of low rainfall. Close and long distance views will be more affected than mid distance ones where the edge of the lake is not visible due to sharp breaks in slope and screening vegetation.

Additionally, a potential indirect effect of doing nothing may include the long term demand for development along the lake shore as jetties and boathouses are left high and dry by receding water levels. This pressure already exists to some degree, with the 1995 low water level causing access problems to the boating community. Though this would involve features which already exist and form part of the character of the area the scale and extent of the development is critical to retaining the scenic quality of the area. Extended development could tip this balance.

The visual impacts of doing nothing can thus be summarised as follows :-

- With associated increased development :-
  Short distance views - from lake and shoreline - substantial adverse impact.
  Middle distance views - from valley sides - moderate adverse impact.
  Long distance views - from adjacent fells - slight-moderate adverse impact.
- Without associated increased development :-
  Short distance view - from lake and shoreline - moderate adverse impact.
  Middle distance views - from valley sides - slight-moderate adverse impact.
  Long distance views - from adjacent fells - slight adverse impact.

The 'do nothing' option would have a negative impact on the landscape quality in its effect on the relationship between open water, shoreline and surrounding woodland. This would be

intensified by the extensions of jetties and boathouses required for a sustained lower water level.

12.1.7 Maintenance and Costs

The do-nothing option would have no construction or maintenance costs, however, jetties and boat houses may need to be extended to allow access to the lake.

12.2 Map and Mark Obstacles

As this option does nothing to counteract the possible decrease in lake levels it should be noted that all the impacts discussed in section 12.1 for the 'do nothing' option will also apply to this option.

12.2.1 Lake level/Hydrology

Continued erosion of the sill, at any rate, will result in increasing incidences of low water even if climatic factors do not change. Some measure of the degree to which this may occur with increasing frequency can be gained by comparing the recorded lowest lake level (74.38m AOD in 1995), with that experienced in 1893 (74.65 m AOD).

12.2.2 Ecology

This option does not address the problem of falling lake levels, the impacts for the do-nothing scenario will still exist.

The buoys that are used to identify obstacles to navigation will cause scouring of lake bed and macrophytes. The scouring occurs due to the normal fluctuations in lake levels. However if the minimum lake level continues to fall there may be a demand to move the moorings into deeper water. This may lead to the area of scouring being extended. However the use of non-scouring moorings will assist in redressing this problem.

12.2.3 Recreation

This option aims to alleviate the negative impacts on recreation by the introduction of warning buoys at strategic locations, allowing limited navigation of the lake to continue under low water level conditions. Although this would reduce the risk of navigation incidents access problems would still be encountered at the jetties.

However, the lake levels would continue to fall which would lead to an increase in the frequency of when the buoys were used, and the possible determination of new routes as the lake level decrease.

12.2.4 Archaeology

As this option does nothing to counteract the falling lake levels it should be noted that any impacts associated with the 'do nothing' option will also apply to this option. In addition, if any markers are required in the area of Copperheap Bay they should be placed carefully in order to prevent any disturbance to any as yet unidentified archaeological remains which could be lying beneath the lake.

12.2.5 Agriculture

If minimum water levels continued to get lower this is likely to cause an increase in the periods during which these areas are relatively dry. A marginally increased use of the area could therefore be made for grazing animals, although this would be for relatively short

periods at intermittent intervals that would be very unlikely to have a lasting impact on the agricultural value of the land.

12.2.6 Landscape

Buoys would cause an introduction of man-made elements into the landscape of the lake. Elements such as landing stages and boating facilities already exist, and are discreet and distinct in their location. Buoys would cause an increase in the scale of these elements and spread their location over a large part of the lake.

The buoys would be visible at low and middle distance viewpoints but would probably not be discernible in long distance views, with the magnitude of the impact generally decreasing with distance. Although there may be a certain level of expectation on the part of the viewer to the presence of such objects on the lake, based on the lakes current natural appearance we would assess the visual impact of marking obstacles is assessed as follows :-

Short distance view - from lake and shoreline - substantial adverse impact.
Middle distance views - from valley sides - slight to moderate adverse impact
Long distance views - from adjacent fells - no change to slight adverse impact.

Short-term disturbance of lake sediments during hazard marking would be insignificant in comparison with naturally-occurring processes.

12.2.7 Maintenance

Limited costs would be encountered for the mapping, installation and maintenance.

12.3 Dredge Boating Channels

Again this option does nothing to counteract the possible decrease in lake levels such that all the impacts discussed in section 12.1 for the 'do nothing' option will also apply to this option.

The impact of this policy will depend on currently unknown factors such that assumptions are required at this stage to allow an assessment to be made. These factors include the following:-

- The frequency at which dredging will be required (siltation rates are unknown).
- Number of dredgers required.
- The system of the dredger - suction or bucket operated.
- Associated buoys - line of buoys around area or along line of suction pump for navigation warning.

There are also two options for the disposal of the dredgings; removal or redistribution. Whichever option is taken up for the disposal the overall impact would be intermittent due to the periodic nature of the activity.

12.3.1 Lake level/hdyrology

Continued erosion of the sill, at any rate, will result in increasing incidences of low water even if climatic changes do no not change.

12.3.2 Ecology

There are several negative ecological impacts of dredging the boating channels. Dredging operations will inevitably give rise to the disturbance and resuspension of sediments from the lake bed. Increased sediment deposition rates on fish spawning grounds could exert an adverse effect and the internal dynamics of phophurus may also be effected. This may temporarily enhance de-oxygenation rates through the resuspension of nutrients within the lower part of

the water column. In turn, this could exert a short-term negative effect on fish species associated with the deeper parts of the lake, such as vendace. This effect would probably be minor when compared with the natural process of sediment re-suspension.

In addition, the dredger will need to gain access to areas of the lake which are significant for wildfowl. This could cause disturbance to wildfowl if undertaken during inappropriate seasons, although it is likely that the timing of dredging activities could be scheduled to minimise disturbance.

Dredged sediments will need to be transported and deposited at a suitably licenced facility. Care will need to be taken to ensure that disposal of dredgings does not lead to the inadvertent release of flora and fauna into other water bodies.

12.3.3 Recreation

This option aims to alleviate the negative implications of low water level for navigation by the periodic dredging of specific channels to allow limited navigation to continue under low water level conditions.

With this option there is also an additional negative implications to consider regarding recreational safety, noise and visual impact when the dredger and suction equipment are in use.

As in 12.2.1, map and mark obstacles, this option does not stop the falling lake levels. By dredging channels, the landing stages and routes may be more accessible. However dredging would probably be to a specific route in and out of the landing stages. As lake levels decrease the frequency of dredging the channels will increase.

12.3.4 Archaeology

As this option does nothing to counteract the falling lake levels it should be noted that all the impacts associated with the 'do nothing' option will also apply to this option. The potential for damage to as yet unidentified archaeological remains in Copperheap Bay would be greater during dredging operations than for the map and mark obstacles. If any dredging were to be required in these areas, therefore, an archaeological investigation should be carried out beforehand to assess the potential risk to archaeology.

12.3.5 Agriculture

If minimum water levels continued to get lower this is likely to cause an increase in the periods during which these areas are relatively dry. A marginally increased use of the area could therefore be made for grazing animals, although this would be for relatively short periods at intermittent intervals that would be very unlikely to have a lasting impact on the agricultural value of the land.

12.3.6 Landscape and Noise

Generally there would be the visual and noise impacts of the dredger in operation, with associated buoys. If the dredgings are disposed of off site to a licensed waste disposal site there will be the additional impact of heavy lorries creating noise and additional traffic, possibly with extended routes through the National Park and beyond. The redistribution of material within the lake would create a greater visual impact due to the effect on the colour of water by disturbed sediment, especially in long distance views from the fells. Redistribution of the dredgings by spreading on land would require approval from the Environment Agency and transport to the site. This would also cause a limited visual impact at the spreading site.

The visual impacts of dredging can thus be summarised as follows :-

Short distance view - from the lake and shoreline - slight-moderate adverse impact.
Middle distance views - from valley sides - slight adverse impact
Long distance views - from adjacent fells - slight adverse impact.

12.3.7 Maintenance & Costs

Before disposal to a waste disposal site the metal level and other chemical parameters of the sediment must be determined, especially given the history of mining within the Derwentwater catchment. This will then determine the cost and which landfill site the sediment may be disposed too.

Dredging will need to be undertaken on a regular basis, and this therefore represents an ongoing, long-term management option.

Costs would include the determination of the dredging route, dredger boat costs, and the transport and disposal of the sediment costs. Costs would be ongoing.

12.4 Permanent Weir

This option proposes the construction of a permanent weir downstream from the lake outfall.

12.4.1 Lake Level/Hydrology

The weir would be designed to maintain lake levels to a minimum of 74.61m AOD. The figure is close to the minimum recorded level in 1893 (74.65m AOD). Naturally occurring fluctuations in lake level would remain largely unchanged, apart from the extent of extreme minimum water levels. (See Appendix C). In effect, the minimum water level in the lake would be increased by 23cm, when compared to the 1995 minimum level of 74.38m AOD.

12.4.2 Ecology

The ecological impacts of a permanent weir would be limited as the weir would exert an influence on the physical characteristics of the lake only during periods of unusually low water levels. The naturally-fluctuating conditions along Derwentwater's lakeshore habitats would effectively remain unchanged, although the absolute minimum level would be increased by 23cm. In ecological terms this is most unlikely to represent any constraints to the status of habitats or individual species. Construction works could be timed to avoid fish migration and spawning periods.

Raising the minimum water level by means of a weir option will have no significant effect on the thermal characteristics of the lake. There will be no negative impacts to fish caused by a weir. Salmon and sea trout are unlikely to be impeded by the proposed weir.

An access point to the weir would be required for both the construction and operation phases of the development. This would require the sensitive location of vehicle access routes to ensure that localised damage to terrestrial and riverine habitats was kept to an absolute minimum. Both sides of the river provide possible access points, although the campsite side is not as ecologically important as the wetlands to the west.

12.4.3 Recreation

Raising the minimum water level will reduce some of the navigation problems experienced by the commercial boat users and the marinas.

12.4.4 Archaeology

This option will raise the minimum lake levels and thus will provide a positive impact by avoiding the impacts associated with the 'do nothing' option. Maximum lake levels would not be increased by this option and no impacts on the archaeological heritage of the area would be caused by the new lake level regime. No sites of archaeological interest have been identified at the site of, or along the access routes to, the proposed location of this weir. Construction of the weir would not have any impact on the archaeology of the area.

12.4.5 Agriculture

The effect of any carefully designed solution to the minimum lake level problem will not lead to increases in flooding of these areas. The hydraulic assessment has demonstrated that flood flows and levels would be unaffected by a weir (Appendix C). Similarly any under-drainage systems discharging to the lake or to the river upstream of the lake should remain unaffected since these drains should discharge above the 'normal' water level. The average water level in the lake is 74.95 mAOD and the hydraulic analysis shows that the frequency at which this level is exceeded would not be increased by raising the minimum lake level by a weir.

12.4.6 Landscape

The stretch of river where the weir would be constructed has earth banks, steep and bare in places whilst grassed in others (see Figure 12). The rivers edge has some areas of marginal vegetation backed by rough or mown grassland. Scattered groups of scrub and mature trees effectively screen the site from long and mid distance views such that the only views are immediate from the adjoining hotel grounds and campsite (Figure 8).

The proposed form of a weir would be a shallow 'V' which would be totally submerged during normal flow conditions and not visible. However, under extreme low flows, water would be concentrated in its lower central section such that the edges may be exposed. Rock abutments would be required on either bank side.

Due to the size and scale of the construction required and the limited view points the visual impact of a weir would be slight. The weir would be visible from the hotel grounds and camp site. However, mid and long distance views would be insignificant due to the screening by intervening vegetation.

The construction of a weir would constitute the introduction of a man-made element into a natural river bed. This would have a negative impact on the landscape quality, although this impact may be minimised by detailing in character with the area and due to the level of expectation of such a structure sited in such a location.

