United Utilities Plc

REFRESH OF THE IMPACT ASSESSMENT STUDY OF TWO DROUGHT PERMITS AT WINDERMERE

SCOPING REPORT

REVISED DRAFT REPORT

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APPENDICES

1 INTRODUCTION

1.1 Introduction

Windermere, in the catchment of the River Leven, is the largest of the Cumbrian lakes. It is a natural lake with level control provided by a masonry weir at the lake outlet at Newby Bridge. The River Leven flows from the southern edge of Windermere for 5km to its tidal limit at Low Wood Bridge (NGR: SD345836) and then into Morecambe Bay. A number of major tributaries enter the lake, including the River Rothay, River Brathay and Troutbeck.

United Utilities (UU) abstracts from Windermere for the purpose of public water supply, and it is a critical part of UU's Integrated Resource Zone, which supplies 6.7 million customers within the North West of England.

Windermere is one of 18 potential sites for Drought Permits listed within UU's current Drought Plan (published in 2008), and one of 16 potential sites proposed within its Draft 2012 Drought Plan (not yet published), following the removal of the Cliburn and Broughton A borehole sites.

According to the Environment Agency's (EA's) Water Company Drought Plan Guideline (EA, 2011), an Environmental Assessment Report (EAR), which includes monitoring plan and mitigation measures, is required for each supply-side management action (e.g. Drought Permits (DP) and/or orders (DO)) included within the Drought Plan. Each EAR should provide details of baseline flow conditions, assess impacts of potential changes to the flow regime due to implementation of the DP and/or DO, and provide an Environmental Monitoring Plan (EMP) to support the requirement for baseline, during and post DP/DO monitoring.

There is an existing EAR for Windermere. This was completed between 2005-2008 and mostly covered data to up to 2005. An interim data retrieval exercise was completed in 2009. In 2010, this was updated as part of a targeted review for a DP application. Given that the document was updated for a specific application for drought powers, this update only covered one of two potential DP scenarios at Windermere and the impact assessment only covered a six month period (August 2010 to January 2011). It therefore does not include other potential scenarios, or monitoring and findings from the 2010 low flow event.

The 2010 DP application brought numerous objections from two key stakeholder groups:

- users of the lake for leisure and commercial craft, concerned about the impact of the lake level on tourism and boat use; and
- environmental concerns with regards the impacts on the river downstream.

These objections demonstrated that more work was required to assess mitigation measures and to more fully understand the socio-economic impacts on lake users.

1.2 Regulatory framework

In periods of unusually low rainfall, where water resources become scarce, powers are available to grant ordinary and emergency Drought Orders under the Water Resources Act 1991, administered by the Secretary of State.

DPs can be applied for where the main issue is variation of an abstraction licence condition, such as the maximum yearly allocation or a compensation flow. DPs are enacted through the Water Resources Act 1991 as amended by the Environment Act 1995, which identifies the EA as the relevant authority to determine the application.

Following the severe drought in northern England in 1995/96, the Government set out a wide range of actions to be taken by the water industry, including the need for water companies to demonstrate that they have adequate drought contingency plans. As required under Section 39B(7) of the Water Industry Act 1991, there is now a statutory duty for water companies to agree publicly available drought plans following consultation with the EA, the Secretary of State, the Water Services Regulation Authority (Ofwat) and other statutory bodies.

Prospective DP options are identified in UU's current Drought Plan (published in 2008), and within its Draft 2012 Drought Plan (not yet published). These documents detail the range of actions that UU will consider implementing during drought conditions in order to maintain essential water supplies to its customers and minimise environmental impact.

The environmental assessment of DOs and DPs is undertaken in recognition of the guidance from the EA for DP applications, as contained in:

- "Defra (2011). Drought Permits and Drought Orders"
- "Environment Agency (2011). Water Company Drought Plan Guideline"
- "Institute of Environmental Management and Assessment (IEMA) (2004). Guidelines for Environmental Impact Assessment"

The environmental assessment to be carried out to support the DP is not a statutory Environmental Impact Assessment (EIA), as recognised, for example, within the Town & Country Planning regime and its enabling regulations. However, this Scoping Report and the environmental assessment will be undertaken in accordance with best practice guidance wherever applicable.