The visual impacts of a weir can thus be summarised as follows :-
Short distance view - from camp site and hotel grounds - slight-moderate adverse impact.
Middle distance views - from upper floors of adjacent houses - no change.
Long distance views - from adjacent fells - no change.

An additional though temporary visual impact of a weir would be its construction. This would create a short term negative impact but would be minimised by the scale of the proposal requiring a short construction period.

As this option does affect the falling lake levels it does not suffer from the impacts associated with increased width of the shoreline common to the 'do nothing, 'map and mark obstacles' and 'dredging' options. It thus has a positive visual impact associated with the reduction of unsightly exposed shoreline and a positive navigation impact.

12.4.7 Maintenance and Costs

Costs would be required for ground investigations to determine the ground conditions, design and construction of the weir, maintenance of the weir, supervision and checking that it is in compliance with the Reservoirs Act 1975 (discussed in section 12.7).

12.5 Temporary Weir

12.5.1 Lake Level/Hydrology

This option would consist of a temporary construction of boards to be fitted between permanent posts located near the outfall of the lake. The positioning of the boards would be implemented when low water level events are predicted in order to maintain lake levels to a minimum of 74.61m AOD.

12.5.2 Ecology

The ecological impacts of a temporary weir are similar to those of the permanent option.

12.5.3 Recreation

Raising the minimum water level will reduce the navigtional problems experienced by the commercial boat users and marinas. However, the possible hazard to recreational use of the river would also have to be considered. In high flow conditions, the posts would be submerged which could form a hazard to canoeists and other boat users on the lake.

12.5.4 Archaeology

This option will raise the minimum lake levels and thus will provide a positive impact by avoiding the impacts associated with the 'do nothing' option. Maximum lake levels would not be increased by this option and no impacts on the archaeological heritage of the area would be caused by the new lake level regime. No sites of archaeological interest have been identified at the site of, or along the access routes to, the proposed location of this weir. Construction of the weir would not have any impact on the archaeology of the area.

12.5.5 Agriculture

The effect of any carefully designed solution to the minimum lake level problem will not lead to increases in flooding of these areas. The hydraulic assessment has demonstrated that flood flows and levels would be unaffected by a weir (Appendix C), and in any case the stop logs would not be in place during wet periods. Similarly any under-drainage systems discharging to the lake or to the river upstream of the lake should remain unaffected since these drains should discharge above the 'normal' water level. The average water level in the lake is 74.95 mAOD and the hydraulic analysis shows that the frequency at which this level is exceeded would not be increased by raising the minimum lake level by a weir.

12.5.6 Landscape

The proposed location is approximately 30 m up river from that of the permanent weir. The river is thus similar with earth banks and marginal vegetation (Figure 12). Again scattered groups of scrub and mature trees effectively screen the site from long and mid distance views such that the only views are immediate from the adjoining hotel grounds and campsite. Potential views from the lake itself are screened by reed beds and minimised by a slight bend in the river (Figure 8).

The posts and levelled bed will be the only permanent structures. Due to their small size and the limited visibility of the location the visual impact would be slight. The installation of permanent posts would change the character of the river bed. However, this effect is minimised by the expectation of such structures in this sort of location and the scale of the items required. The visual impacts of the weir can thus be summarised as follows :-

Short distance view - from the lake, camp site and hotel grounds - moderate adverse impact.
Middle distance views - from upper floors of adjacent houses - no change.
Long distance views - from adjacent fells - no change.

It is assumed that storage space for the boards would be available within a local boathouse. The impacts would be potentially increased should a new storage structure be required.

Again this option arrests falling lake levels, eliminating the impacts of increasing exposed shore.

12.5.7 Maintenance and Costs

The operation and management of the weir would require more input from the 'owners'. The weir would have to be carefully designed to ensure that the placement and removal of boards was manageable and to ensure that the risk of vandalism was minimised. The Reservoirs Act 1975 would still have to be adhered to. Careful consideration would have to be given to the method of removing the stop logs after low water level periods to ensure that excessive river scour does not occur.

Costs would be required for a ground investigations, design and construction, maintenance and storage of the locking mechanisms for boards, manpower costs for installation and removal. Costs would also be required for supervision, in compliance with the Reservoirs Act 1975.

12.6 Maintain at Present Levels

12.6.1 Lake Level/Hydrology

This would entail preventing the minimum lake level from falling below the 1995 74.38 m AOD level. This may be achieved by two possible options, the construction of a permanent weir or by protection of the sill.

The construction of a permanent weir would be as described for that of a permanent weir to raise the minimum lake level. However, it would be designed to maintain a lower minimum lake level. Generally the impact of this option would be that of the higher permanent weir. A slightly smaller weir would be required which would be less exposed in low flow conditions. The overall impacts would thus be fractionally smaller.

Another option would be to protect the sill. This may be achieved by placing additional rock armour on the sill. This may be slightly larger sized river gravel than that on the existing sill. The extent and size of the rock armour and viability would be depended on physical investigations on the existing situation. This option would require the transport of river gravel to the site.

The source of the gravel would have to be carefully investigated. The source would have to be similar to that existing. It would also have to be washed before placing to prevent disease.

12.6.2 Ecology

From an ecological management perspective, this option would ensure that the lake's existing physical characteristics, which contribute to its high biological status, are maintained. With future lake levels 'fixed' at a present day minimum level, reasonable confidence could be attached to ensuring the ongoing, long-term biological status of the lake. In addition, water level issues could be eliminated from any future investigations that may be required to investigate changes in the status of a species or habitat.

12.6.3 Recreation

By maintaining the existing sill levels, under the same climatic conditions this should maintain the existing fluctuating lake levels. This will result in the commercial boat users and marinas still experiencing navigational problems. However the chance that the low lake level occurs should remain at 10%.

12.6.4 Archaeology

By maintaining the existing sill levels, under the same climatic conditions this should maintain the existing fluctuating lake levels. This will therefore have no effect on the archaeological remains in or around the lake.

12.6.5 Agriculture

Protecting the sill will not increase the frequency of the flood events. The fluctuations in lake level should remain the same, as the existing fluctuations. Hence there should be no change to the effects that Derwentwater already has an agriculture.

12.6.6 Landscape

This option will arrest the falling lake levels, eliminating the impacts of increasing exposed shore. Providing suitable material is used armouring the sill would have a lesser visual impact than the weir.

12.6.7 Maintenance and Costs

Costs would be required for a study to determine the feasibility of this option. This would include topographic and ground investigations, computer modelling and visual inspection. Rock armour from a similar source would have to be identified and transported to site. Costs would also be incurred in the placement of the rock armour. Maintenance could be by visual inspection and by reviewing hydrology data. Rock armour would need to be replaced as required.

This method of protection of the sill is not regulated by the Reservoirs Act 1975 as it is not 'retaining water'.

12.7 Legislation Regarding Construction of a Weir

Various legislative requirements may have to be addressed if a weir is proposed. These are summarised below.

If a weir retains or is capable of retaining a volume of water in excess of 25,000m^3 then a 'large raised reservoir' would be formed. The proposed weir would retain in excess of 25,000m^3 under certain conditions and this would therefore mean that the requirements of the Reservoir Act 1975 would be applicable.

The purpose of the Reservoirs Act 1975 is "to make further provision against escapes of water from large reservoirs or from lakes or lochs officially created of enlarged. This requires that any weir structure must be properly and safely designed and constructed under the supervision of a suitably qualified engineer.

Details of the roles and responsibilities under the Reservoir Act 1975 and the Panel Structure for Engineers appointed under the act are included in Appendix B.

The 'Engineer' requirements that would result from adopting a weir solution that involves the Reservoirs Act 1975 are as follows:-

- An "All Reservoirs Panel (AR) Engineer" would have to be appointed for design and construction supervision.
- A separate "All Reservoirs Panel Engineer" would have to be appointed for subsequent inspection (frequency not greater than 10 years). This would generally involve one site visit and the submission of an inspection report.
- A "Supervising Engineer" would have to be appointed for supervision (on a continuous basis). Approximately 2 visits per year and an annual submission statement would be required.

A permanent weir may have benefits in preference to a temporary weir, with regard to satisfying the requirements of the Act, although permanent construction with inbuilt flexibility to provide temporary water retention to a specified level may be appropriate (eg a stop log arrangement). The requirements of the Reservoirs Act 1975 would apply, whether a permanent or temporary solution is adopted. An appointed authority would be required to keep a statutory record in accordance with the Reservoirs Act 1975.

12.7.1 Cost Estimate

Panel Engineer	Cost to be included in design costs.
Panel Engineer for inspection	Approximte cost £1000 every 10 years, say £100 per year.
Supervising Engineer	£500 per year.
Statutory Record by Appointed Authority	£500 per year.
Approximate yearly costs	£1100

13. POTENTIAL MITIGATION MEASURES

13.1 General

The potential impacts of the various options may be decreased by the incorporation of mitigation measures. These possibilities are discussed below for each option.

13.2 Water Level Management Options

13.2.1 Do Nothing

The effects of increasingly low water levels can not be mitigated. The associated pressure for development may be resisted although this may have negative impacts on the viability of the two marinas and launch company.

13.2.2 Map and Mark Obstacles

Some mitigation of the impacts may be achieved by :-

- Restricted number of buoys, limited to the minimum number required to ensure safety.
- Buoys to be installed only during incidents of low water levels.
- Resist associated pressure for development
- Use non-scouring Buoys

13.2.3 Dredge Boating Channels

Some mitigation of the impacts may be achieved by :-

- Restricting the area of lake to be dredged
- Restricting the number of dredgers operating
- Using quieter suction dredgers
- Minimising the associated buoys required
- Operations to avoid weekends, high season and bank holidays

13.2.4 Permanent Weir

A significant degree of mitigation may be achieved by :-

- Restricting the scale of the construction to the minimum necessary
- Designing to ensure a more 'natural' appearance, especially where the weir is likely to be exposed at low levels
- Investigating the possible use of reinforced earth as opposed to rock abutments to achieve a softer edge more in keeping with the existing character of the bank sides.
- Restricting the working area during construction to the absolute minimum necessary.
- Planting of appropriate tree and shrub species to reinforce existing screening and minimise the visual intrusion. Such planting would be in character with the existing vegetation and the incorporation of willow would ensure that it was quick to establish and take effect.

13.2.5 Temporary Weir

Some mitigation of the impacts may be achieved by :-

- Keeping the number of posts required to a minimum.
- Storing boards within an existing building.
- Detailed design of storage shed, should it be required, to be in character with the area in a traditional, vernacular style.

13.2.6 Maintain at Present Levels

Mitigation measures would be as discussed in section 13.2.4 for the weir option.

For the protection of the sill option some mitigation of the impacts may be achieved by:

- Ensuring the rock armour is of a similar source to the existing, natural sill protection.
- By further investigation, restricting the size of the imported rock armour.
- Limiting the extent of the protection.

14. DISCUSSION

A review of the technical, environmental and socio-economic issues relating to the management options indicate that the 'do nothing' option may potentially have the greater risks.

Under the 'do nothing' option, the sill at the mouth of Derwentwater would continue to erode. Erosion of the sill is a natural process, which has occurred at various rates since the last glaciation. This is due to the sill being composed of layers of material with differing resistance to erosion. Over the past 100 years human influenced events may have triggered additional erosion. Future erosion rates are likely to be variable and are difficult to predict. Examination of long term records indicates that at present there is 10% probability in any one year that the minimum lake level experienced in September 1995, or lower, will occur. The probability of this lake level occurring will increase as the sill erodes further, assuming climate does not change.

As the ecology of the lake is a dynamic system, it is difficult to predict long-term future changes in the biological resources of the lake brought about by erosion of the sill. Marginal vegetation and shoreline habitats would be adversely affected if they were unable to adjust to lower water levels. Freshly exposed, shoreline habitats may be unsuitable for colonisation. Biological impacts are dependent on the rate of change brought about by declining water levels and the capacity of flora and fauna to respond to this change. However, by doing nothing there would be no interference in the existing semi-natural aquatic system.