1.3 Objectives and scope

Within the scope of this project, UU requires an update of the existing EAR. A summary of the issues to be included in the study is presented in Table 1.1 below, including comments on the anticipated level of study required to update the previous reports, for two Drought Permit scenarios (as set out in Section 2.3).

A consultative and phased approach is proposed in order to meet the project objectives, supported by clear direction from the PSG. As defined in the specification, the study will comprise an initial scoping phase (Phase 1) followed by a detailed environmental assessment (Phase 2).

The objectives of the scoping stage (Phase 1, this report) are as follows:

- review previous reports relating to Windermere DPs;
- collate and review data collected since the previous EAR was produced;
- confirm the level of study required for each issue detailed in Table 1-1; and
- propose and confirm methods of assessment for Phase 2.

The objectives of the environmental assessment stage (Phase 2) are to update the existing EAR including the following main aspects:

- update the previous environmental assessment with new data for both DP scenarios, particularly from the 2010 drought, and ensure that any existing aspects are still current and fit for purpose;
- significantly update the socio-economic impacts element of the assessment to include the potential impacts on tourism, lake users etc.; and
- consider mitigation measures in greater detail and in liaison with stakeholders, particularly relating to lake users and the options for use of the fish sluices/waterbank (and the relative balance of impacts).

Table 1-1 Issues to be considered at Windermere

Issue - Impact of DP on Windermere and d/s watercourses:	**Anticipated level of study required to refresh study**
Atlantic salmon and sea trout	Detailed study of impacts on fish including upstream and downstream migration covering all life stages
Fish	Detailed study of impacts on fish including upstream and downstream migration covering all life stages
Invertebrates and Macro-invertebrates	Moderate study, applying latest datasets
Macrophytes, marginal vegetation and aquatic lake flora in Windermere	Moderate study, applying latest datasets
Habitats	Detailed study, applying latest datasets
Otter, wading birds, wildfowl, water voles, great crested newts and riverine birds	Minor study
Lake level and exposure	Detailed study due to updating of socio-economic impacts on lake users
River level/depth/velocity/flow; wetted width/area	Detailed study, applying latest datasets
Water quality and water temperature	Moderate study, applying latest datasets
Geomorphology (channel and sediment dynamics)	Moderate study, applying latest datasets
River structures	Minor study with regards downstream structures. However, downstream structures should be recognised as part of the consideration of how the DP affects river flow. Detailed study with regards the balance between lake levels and river flows due to the weir at the bottom of Windermere, and the related operation of the fish sluices.
Aesthetics/landscape	Minor study
Archaeology	Minor study
Tourism/recreation	Detailed study (impacts on lake users)
Noise	No study
Socio-economic and community impacts	Detailed study (impacts on lake users)
Other abstractors (including HEP)	Minor study
Fishing groups	Detailed study, with links to key ecological sections, use of sluices and balance with lake users

NB the table above indicates the expected level of study required and does not reflect the relative importance of the various issues (e.g. level of species protection or designations). The extent of each study will be determined through discussion with the Project Steering Group during Phase 1: Scoping.

1.3.1 This report

This report is a scoping report and presents a summary of the results of Phase 1 of the project.

Following the introduction, the report is structured as follows:

- in Section 2 background information about the abstraction licences, DPs and the approach to Phase 1 of the project are presented;
- in Section 3 context for the socio-economic aspects of the study is presented;
- in Section 4 baseline data are reviewed for the various aspects of the project, together with an assessment of data gaps and proposed Phase 2 assessment methodologies for these aspects;
- the proposed Phase 2 assessment framework is presented in Section 5; and
- a summary, data gap analysis, conclusions and recommendations are provided in Section 6.

1.4 Consultation

Targeted and effective consultation with relevant parties will be an important element of this study, especially in light of the extent of objections to UU's 2010 DP application at Windermere. Consultation is intended to encompass: identifying issues of concern and priorities for assessment; agreement of assessment methodologies; gathering information; and agreeing the framework of the environmental assessment.

As part of the study, two consultation groups have been formed:

- A Project Steering Group (PSG) – including representatives from UU and the EA. The aims of this group will be to steer the project to ensure the assessment is on-track and the level of assessment together with issues to be considered are appropriate. Six meetings of the PSG are proposed, with meetings taking place at regular intervals throughout the project.