The Keswick Launch Company and private marinas have navigational and access problems during periods of low water levels. Safety boats also have navigation problems during low water. If the 'do nothing' option is followed, the frequency of the low water events and hence the occurrence of navigational problems will increase, if no changes in climate occur.

In areas where the shoreline is shallow, particularly at the inflow and outflow areas, as the sill erodes the frequency and extent of exposed shoreline will increase. With time this effect will be detrimental to the views of the lake, with the extent and timescale dependent on the actual rate of erosion and incidences of low water. The 'do nothing' option would have a negative impact on the landscape quality in its effect on the relationship between open water, shoreline and surrounding woodland. This would be intensified by the extension of jetties and boathouses required at a sustained lower water level.

The 'do nothing' option would have no construction or maintenance costs, however commercial boat users may find with the increasing frequency of low water events that revenue decreases if the navigable area if the lake is reduced and landing stages are inaccessible. There may also be additional costs if jetties and boat houses are extended.

To prevent the above scenario from fully occurring it may be advisable to adopt a policy of managing the minimum lake level.

Of the management options discussed in the report, the 'map and mark obstacles' and 'dredging' options do not address the basic problem that lake levels are falling. Thus the problems of restricted navigation and the visual impact of exposed shoreline would persist.

In addition, these management options have various negative environmental impacts associated with them.

The permanent and temporary weir option could increase the minimum lake level. The main positive impacts of a proposed weir would be a reduction in the navigation and visual impact problems. However, a temporary weir has increased hazards due to submerged posts. Both the weirs would be required to comply with the Reservoirs Act 1975. This requires design,

supervision and annual submission by a Panel Engineer and Supervising Engineer. The main beneficiaries would be the commercial boat users.

The option to maintain the present water level by protection of the sill would still have the probability of the 1995 low water event occurring 1 in every 10 years, however, this rate should not increase. The fluctuations in the water levels and exposed shorelines would remain as existing.

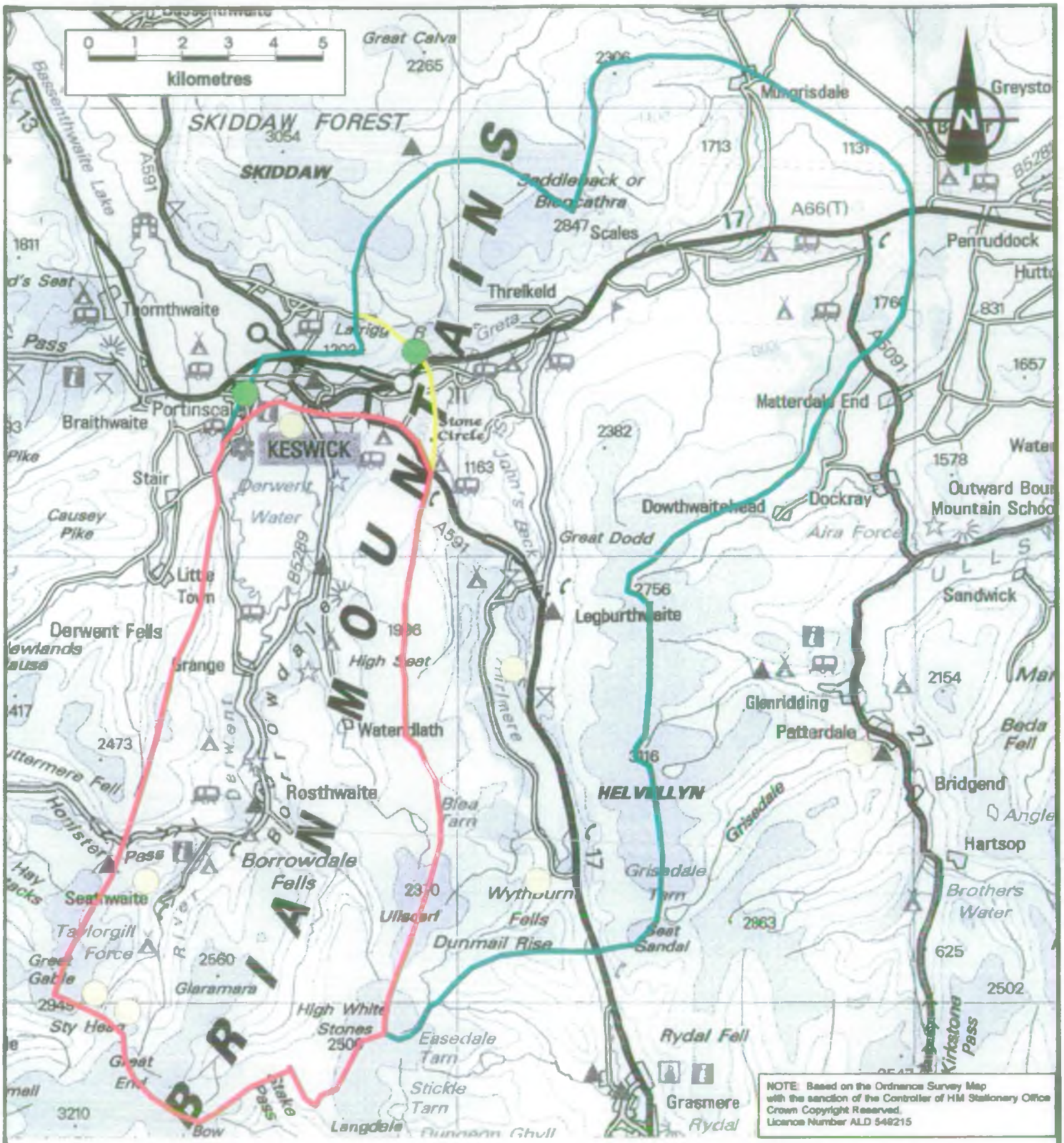
Navigational problems at low water events will still exist, but should remain at a 1 in 10 year probability of occurrence in any one year.

The 'maintain at present levels' option would preserve the biological resources of the lake within an understood and well defined naturally - fluctuating system. These naturally-occurring fluctuations do not compromise the statutory designations conferred upon Derwentwater. For example, candidate Special Area for Conservation, Site of Special Scientific Interest and Salmonid Fisheries. The lake's status as a site of county importance for wintering wildfowl and breeding resident birds should also be placed in the context of a frequently changing, dynamic system of lake levels. Individual species protected by law, for example, the vendace and the floating water plantain, and naturally-scares species such as the fine leaved water dropwort and the brook lamprey, remain unaffected by natural fluctuations in lake level. Maintaining current minimum lake levels would therefore not compromise the international status of the lake.

As this option would not be retaining water but protecting an existing sill, the Reservoirs Act 1975 would not apply. However, it is still anticipated that visual inspection and review of hydrology data would be required to monitor the sill level.

Further work would be required to determine the detailed feasibility of this option.

FIGURES



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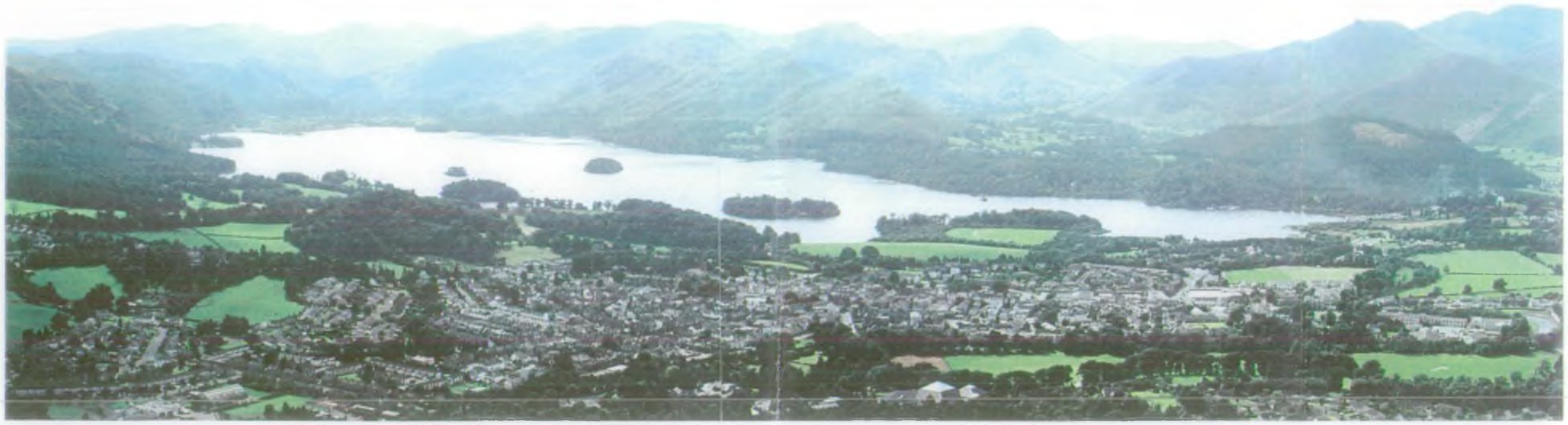
NORTH WEST REGION

Lake District National Park Authority

Derwentwater
January 1999
Approximate position of catchment boundaries, raingauges and flow gauging stations.
55390
Figure 1



PHOTOGRAPH No 1 - Long distance view from Langtrigg Fell

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Lake District
National Park Authority

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Figure 2

PHOTOGRAPH No.2 - View over marsh area to southern end of Derwent Water around the inlet

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National Park Authority

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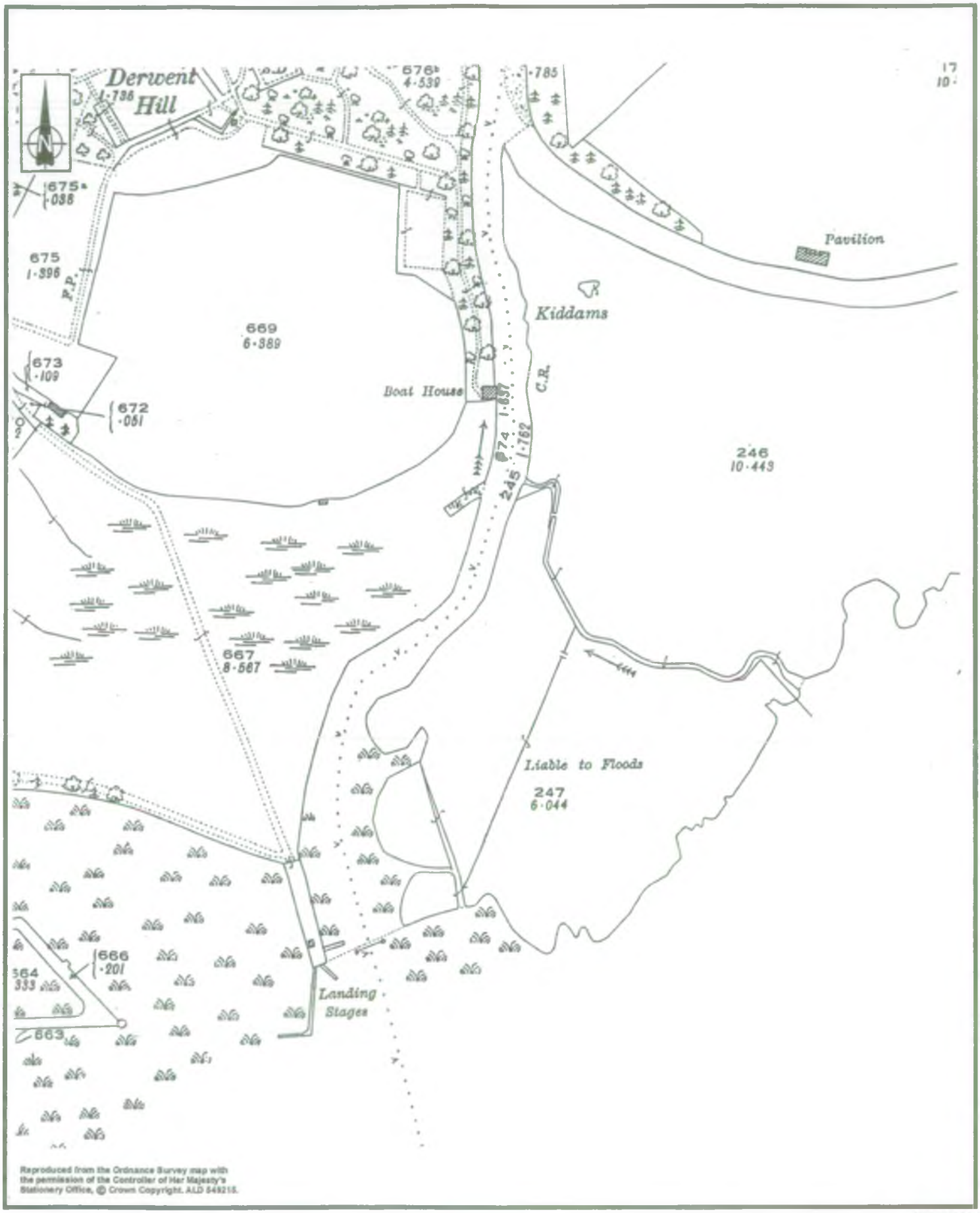
Figure 3



Scale 1:2500

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Derwentwater
January 1999
Historical Map - 1925 (Ordnance Survey Sheet - Cumberland LXIV. 6.)
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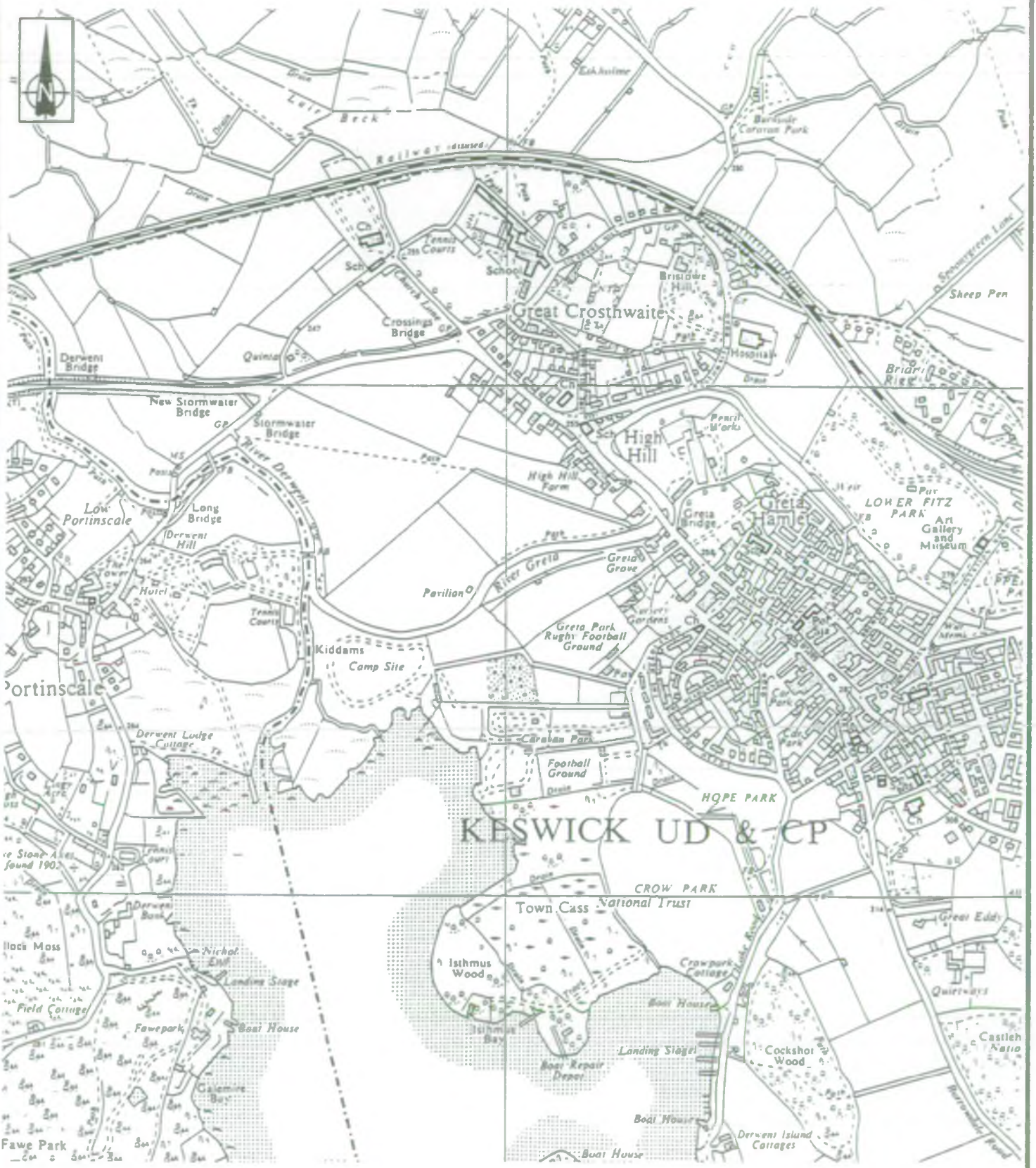
Figure 4



Scale 1:10,560

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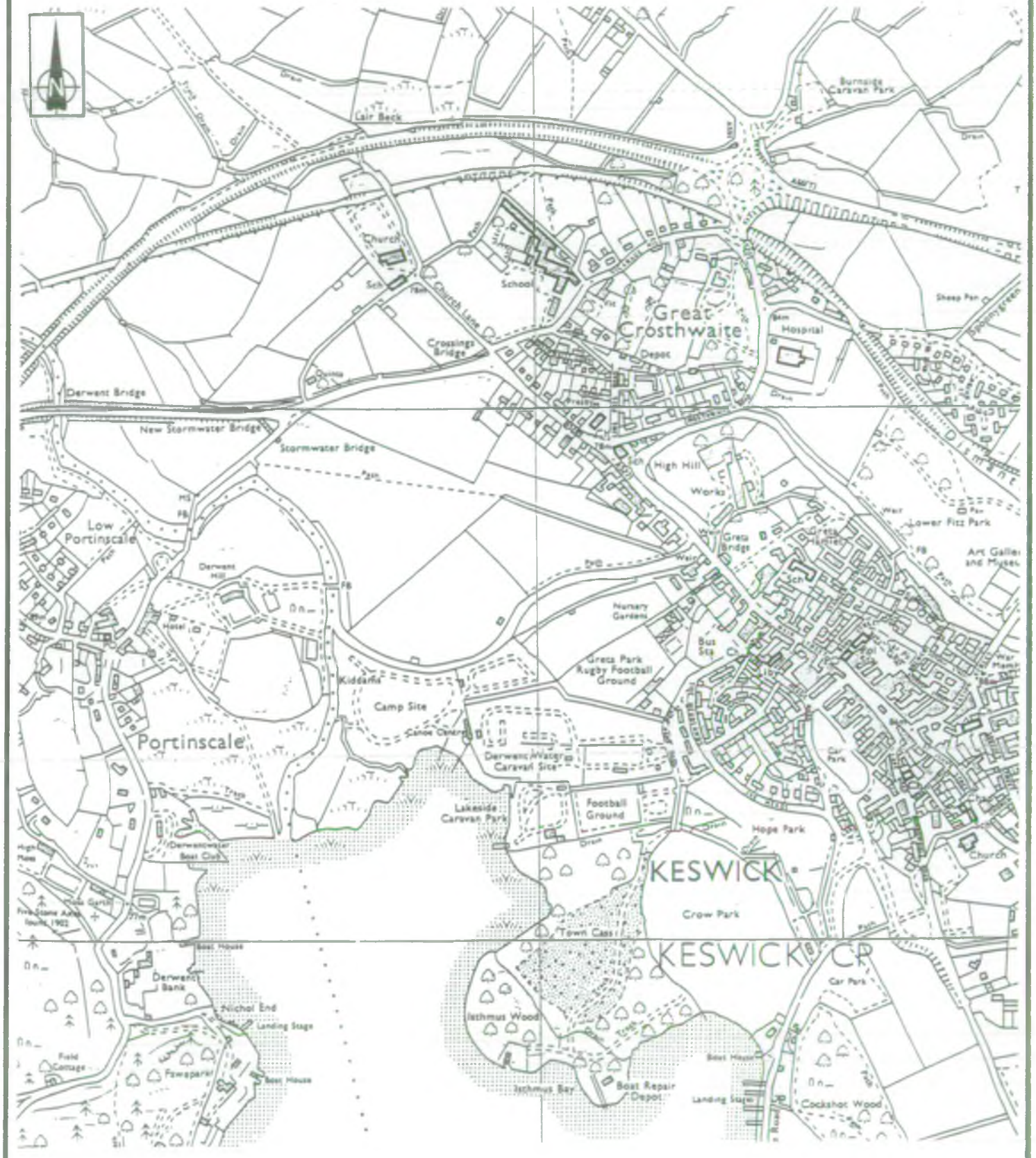
Derwentwater
January 1999
Historical Map - 1970 (Ordnance Survey Sheet - NY 22 SE)
Figure 5



Scale 1:10,000

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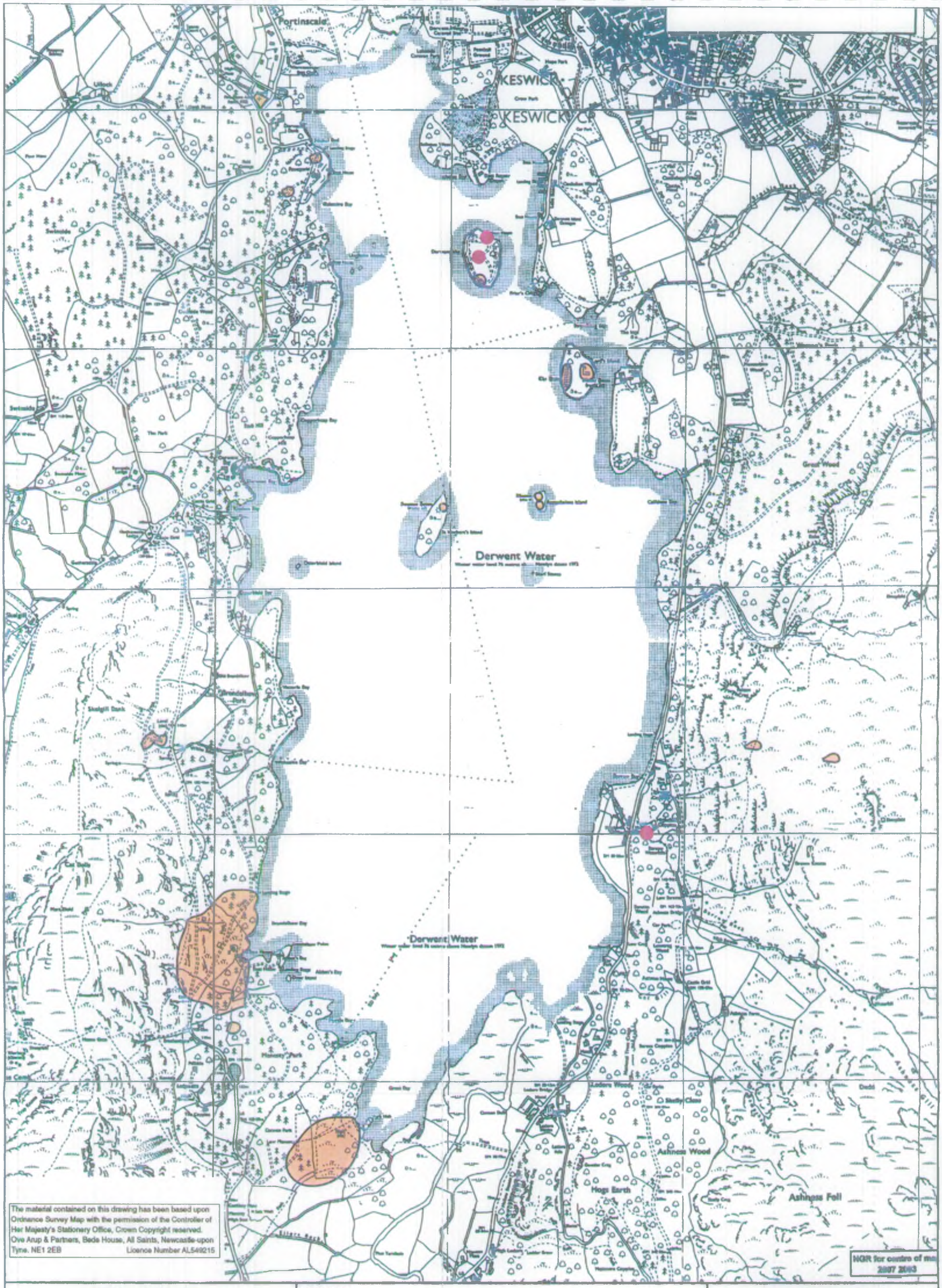
Lake District National Park Authority