- A Stakeholder Group (SHG) – formed by representatives from relevant interested parties including (but not limited to) Natural England (NE) the Lake District National Park Authority, local and district councils, river trusts, hospitality associations, recreational users, fishing/angling clubs and fisheries. This aims of this group will be to provide input in terms of the level of study and aspects to be considered and to raise any specific concerns which need to be considered. Four meetings of the SHG are proposed, which will be centred around discussing draft and final report outputs.

Formal consultation with both groups will be undertaken at the draft scoping and environmental reporting stages. The scoping report (Phase 1) will be issued to the PSG and SHG for a 3 week consultation and the environmental assessment report (Phase 2) will be issued for a consultation period of at least 6 weeks.

SHG1

Prior to consulting on this draft scoping report, one PSG meeting and one SHG meeting have taken place. The first PSG meeting took place on 17th October at the start of the project and the first SHG meeting took place on 7th February, prior to preparing the draft scoping report. At the SHG meeting, the suggested scope was presented and discussed, focussing specifically on the socio-economic assessment.

Attending the first stakeholder meeting were representatives from the Centre for Ecology and Hydrology (CEH), South Lakeland District Council (SLDC), Windermere Lake Cruises, Friends of the Lake District (FOLD), Holker Estates, Lake District National Park Authority (LDNPA), Windermere Lake User Forum, Windermere Marina Village and South Cumbria Rivers Trust. It was agreed during the meeting that the EA and NE should be invited to all future SHG meetings and that the membership of the SHG be extended to include English Lakes Hotels, Lakes Hospitality Association, Chamber of Trade, Lakes Parish Council and Windermere Town Council.

A copy of the SHG meeting minutes is provided in Appendix B.

A further three SHG meetings are proposed as follows:

- *SHG2*: Scoping (following consultation) – May 2013;
- *SHG3*: Draft Environmental Report – Autumn 2013; and
- *SHG4:* Post Environmental Report consultation – Feb/Mar 2014.

Further stakeholder consultation is also proposed as part of the socio-economics element of the study, which is described further in Sections 3 and 4.12.

1.4.1 Draft Scoping Report consultation

This draft Scoping Report is being issued to the SHG for consultation and will be open for approximately four weeks, ending on Friday 31st May.

Please submit your comments on the draft Scoping Report to Liz Gunn, at the following address:-

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In addition, we will be holding the second stakeholder group meeting (SHG2) during the consultation period, during which your initial comments may be discussed. This meeting will be taking place at on Monday 20th May (venue details to follow). Further details including an agenda and timings will be provided by w/e 10th May.

2 BACKGROUND AND APPROACH

2.1 Site setting / background

2.1.1 Water supply from Windermere

UU supplies water to 6.9 million customers (2.9m households) and 200,000 businesses or organisations within Cumbria, Lancashire, Greater Manchester, Merseyside, most of Cheshire and a small proportion of Derbyshire. UU's region is split into four water resource zones:

- Integrated Resource Zone – an integrated regional network serving south Cumbria, Lancashire, Greater Manchester, Merseyside and most of Cheshire. The Integrated Resource Zone supplies 95% of the North West of England population (UU 2009 Water Resources Management Plan).
- West Cumbria Resource Zone – serving Workington, Whitehaven, Wigton and Solway.
- Carlisle Resource Zone – serving the Carlisle area.
- North Eden Resource Zone – comprising solely boreholes which serve the rural, northern part of the Eden district of Cumbria.

Figure 2.1 United Utilities' Strategic Lake District Sources

Abstraction from Windermere is an integral part of UU's Integrated Resource Zone. It forms part of the Lake District supply system also comprising Haweswater and Thirlmere reservoirs, Ullswater and associated aqueducts (Figure 2.1). As strategic sources within a wider, integrated supply system, the Lake District sources may effectively support demand across the wider system either directly, or indirectly to offset demand from other sources (e.g. local

sources cut-back to sustainable rates). Due to the importance of these Lake District sources, Haweswater reservoir is one of two sites in the Integrated Resource Zone with drought triggers, as outlined in UU's Drought Plan, and there are various actions (including the proposed Windermere DPs) associated with these triggers.