Derwentwater
January 1999
Historical Map - 1983 (Ordnance Survey Sheet - NY 22 SE)
55390
Figure 6



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Lake District National Park Authority

LEGEND

Sites and Monuments Record

Listed Buildings

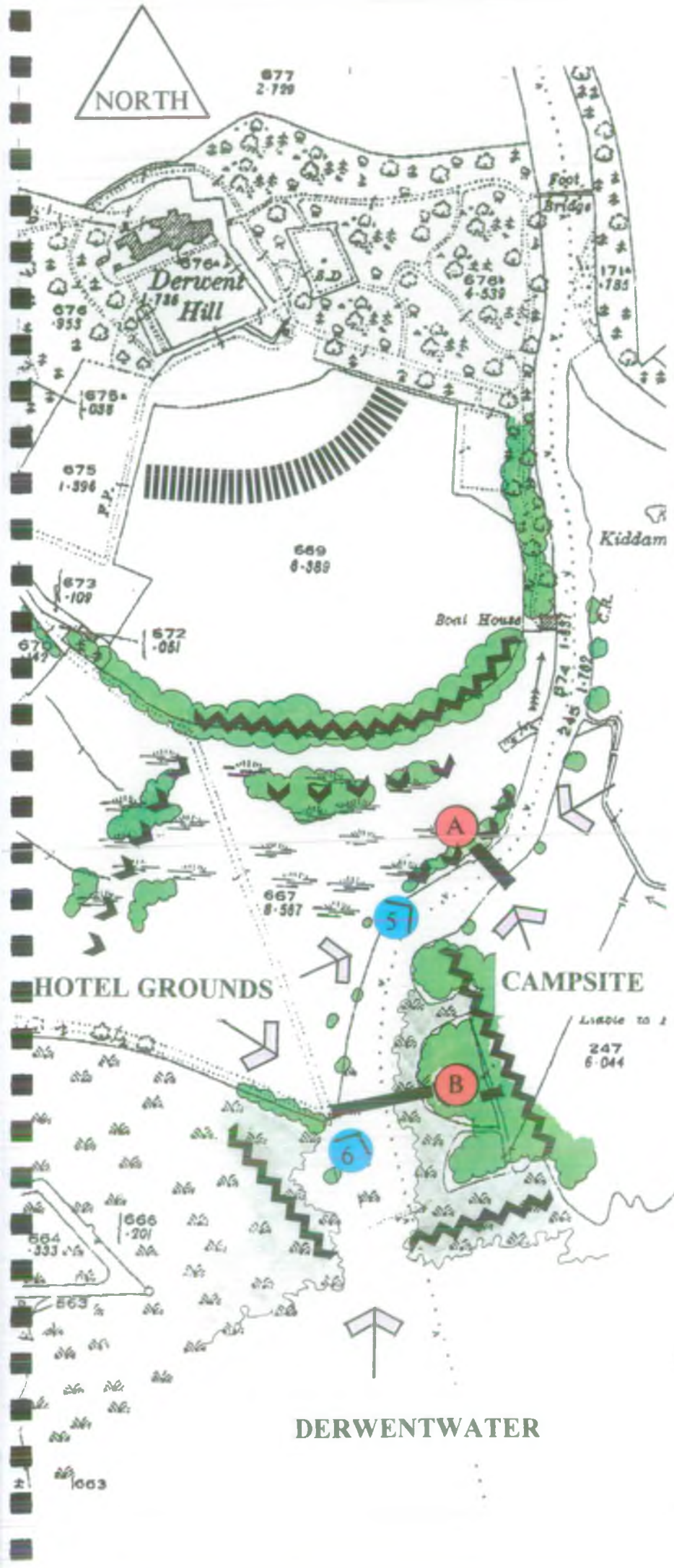
DERWENTWATER

Title: SITES OF ARCHAELOGICAL INTEREST

Date: JANUARY 1999

Figure: 7

55390-8500 FIG 7



DERWENTWATER
CUMBRIA

Existing vegetation - trees and scrub

Existing vegetation - reeds and marsh

Visual barrier - landform

Visual barrier - vegetation

Significant view points

Photograph locations

Permanent weir - proposed location

Temporary weir - proposed location

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Derwentwater
January 1999
Landscape Analysis
Weir Location Scale 1:10,000

55390

Figure 8

Notes:

Visual assessment of 1995 low water level. Comments from Lake District National Park Authority and the Environment Agency.

1. Water in North Bay very shallow. A shingle bar developed in front of caravan park.
2. Bay nearly dried up.
3. Shallow water. Front of reed bed fringe dry.
4. Rocks exposed
5. Shingle bar.
6. Stone shore exposed.
7. Lake bed exposed.
8. Scarf Stones more exposed. Vegetation established.
9. Rock exposed
10. Very shallow between Lingholm islands. Dry land exposed around each island.
11. Very shallow

Portinscale

KESWICK

KESWICK CP

Derwent Water

Derwent Water

Ashness Wood

Hogs Earth

Ashness Fell

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LEGEND

- Exposed Shore at Water level of 74.61m AOD (proposed minimum lake level)
- Exposed Shore at Water Level of 74.38m AOD (1995 minimum lake level)

Note: Areas estimated from bathymetric survey

DERWENTWATER

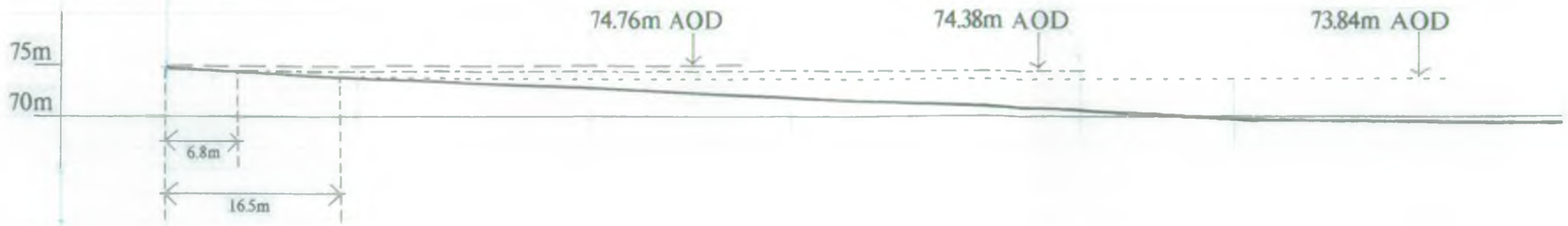
Title: EXPOSED SHORE

Date: JANUARY 1999

Figure: 9

DERWENTWATER
CUMBRIA

SECTION A–A

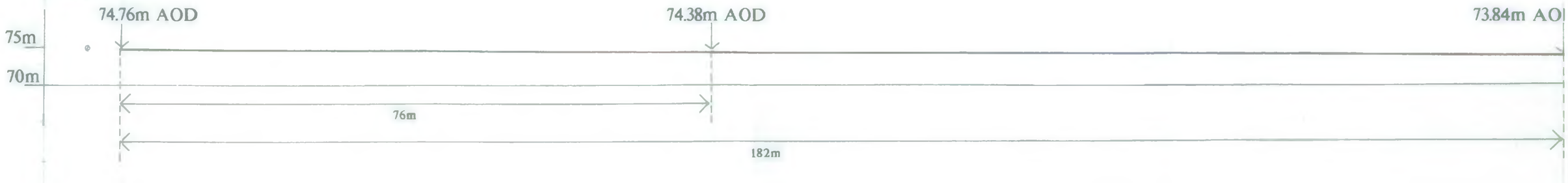


74.76m AOD - normal summer water level.

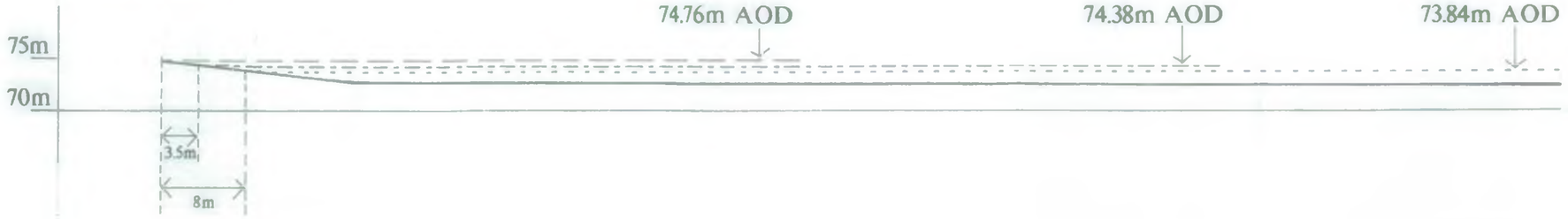
74.38m AOD - lowest recorded summer level.

73.8 m AOD -

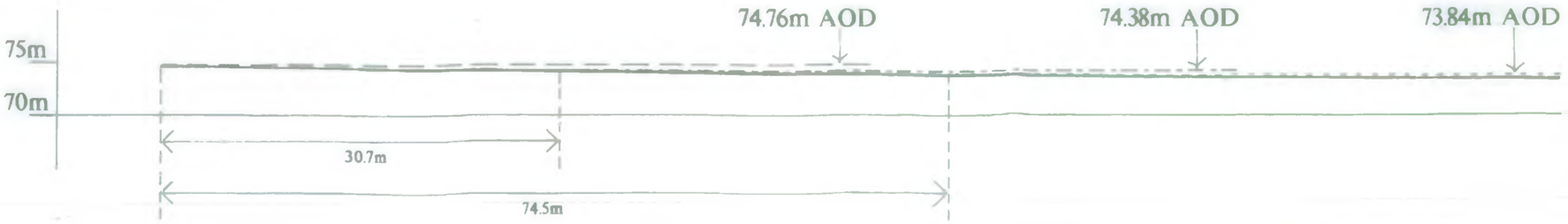
SECTION B–B



SECTION C–C



SECTION D–D



NOTES

- For section locations see Figurel0

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NORTH WEST REGION

Lake District
National Park Authority

Derwentwater
January 1999
Sections - Lake Edge
Scale 1:10,000

55390 **Figure 10**

DERWENTWATER
CUMBRIA

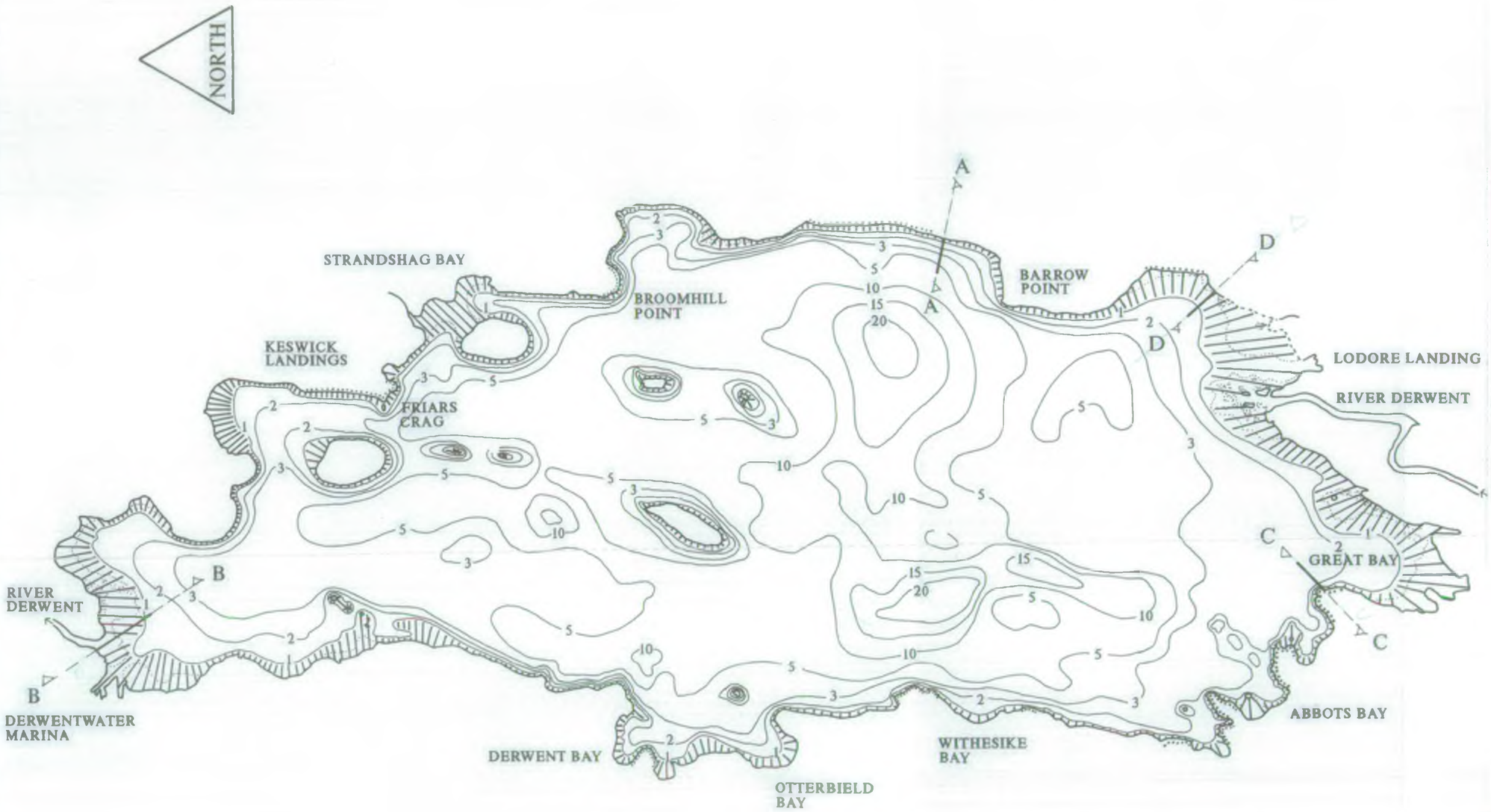

Chart datum - 74.76m normal summer level.

Steep shoreline

Shingle banks

Shallow water

Exposed shore - if still reduced by a further 0.5m

Sections - see Figure 03.

- Information based on chart prepared by John Holden (1989)

0.1km

0km 0.5km 1.0km

SCALE

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North West Region

Lake District National Park Authority

Derwentwater
January 1999
Bathymetric Chart -
With Exposed Shore Scale - As Shown

55390

Figure 11

PHOTOGRAPH No 5 - The proposed location for a permanent weir

PHOTOGRAPH No 6 - The proposed location of temporary weir

Derwentwater
January 1999
Landscape Photographs

55390

Figure 12

Appendix A

Landscape Policy and Regulatory Framework

LANDSCAPE POLICY AND REGULATORY FRAMEWORK

The Lake District National Park Authority is governed by specific policies and legislative framework. A brief summary of the main aims is given below.

The National Park designation was first established under the National Parks and Access to the Countryside Act 1949, and subsequently amended by the Environment Act 1995. These acts set out the purpose of the National Parks as follows:-

1. To conserve and enhance the natural beauty, wildlife and cultural heritage
2. To promote opportunities for the understanding and enjoyment of the special qualities (of the Parks) by the public

The Lake District has particular renown for being at the forefront of the campaign which lead to the act and was subsequently one of the first National Parks to be designated in 1951.

The two purposes of the Parks are not necessarily mutually supportive such that conflicts could arise between them. The potential conflict between these two purposes was clarified by the 1974 Sandford Committee which stated that:-

> '..... *if it appears that there is a conflict between those (National Park) purposes, greater weight shall be attached to the purpose of conserving and enhancing the natural beauty, wildlife and cultural heritage of the National Park area'.*

This ensures that the quality of the landscape is maintained as a priority where the possibility of over-demand for use may otherwise lead to a decline.

A1. Designations and Legislative Framework

Derwentwater is located entirely within the boundary of The Lake District National Park.

Each National Park has a National Parks Authority which controls activities within the park and takes on the planning functions of County and Local Councils. Where other authorities have powers or undertake works within the National Parks they are obliged to take into account the purposes of the Parks. Section 62 of the Environment Act 1995 places a duty on relevant authorities to have regard to the statutory purpose of the National Parks:-

> '..... *to have regard to the purposes of National Park designation when coming to decisions or carrying out their activities affecting the national Parks'.*

Additionally, if there is a conflict between the two purposes, they are also to give greater weight to conserving the natural beauty, wildlife and cultural heritage of the national Park.

Since the 1995 Act the National Park Authorities have also been conferred with duties in supporting local communities as intrinsic to the maintenance of the character and continued use of the parks:-

> '..... *seek to foster the economic and social well being of local communities (within The National Park) by working closely with the agencies and local authorities responsible for these matters, but without incurring significant expenditure'.*

A2. Policy

The Lake District National Park Authority is the designated Planning Authority for Derwentwater. Its Planning Policies are contained in the following documents:-

- National Park Management Plan (*August 1998*) - currently in draft
- Cumbria and Lake District Joint Structure Plan 1991-2006 (November 1995)
- Lake District National Park Local Plan (*1998*)

A2.1 National Park Management Plan

The purpose of the management plan is stated as:-

> '..... *provides a framework to conserve and enhance the special qualities of the National Park, secure the future of its local communities and ensure that it can continue to be appreciated and enjoyed.....*'

The plan is divided into 12 Chapters covering the scope of the plan, the special qualities of the district, principles and approaches to meeting the purposes of the park, how the authority intend to meet its responsibilities to foster economic and social well-being, the application of the principles and approaches to specific areas and how the plan is to be redeveloped on the ground.

The areas relevant to this study are those covered in Chapter 2 describing the special qualities of the Lake District and Chapter 3 covering the principles and approaches to be used in the purpose of conservation of these qualities.

In Chapter Two, The Conservation and Enhancement of the Special Qualities of the Lake District, these special qualities are listed below:-

- the combination of spectacular natural features and farmed landscapes - fells, valleys and cultural heritage
- the opportunities for quiet enjoyment - space, sense of freedom and tranquillity
- the diversity of landscape - coast, fells, valleys, lakes and woodlands
- the wealth of wildlife - through diverse habitats
- the open nature of the fells and the freedom to enjoy them
- the lakes, tarns and rivers - character, wildlife and enjoyment
- the semi-natural woodland - character and wildlife
- the character of settlements - traditional, vernacular architecture
- the wide range of opportunities for outdoor activities
- the social and cultural roots - rich history and traditions.

These special qualities are those recognised as giving the area its distinctive character and form the basis of its designation as a National Park. They should therefore be given the highest protection possible.

The National Park Plans vision of the future is set out to incorporate the landscape, visitors, and the local community, setting out its important policy areas to include:-

- Maintaining quiet enjoyment
- Sustaining local life and economy
- Farming
- Traffic management
- Visitor pressures and recreational activities
- Character of the countryside and settlements
- The diversity of wildlife
- Pollution

With reference to this study these policies give rise to potential conflicts in the areas of continued passive and active recreational use of the lake, inappropriate development, loss of economic value, increased heavy traffic, character of the landscape, impact on wildlife and noise pollution.

In Chapter 3, Conserving and Enhancing Natural Beauty, Wildlife and Cultural Heritage, the principles and approaches to be used in the conservation of the special qualities identified in

Chapter 2 are discussed. In terms of conserving natural beauty this is summarised in the National Park Management Plan as:-

3.38 The conservation and enhancement of the natural beauty of the Lake District should be guided by the following general principles:

- *the diversity of landscapes across the National Park should be conserved and enhanced, and very high regard paid to the distinctive character of individual places, and the areas defined on the Section 3 Conservation Map.*
- *approaches to the protection, conservation and enhancement of designated sites and features should be integrated with measures to conserve the special qualities of the national park.*
- *particular efforts should be made to protect those habitats and features which are irreplaceable or are of special local significance.*
- *change should be gradual, wherever possible usually directed to strengthening the individual character of an area, and maintaining or enhancing the quality of the landscape.*
- *radical changes to the character of the present landscape should be fully justified in terms of the specific benefits that they will bring.....'*

Chapter 8 of of the National Park Management Plan (Proposed National Park Management Plan adopted by the National Park Authority October 1998) looks specifically at the lakes, tarns and rivers. It outlines the following objectives for these area and translates these into policies and actions.

Objectives

8.6 Objectives for the lakes, tarns, rivers and streams are to:

(a) ensure the surface waters and ground waters in the National park are of the highest possible water quality and the diversity of surface water types are maintained;

(b) maintain conditions for self sustaining populations of the full range of indigenous plants and animals associated with freshwater and wetlands habitats;

(c) permit the quiet enjoyment of lakes, tarns and rivers in ways which are compatible with maintaining their character and that of the surrounding area;

(d) allow some appropriate parts of river systems to become wild and to restore highly engineered sections to a more natural state.

Paragraph 8.16 of the National Park Management Plan states specifically:

The National Park Authority will work with the Environment Agency and other agencies to:

- **promote sensitive management of rivers through the capital and maintenance works programmes;**
- **promote the creation of new semi-natural floodplain woodland;**
- **maintain rivers and streams in as natural a state as possible retaining natural fluvial processes, high water quality and associated range of marginal habitats, coupled, where possible, with restoration of canalised and otherwise degraded streams;**
- **ensure no loss of important hydroserers;**
- **promote restoration of more natural drainage in intensively drained catchments.**

A2.2 Cumbria and Lake District Joint Structure Plan

The Cumbria and Lake District Joint Structure Plan was adopted in 1995. Applicable to the entire county it covers a much wider area than the Park Plan but does contain policies which are relevant to the park:-

POLICY 11 - Landscapes of National Importance

'..... Development and other land use changes detrimental to the present characteristics and qualities of the landscape of the National Park, AONB'S [Areas of Outstanding Natural Beauty] *and the Heritage Coast will not normally be permitted. Particular regard will be paid to the protection and enhancement of undeveloped open countryside and coast, the lakes and other sensitive locations, and in addition in National Parks the character of land identified on Section 3 Conservation Maps .....'*

POLICY 15 - Landscape Enhancement

'..... Measures which encourage the enhancement of landscapes and their wildlife and historic features will normally be supported'.

POLICY 18 - Nature Conservation Interests of International Importance

'..... Development and other land duse changes which are detrimental to nature conservation interests of international important will not normally be permitted. Exceptions will be made only:

(a) where an overridding public interest can be demonstrated to outweigh the international conservation interest;and
(b) where the need for the development or land use change cannot be met in other locations where they would be less damaging or be reasonable alternative means

unless the harm caused to the value of those interests is clearly outweighed by the need for development'.