2.1.2 Existing abstraction and operation

The existing Windermere abstraction licence was issued by Lancashire River Authority with the licence number 2673705021. The licence authorised the abstraction of water from Lake Windermere at Calgarth for the purpose of public water supply. The abstraction should not exceed 45,000,000 gallons per day (204.57 Ml/d) and 8,030,000,000 gallons (36,505 Ml/d) in any period of twelve consecutive months.

Conditions were imposed on the licence which state that the company shall not abstract:

1. In any day in the months of May to September (inclusive) when the flow of water through the gauge measuring the flow in the River Leven during the preceding day was less than 60,000,000 gallons (273 Ml/d).
2. In any day in the months of October to April (inclusive) if the flow of water through the gauge during the preceding day was less than 30,000,000 gallons (136 Ml/d).

Water is drawn from the lake at the Company's pumping station at Calgarth and is pumped to Watchgate Water Treatment Works via the Staveley pipeline. After treatment at Watchgate, water is put into supply via the Haweswater Aqueduct (Figure 2.1).

As noted above, abstraction of water from Windermere is subject to a daily maximum of 205Ml/d, which is only permitted when the rate of flow in the River Leven is greater than 273Ml/d during May-September and 136Ml/d between October-April. Abstraction is from the lake itself, whilst hands-off flow (HoF) conditions are on the River Leven downstream.

It should be noted that the interaction of lake level and river flow at Windermere is complex, and may be influenced by factors such as wind. There is a (two stage) weir at the outfall of Windermere (Newby Bridge weir), and small changes in level may have a pronounced effect on river flows. Moreover, because of the storage in the lake, changes in downstream river flows can be quite sustained. This is important in the context of this assessment.

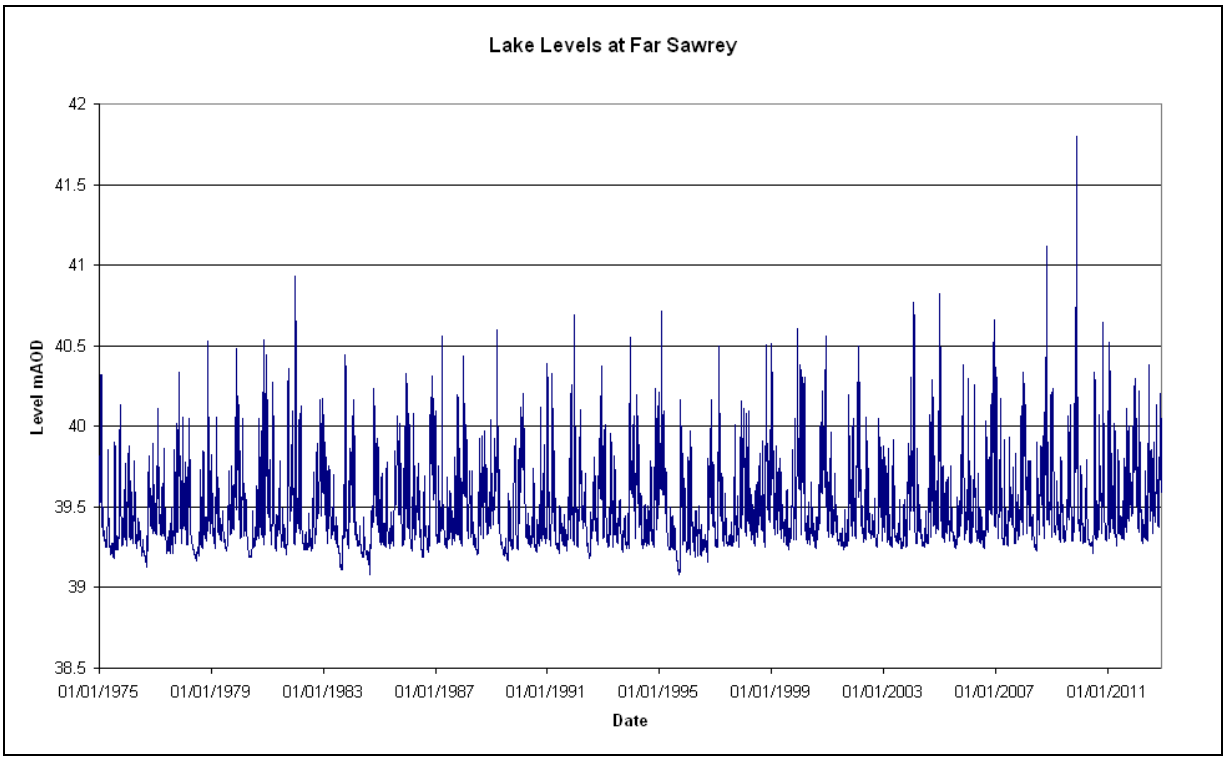


Figure 2.2 Historic Change in Water Levels at Windermere, Far Sawry (EA, 2013)

Error! Reference source not found. shows Windermere's historic lake levels since 1975. It indicates reasonably consistent lake levels over the historical record with seasonal variation. Low points are visible during the 1995/96, mid-eighties and 1975/76 droughts. The 2011 Windermere Management Strategy (LDNPA, 2011, p.12) notes that the 2008 and 2009 flood events 'had a serious economic impact on businesses based on the lake shore. Tourism is a significant part of the economic prosperity of the area and extreme weather events are likely to increase as a result of climate change'.

2.1.3 Previous Drought Permits

The UU supply area has been subject to the following historic droughts:

- 1933/4: a two-season drought event concentrated in the south of UU's region;
- 1963: a two-month drought event affecting the West Cumbria Resource Zone;
- 1975/6: a two-season drought event that particularly affected the north of UU's region, including the Pennines;
- 1984: a single season summer drought event that particularly affected the north of UU's region including the Pennines;
- 1995/6: a severe two-season drought event that affected the whole of UU's region;
- 2003: a short-lived winter drought where drought powers were granted but not implemented due to subsequent rainfall; and
- 2010: a short-lived summer drought where drought powers were applied for but later withdrawn following subsequent rainfall

Given the strategic importance of Windermere to water supplies, the site has been subject to applications for drought powers in 1976, 1984, 1995/96, 2003 and 2010. Powers were granted and implemented in the 1976, 1984 and 1995/96 cases, although the conditions were more severe than those proposed in the current Drought Plan.

Two more recent drought events have occurred, in 2003 and 2010, which were not as severe as the above. In both these years UU implemented drought actions and applied for DPs/DOs, but the powers were never implemented because of subsequent rainfall. In 2003, a DP application was made following dry weather during the autumn of 2002 and into 2003. The application was granted just before Christmas 2003, yet was not implemented due to subsequent rainfall in December 2003 and January 2004. In 2010, a DP application was made to the EA at the beginning of July, but UU withdrew the application shortly afterwards following the onset of significant summer rainfall. However, this particular drought application also brought with it a number of objections from two key stakeholder groups:

- users of the lake for leisure and commercial craft, concerned about the impact of the lake level on tourism and boat use; and
- environmental concerns with regards the impacts on the River Leven downstream.

These objections highlighted the need to update the impact assessment studies, in particular with regards potential mitigation measures and socio-economic impacts on lake users.

The EA has also requested that the study includes a full review of the different operating regimes that could occur in a DP context, and how this might impact on the balance between river and lake needs.

2.1.4 Previous reports

There is an existing EAR for Windermere. This was completed between 2005-2008 and mostly covered data to up to 2005. An interim data retrieval exercise was completed in 2009. In 2010, this was updated as part of a targeted review for a DP application. Given that the document was updated for a specific application for drought powers, this update only covered Scenario 1 and the impact assessment only covered a six month period (August 2010 to January 2011). It therefore does not include monitoring and findings from the 2010 low flow event.

2.2 Windermere waterbank and flood releases

As aforementioned, there is a weir (Newby Bridge weir) at the lower end of Windermere, and releases from the lake may be made for the purpose of flood mitigation and environmental needs.

In 2009, Windermere was subject to major flooding around the lake margins, and UU since been involved in discussions between EA and stakeholders to examine alterations to flood sluice operation, which have now been agreed. These have a negligible impact on water resources.

More importantly, the EA also have an annual 'waterbank' of 2273Ml, a defined amount which may be released for environmental purposes. Waterbank operation was discussed in the 2010 drought and subsequently UU, EA and key stakeholders discussed altering the terms of this waterbank under normal operation. The revised waterbank agreement was finalised in December 2012 (Section 2.2.1).