POLICY 25 - The Quality of Development

'..... The siting, appearance and landscape of all new development and alterations should aim to enhance the quality of the existing environment. It should be in keeping with the local character of the townscape or landscape, be well integrated with the existing pattern of surrounding land uses and, where appropriate, be in keeping with the local vernacular tradition .....'

A2.3 Lake District National Park Local Plan

The Local District National Park Local Plan was adopted in 1998. It contains the following policies relevant to protecting the landscape quality of the park and controlling development

POLICY NE1 - Development in the Open Countryside

'..... Development in the open countryside will only be permitted where it would:

(a) be closely integrated with existing uses; or
(b) be in accord with policies in the Structure and Local Plan to meet the social and economic needs of local communities and to protect and enhance the scenic beauty, natural resources and quality of the built environment.

In all cases, development should:

(c) not conflict with the enjoyment of the special qualities of the National Park
(d) respect the character of the area in which it is proposed; and
(e) not cause demonstrable harm to landscape, nature conservation interests or cultural heritage ..... '

POLICY NE6 - Development in Busier Central Valleys

'..... Development will not be permitted where it would cause demonstrable harm by exacerbating the adverse impacts of existing levels of use in the Busier Central Valleys shown on the proposals map by reason of:

(a) an increase in traffic or recreational activity; or
(b) harm to residential amenity or enjoyment of the special qualities of the area as a result of visual intrusion, noise or other forms of disturbance'

POLICY NE7 - Lakeshore Development

'..... Development within or on the edges of lakes and tarns will not be permitted, except for development which has a function in providing facilities associated with appropriate recreational uses of the lake or tarn, or involves appropriate changes to existing development and which in either case cannot reasonably be located elsewhere and which satisfies all the following criteria:

(a) it would be appropriate in its scale, siting and design and would not harm the character and appearance of the lake or tarn or its edges;
(b) it would not introduce inappropriate levels of use or adversely affect the recreational enjoyment of other users of the lake or tarn; and
(c) it would not adversely affect nature conservation interests, cultural heritage, or water quality..... '

POLICY NE8 - Development Adjacent to Lakes and Tarns

'..... Development on land adjacent to lakeshore roads and on land lying between such roads and a lake or tarn, will not be permitted except where it would:

(a) provide necessary access to lake or tarn edge developments acceptable under Policy NE7, or
(b) be ancillary to existing development or uses and would be appropriate in its scale, siting and design, and would not harm the appearance of the lake or tarn or its setting.

Such development will only be permitted if it would:

(c) not introduce inappropriate levels of use, nor adversely affect the recreational enjoyment of other users of the lake or tarn and its foreshore; and
(d) not adversely affect nature conservation or archaeological interests or water quality..... '

POLICY NE18 - Protection of River Corridors

'..... Development within river corridors and development within or on land adjacent to watercourses will only be permitted where it would not cause demonstrable harm to amenity, landscape character, nature conservation, cultural heritage, fisheries or public access..... '

In addition to specific policy statements in the reports Section 2.1 the general importance of protecting the Parks character and special qualities is also recognised:-

'..... It is crucially important to the future of the National Park that high priority is given to the conservation and enhancement of its character and special qualities, some of which are

recognised by additional statutory designations, and to safeguarding it from inappropriate changes and development. Development which is permitted should demonstrate full regard to the area's designation as a National Park through:

- *sensitive siting and high standards of design and use of materials;*
- *the appropriate scale of both physical structures and the uses to which they are put; and*
- *by minimising potentially adverse impacts on the environment.....'*

The particular importance of specific landscape features relevant to the current appraisal are also found in the Local Plan Sections 2.11 - The Fells and 2.16 - Lakes and Tarns.

Section 2.11 - The Fells:-

'..... access to 'wild' country was, after all, one of the key reasons for the National Park's designation and is secured by a mixture of custom and co-operation and in some areas by statute. Special consideration should therefore be attached to the visual impact of development when viewed from the fells .....'

Section 2.16 - Lakes and Tarns:-

'..... The lakes and tarns are fundamental to the identify and beauty of the National park and are amongst its most important assets for recreation and wildlife conservation .....'

Methodology for Landscape and Visual Impact Assessment

In assessing the landscape and visual impacts of the management options described in section 16.0 reference has been made to the handbook 'Guidelines for Landscape and Visual Impact Assessment', prepared jointly by the Landscape Institute and the Institute of Environmental Assessment in June 1995. The handbook advises that

"**Landscape impacts** are changes in the fabric, character and quality of the landscape as a result of development. Hence landscape impact assessment is concerned with:

- direct impacts upon specific **landscape elements**;
- more subtle effects upon the overall pattern of elements that give rise to **landscape character and regional and local distinctiveness;**
- impacts upon acknowledged **special interests** or values such as **designated landscapes, conservation sites and cultural associations.**

Visual impacts relate only to changes in available views of the landscape. Hence visual impact is concerned with:

- the direct impacts of the development upon views of the landscape through intrusion or obstruction;
- the response of viewers who may be affected;
- the overall impact on visual amenity, which can range from degradation through to enhancement."

In assessing effects on the view from both public places and private residences the visual change anticipated has been categorised according to the following scale:

- Substantial adverse or beneficial impact - where development would cause a significant deterioration (or improvement) in the existing view;
- Moderate adverse or beneficial impact - where development would cause a noticeable deterioration (or improvement) in the existing view;
- Slight adverse or beneficial impact - where development would cause a barely perceptible deterioration (or improvement) in the existing view;
- No change - no discernible deterioration or improvement in the existing view.

In some instances the impact has been assessed to an intermediate level and has been categorised as substantial to moderate or moderate to slight.

A general landscape analysis illustrating the main view points and visual barriers is shown on Figure A1. The following landscape and visual impacts are considered for each of the management options.

- the overall character of the landscape
- short distance views from the lakeside and from the surface of the lake itself
- middle distance views from the valley sides, many of which are screened or filtered through intervening woodland
- long distance views from the high fell.

DERWENTWATER
CUMBRIA

Visual barrier - landform

Visual barrier - vegetation

Ridge lines - definition of visual envelope

Significant view points

Photograph locations

NORTH

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Derwentwater
January 1999
Landscape Analysis
DerwentWater Scale 1:25,000
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Appendix C

Assessment of Impact of Proposed Weir on Flood Levels

Introduction

In order to assess the potential impacts of a weir situated downstream of the outfall of Derwentwater and the campsite drainage channel a HEC-RAS model has been used to simulate river levels. This model has been constructed for the purposes of a preliminary investigation and should be considered to be indicative only. The modelling procedure undertaken is briefly described below.

Model construction

Use has been made of a survey by J.M.Banks to provide river cross-section data. The river was surveyed on the 16 June 1996, with cross-sections being taken at the locations indicated on Figure C1. Cross-section 1 was not included as this is only a partial cross-section within the lake and does not provide sufficient information for HEC-RAS to calculate water levels at this point through backwater analysis. The upstream boundary of the model is therefore just downstream of the sill controlling outflow from the lake.

The ground survey of the lake outfall does not extend very far either side of the main channel of the River Derwent so LIDAR survey data was obtained from the Environment Agency to allow extension of the cross-sections into the floodplain.

Boundary Conditions

The low gradients experienced in this area mean that flow within the River Derwent is likely to be subcritical along this reach. This means that only a downstream boundary condition is required, as under subcritical conditions water levels are controlled by downstream water levels. The final cross-section before the confluence with the Greta, cross-section 13, was used as the downstream boundary for this model. The slope of the river bed in this area was calculated as 0.0006 from a long-section of the river. This slope was used to determine the normal water depth for this position, allowing the downstream water level boundary condition to be obtained.

Model Calibration

During the survey of 16 June 1996 water levels were measured within the river between cross-sections 7 and 13. On this date the riverflow was wholly contained within the river banks. These levels correspond to a flow within the river of 3 cumecs, as determined from the difference between average daily flows at Portinscale and Low Briery. The lake level measured during the survey on this date was 0.1 m higher than that calculated at cross-section 2, and this difference is used in further calculations to estimate lake levels from model results.

Modelled and measured river levels (including the downstream boundary condition) differed by less than 20 mm when a channel roughness coefficient of 0.034 was used. This is a physically realistic roughness coefficient for a natural low gradient river (HEC-RAS user manual).

Initial conditions

Analysis of river levels was achieved by running the calibrated model for a range of flows until a flow was reached corresponding to bankfull conditions. It would appear that the channel at the campsite can adequately convey over 8 cumecs (m^3/s) without over-topping its banks.

Impact of weir

The impact of a weir was assessed by adding a weir to the model at a position 2 metres downstream of cross-section 7, on a natural high point in the river bed profile. The weir was assumed to have a 1 m wide crest and a shallow v-shape profile. The sides of the weir were positioned 0.6 m above the bed and the bottom of the "v" was positioned 0.42 m above the bed. This was sufficient to raise the minimum lake level to the required level of 74.61 m AOD, given the minimum flow experienced in the summer of 1995.

An indication of the effect of the weir on river levels may be seen by comparing the rating curve for the lake modelled by HEC-RAS under existing and modified conditions (Figure C2). It can be seen from this that the presence of a weir increases water levels during low flows but does not significantly effect lake levels at higher flows. Table 1 shows the change in river levels with a weir for a range of flows. The important conclusion that may be drawn from this is that the presence of the weir does not increase water levels in the river for flows in excess of 5 cumecs. This is a signficantly lower flow than that at which flooding (over-bank flow) would occur at the camp site.

					Flow (cumecs)				
	0.18	1	2	3	4	5	6	7	8
Cross-section									
2	0.27	0.26	0.22	0.11	0.04	0.01	0	0	0
3	0.44	0.32	0.21	0.11	0.04	0	0	0	0
4	0.44	0.32	0.21	0.11	0.04	0	0	0	0
5	0.44	0.32	0.21	0.11	0.04	0.01	0	0	0
7	0.45	0.33	0.21	0.12	0.04	0	0	0	0
Weir									
8	0	0	0	0	0	0	0	0	0
9	0	0	0	0	0	0	0	0	0
10	0	0	0	0	0	0	0	0	0
11	0	0	0	0	0	0	0	0	0
12	0	0	0	0	0	0	0	0	0
13	0	0	0	0	0	0	0	0	0