2.2.1 Final Windermere Waterbank Agreement (2012)

In order to assist in the conservation of fisheries and ecology in the River Leven a Sluice Gate, to control additional discharges of water from Lake Windermere was incorporated in the weir at Newby Bridge. The sluice is operated by the EA and its use is governed by the Directions agreed between United Utilities Water Plc and the Environment Agency, after consultation with the local parties noted below. There is an agreed 'Direction for Operations of the Fishery Sluice' for a trial period up to 30th September 2016.

The following directions apply:

- Water may be released at any time when the natural flow through or over the gauge does not exceed 273 Ml/d in the months of May to September (inclusive) or 136 Ml/d in the months of October to April (inclusive).
- The total quantity of water released via the Fishery Sluice shall not exceed 1350 million litres per month. This equates to a daily average of approximately 45 Ml/d. These volumes are known locally as the 'Windermere Water Bank'.
- If the situation arises whereby the monthly total Water Bank has been exhausted, and/or Windermere is drawn down to 5 cm below weir crest, then the EA will operate the sluice to mimic inflows to the lake. The EA will use its network of river flow gauges and lake level gauges to estimate inflows to the lake.

In discussion with local parties it was identified that releases made through the sluice gate (also known as the fish sluice) are likely to be between 45 Ml/d and 90 Ml/d, to try and maintain river flows of at least 95 Ml/d to protect the ecology of the River Leven. At extreme low river flows, it may be necessary for the EA to make releases through the sluice which may draw down water levels below the low weir crest at Newby Bridge (39.144 mAOD). The EA would not expect to draw the water level down by more than 5 cm below the weir crest.

2.3 Drought Permit proposals

There are two levels of potential DP at Windermere, which are expected to be applied sequentially:

- Scenario 1: Reduce hands-off flow conditions to 95 Ml/d and relax the 12-month rolling abstraction licence limit.

- Scenario 2: In addition to the conditions in Scenario 1, permit drawdown of lake level (up to a maximum of 0.5 m below weir crest), with potential support to river flows via the fish sluice.

2.4 Designated sites

Windermere was not included in the EA's Habitats Directive review of consents, but is located within the Lake District National Park, is designated as a County Wildlife Site and a small proportion of Windermere is within the Low Wray Bay Site of Special Scientific Interest (SSSI) which is designated for its preserved sediments of Windermere.

The River Leven, which flows out of Windermere, is one of five major fresh water sources to Morecambe Bay (Special Area of Conservation (SAC)/Special Protection Area (SPA)/Ramsar/SSSI) which also includes the rivers Lune, Kent, Keer and Wyre. Discussions with the EA and Natural England (NE), as part of previous environmental studies, ascertained that the impact on Morecambe Bay is likely to be insignificant given the relative volumes of water involved and the large attenuation volumes available in Morecambe Bay. Therefore Morecambe Bay (SAC/SPA/Ramsar/SSSI) will not be considered further during this impact assessment update.

The geological interest of Low Wray Bay SSSI consists of preserved sediments which provide a record of climatic change and enable the site to be compared with others of a similar age in other parts of Britain and Western Europe. NE's main concern (S. Evans, via email, 31/01/2013) is to avoid any activities which could cause deep disturbance to these sediments. If key areas of lake sediment were to be exposed the main risks would be drying and cracking, as well as physical disturbance/erosion of the sediments and sequences by the public, livestock, boats, wave action etc. However, as the key areas of stratigraphical interest are several metres below the water surface, it is unlikely that a permit to draw down the lake to a maximum of 0.5m below weir crest level, as proposed, would have an adverse impact on the nature conservation interest of Low Wray Bay SSSI. Nevertheless, given the importance of the site and that effects on lake level are being considered for other purposes, it is proposed to consider the potential for exposure of sediments at Low Wray Bray SSSI as part of the lake level and exposure assessments during Phase 2.

NE has provided additional details of Low Wray Bray SSSI including a transverse section, map, Geological Conservation Review (GCR) report, geological timescale and report, site description and details of the SSSI designation.

3 SOCIO-ECONOMIC CONTEXT

3.1 The importance of tourism in the Windermere economy

Just under 50,000 people (Census, 2011) live in the Windermere catchment area (area shaded red on Figure 3.1), mainly in Windermere, Bowness and Ambleside. Visitors first started to come to the area in 1847 (when the railway was built) to visit the lake – the largest lake in England. Now, most visitors now arrive by car, mainly from the UK in particular the North West and Yorkshire & Humber regions (Cumbria Visitor Survey, 2012, QA Research).

Examination of published statistics demonstrates the dependence of local jobs upon the tourism industry. The 2011 Windermere Management Strategy (LDNPA, 2011) highlights the importance of tourism to the area's economy, but also indicates the vulnerability of the local economy to this reliance due to factors such as high seasonality of jobs and transport services. Whilst it is not possible to state definitively that all of these jobs and workplaces rely on the visitor economy, it is fair to say that many will. Data is sourced from the:

- 2008 Annual Business Inquiry (ABI) Data (workplace) data – a survey of the number of workplaces and their size (in terms of employees) broken down by sector; and
- 2011 Business Register and Employment Survey (BRES) – an employer survey of the number of jobs held by employees broken down by sector.

The data is mapped in Figure 3.1 and Figure 3.2, and is broken down by sector in Table 3-1 and Table 3-2. This suggests that areas in the north of the catchment around Ambleside, Waterhead, Windermere and Bowness are highly dependent upon tourism; over 40% of workplaces and 60% of jobs in these areas are likely to be linked to the visitor economy in some way.

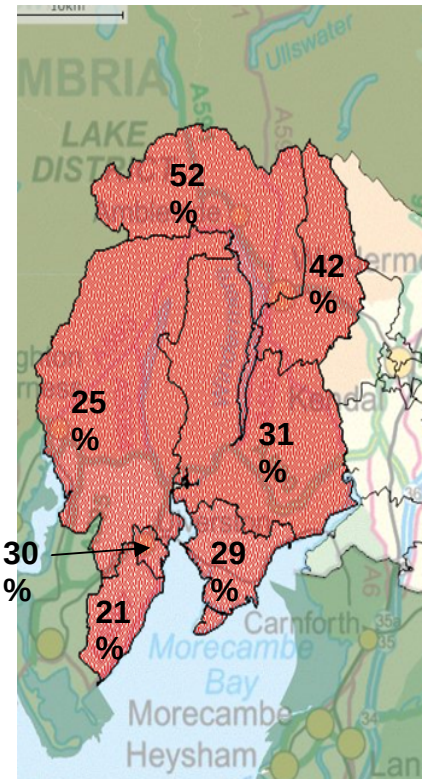


Figure 3.1 – Percentage of tourism related workplaces of total number of workplaces in Windermere catchment (ABI, 2008)

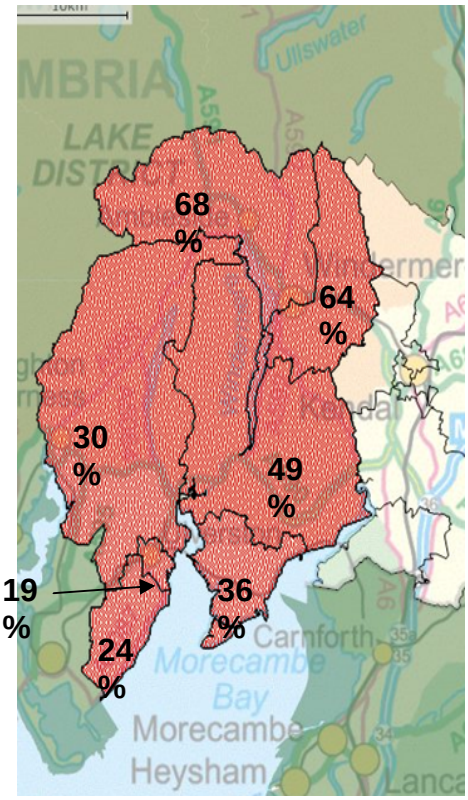


Figure 3.2 – Percentage of tourism related jobs of total number of jobs in Windermere catchment (BRES, 2011)

Table 3-1 Percentage of tourism related workplaces of total number of workplaces in Windermere catchment (2008 Annual Business Inquiry Data)

Area (Middle Super Output Area)	Retail[1]	Hotels and restaurants	Recreational, cultural and sports	Total (tourism related)	Total (all workplaces)	% Tourism related of total
1	132	192	22	**346**	**671**	**52%**
2	90	118	29	**237**	**559**	**42%**
7	34	82	17	**133**	**434**	**31%**
8	32	55	n/a	**96**	**382**	**25%**
12	82	43	n/a	**134**	**449**	**30%**
13	51	49	15	**115**	**401**	**29%**
14	23	28	n/a	**58**	**277**	**21%**
Total	**444**	**567**	**108**	**1119**	**3173**	**35%**