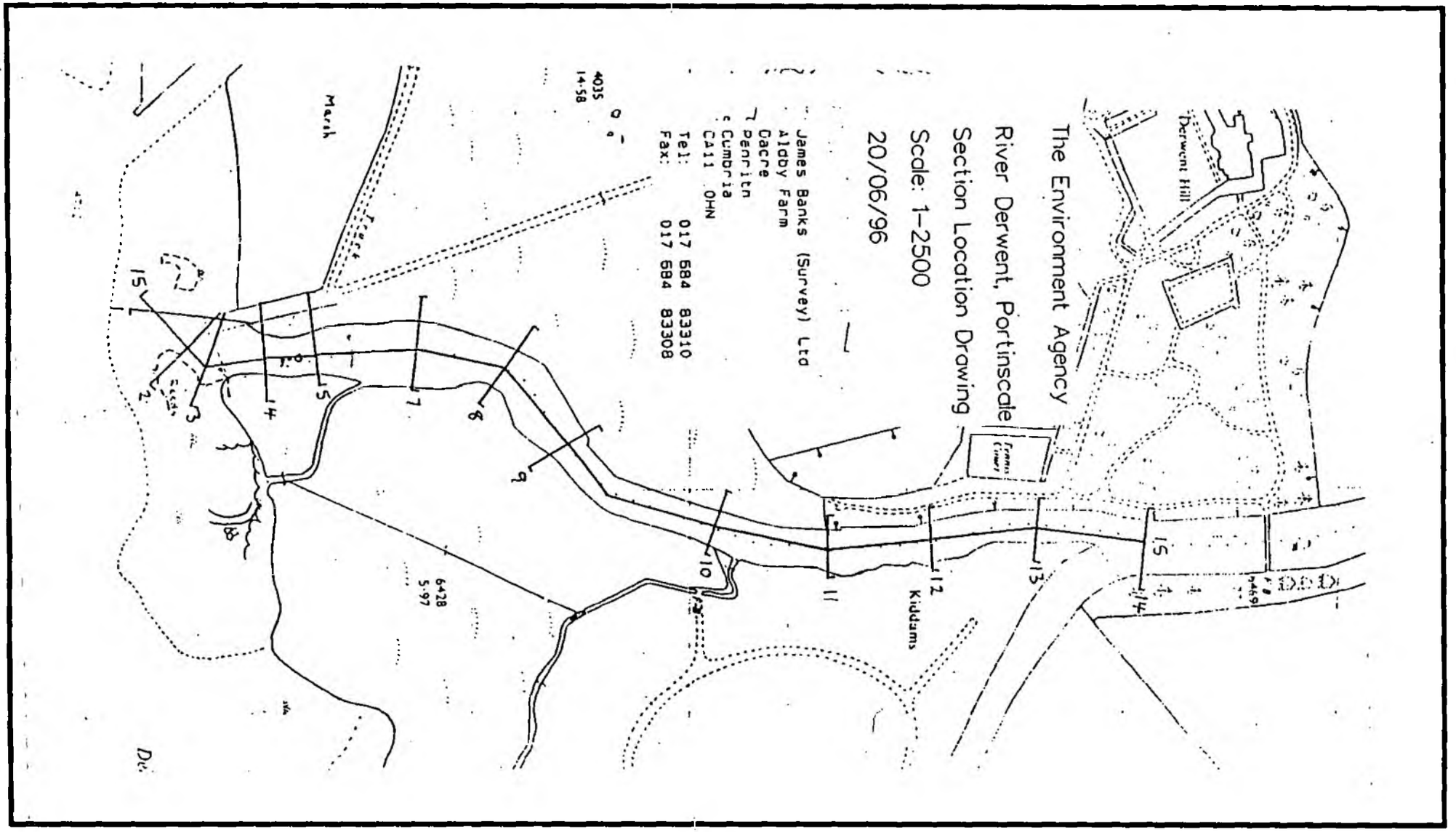
Table 1: Changes in water level (m) caused by a weir for a variety of flows

Conclusions

From the available calibration data the HEC-RAS model appears to simulate existing river conditions well, although modelled lake levels should be treated with some caution given the available data and assumptions that have been made.

The presence of the weir increases water levels at low flows but does not significantly alter water levels at higher flows and would not appear to increase the level or frequency of flooding.

It should be noted that the weir design is preliminary and is one possible design for a weir. More detailed design of the weir is required to maximise hydraulic efficiency and minimise environmental impact. In addition, extension of the model to include the lake would be needed to allow the design of the weir and the impact of such a structure to be fully completed.



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Derwentwater
January 1999
Survey cross-section locations

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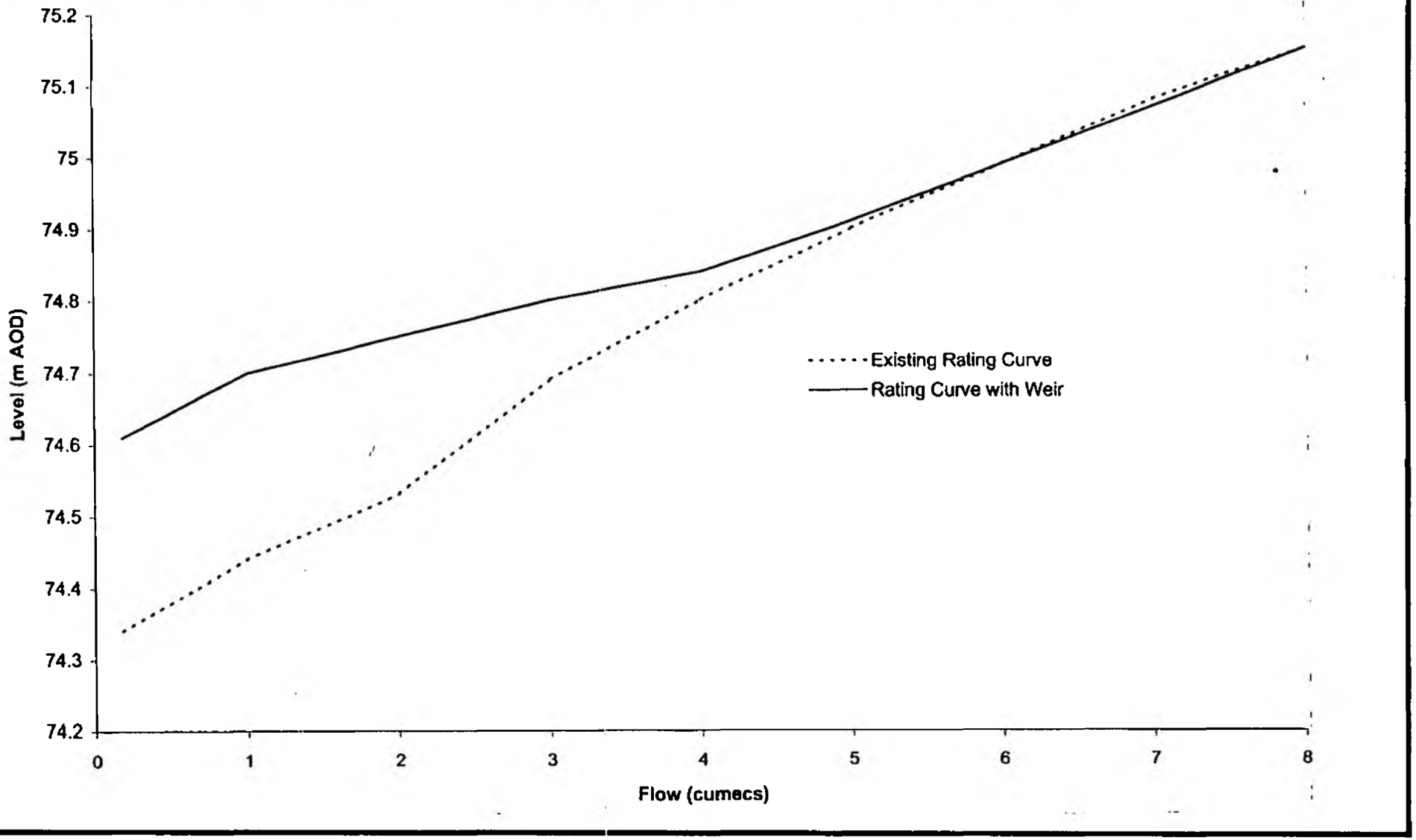
Figure C1



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Rating Curves Before and After weir

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Figure C2

Appendix D

The Reservoirs Act 1975

The Reservoirs Act 1975

The Reservoirs Act 1975 is an Act to 'make further provision against escapes of water from large reservoirs or from lakes or lochs artificially created or enlarged'. The Act continues the system adopted under the Reservoirs (Safety Provisions) Act, 1930 of requiring not only that the design and construction of any new, or certain alterations on existing, large raised reservoirs, are carried out by or under the supervision of qualified civil engineers, but that all large raised reservoirs shall be inspected by qualified civil engineers at prescribed maximum intervals of 10 years. In addition the 1975 Act:

- Imposes a duty on local authorities to enforce the Act (the Enforcement Authority) and provides them with stronger and more explicit powers to satisfy themselves that the Act is being complied with, to maintain a register of large raised reservoirs wholly or partly within their area, to undertake emergency action, to carry out immediate work and recoup the cost from reservoir undertakers.
- Requires reservoir undertakers to appoint a named Supervising Engineer to supervise the reservoir at all times when not under the supervision of a qualified civil engineer.
- Makes non-compliance with the provisions of the Act a criminal offence.
- Limits appointments of engineers to panels of qualified engineers to 5 year terms, subject to re-appointment.
- Lays down procedures if a reservoir is to be abandoned or discontinued.

It applies to "large raised reservoirs", that is, reservoirs designed to hold or capable of holding more than 25,000 m^3 of water as such above the natural level of any part of the land adjoining the reservoir (including the bed of any steam). This volume is about 10% greater than the 5 million gallons specified in the 1930 Act. A proposal to alter a reservoir of less than 25,000m^3 to one or more than that volume comes within the Act.

The Secretary of State under Section 5 of the Act can, by Statutory Instrument (SI), make regulations for prescribing anything which is under this Act to be prescribed. This has resulted in a series of SI's (Statutory Instruments) available from HMSO.

The Reservoirs Act 1975 together with the SI's provide a legal framework within which qualified civil engineers make technical decisions relating to the safety of reservoirs. In effect the legislation imposes a system of safety checks on reservoir construction and operation.

The Act does not cover:

- Mine and quarry lagoons which are liquid tips within the meaning of the Mines and Quarries (Tips) Act 1969.
- Reservoirs/lagoons containing fluids other than "water as such".

The President of the Institution of Civil Engineers (ICE) has corresponded with the Department of the Environment Transport and the Regions (DETR) about these exclusions which have been the cause of concern to panel engineers acting under the Reservoirs Act 1975. As a consequence of these concerns, meetings have been held with the Health and Safety Executive (HSE).

The 1975 Act applies only to reservoirs for "water as such".

Within the Act the expression "reservoir" does not include a canal or inland navigation (but the Act does apply to a reservoir notwithstanding that it may form part of a watercourse or be used for navigation).

The Act recognises four types of person or organisation with distinct functions and responsibilities:

- Undertaker - defines duties as owner or operator,
- Enforcement Authority (EA) - to ensure compliance with legislation, defines duties and powers,
- Qualified civil engineer - to advise on safety, supervise certain works etc,
- Department of the Environment Transport and the Regions - legislation.

Enforcement authorities must maintain a register containing prescribed information on large raised reservoirs wholly or partially within their area as described in SI 1985 No 177. This should include details of failure to implement safety recommendations. This includes the following information:

- Names, locations, height and capacity of reservoirs.
- Names and addresses of reservoir undertakers.
- Names and addresses of panel engineers concerned with each reservoir.
- Details of the most recent statutory inspection and when the next is due.
- Particulars of any enforcement measures/actions under Section 16 of the Act.

Public accessibility is essential. It should contain sufficient information to enable any person to check that any of the various provisions of the Act are being observed. It should not contain information of a commercial nature of any that might affect security.

The Department of the Environment Transport and the Regions is responsible for reservoir safety legislation in Great Britain.

Reservoirs Panel Structure

The 1975 Act requires the Secretary of State, after consultation with the Institution of Civil Engineers, to set up panels of engineers to carry out technical functions under the Act. This panel structure is an essential element of the operation of the Reservoirs Act 1975. Engineers are appointed to a panel for a five year period and can apply to be reappointed. There are currently four panels:

- All Reservoirs Panel (AR)
- Non-Impounding Reservoirs Panel (N/R)
- Service Reservoirs Panel (SR)
- Supervising Engineers Panel (SupE)

The difference between panels is based on function. The first three "inspecting" panels are qualified to design, supervise the construction of, and inspect the different types of reservoir. Engineers in these panels can also act as supervising engineers and as appropriately for emergencies under Section 16 of the Act.

Only a qualified civil engineer who is a member of the appropriate panel can carry out the statutory requirements of the Act relating to technical decisions arising from construction, on-going supervision and inspection. Any reference to a qualified civil engineer is a reference to a member of the appropriate panel. All technical matters relating to safety rely on panel engineers' experience and judgement.

Qualified civil engineers who are members of the appropriate panels, inspect reservoirs at intervals not exceeding 10 years and recommend measures in the interests of safety. It is the

responsibility of the undertaker to arrange that both inspections and the recommendations are carried out, and of the enforcement authorities to ensure that they are done. It should be noted that most reservoir owners will now assume that panel engineers are adequately covered by insurance for any matter that may arise from the performance of their duties under the Act, as recommended as desirable by the ICE Reservoirs Committee.