Table 3-2 Percentage of tourism related jobs of total number of jobs in Windermere catchment (2011 Business Register and Employment Survey)

Area (Middle Super Output Area)	Retail[2]	Water transport	Accommodation	Food and beverage services	Travel agency, tour operator etc.	Entert-ainment	Sports and recreation	Total (tourism related)	Total (all workplaces)	% Tourism related of total
1	1,337	22	1,909	768	33	n/a	68	**4,139**	**6,056**	**68%**
2	522	92	937	654	95	11	64	**2,375**	**3,685**	**64%**
7	127	43	823	238	n/a	n/a	51	**1,287**	**2,623**	**49%**
8	127	0	220	144	10	n/a	33	**535**	**1,766**	**30%**
12	511	0	22	171	24	10	61	**799**	**4,296**	**19%**
13	199	0	491	214	n/a	n/a	14	**924**	**2,550**	**36%**
14	59	0	71	140	n/a	0	13	**286**	**1,214**	**24%**
Total	**2,882**	**157**	**4,473**	**2,329**	**172**	**31**	**68**	**10,349**[3]	**22,191**	**47%**

[1] except of motor vehicles and motorcycles; repair of personal and household goods
[2] except of motor vehicles and motorcycles; repair of personal and household goods
[3] this is a slight under-estimate compared to STEAM 2011 statistics

Table 3-3 and Table 3-4 provide a summary of tourism statistics for South Lakeland. Two sources of information are available: the SLDC STEAM[4] Report (2011) and the Cumbria Visitor Survey (2012). Note that the statistics include data for Coniston and Kendal as well as Windermere. The figures are not broken down to allow them to be presented for the Windermere catchment only.

Points to note in Table 3-3 and Table 3-4 are that approximately 15.8m visitors to South Lakeland spend in excess of £600m per year in the local economy. This generates a further £246m into the local economy via the supply chain. On average, staying visitors spend around six times more than day visitors, although there are far fewer staying visitors than day visitors. Most visitors come from the UK (94%), mainly from the North West and Yorkshire and Humber regions (Cumbria Visitor Survey, 2012, QA Research). Of the staying visitors, most stay for long breaks (over 4 nights) and come to enjoy the landscape.

Table 3-3 Summary of key tourism statistics for South Lakeland (including Coniston and Kendal) provided by Cumbria Tourism (STEAM statistics summary 2011)

Statistic	Value
Tourism spending (direct and indirect) incl. VAT	£982m
- Summer	Approx. £110m/month
- Winter	Approx. £52m/month
Tourism spending (direct) excl. VAT	£613m
- Summer	Approx. £82m/month
- Winter	Approx. £39m/month
Tourism spending (indirect) excl. VAT	£246m
- Summer	Approx. £27m/month
- Winter	Approx. £13m/month
Tourism spending:	
- Accommodation	£180m
- Food and drink	£192m
- Recreation	£55m
- Shopping	£77m
- Transport	£109m
- Day visitors	£480m
- Staying visitors	£503m
Number of visitors	
- Day visitors	13.7m
- Staying visitors	2.1m
Employment	
- Direct	11,276
- Indirect	3,008
Total number of accommodation establishments	
- Serviced	692
- Non-serviced	2233

[4]'Scarborough Tourism Economic Activity Monitor' Report. The methodology, first pioneered in Scarborough, has been applied to all areas of UK and is now the standard source of tourism statistics for local authorities in UK

Table 3-4 Summary of key tourism statistics for South Lakeland (including Coniston and Kendal) provided by Cumbria Tourism (Cumbria Visitor Survey, 2012, QA Research)

Statistic	Value
Proportion of visitors to South Lakeland who said they would take a boat cruise/motor boat cruising	26%
Proportion of visitors to Cumbria who said they would take a boat cruise/motor boat cruising:	
- Staying visitors	27%
- Day visitors	3%
- UK visitors	20%
- Overseas visitors	21%
Average visitor spend per day (Cumbria)	
- Day visitors	£21.14/day
- Staying visitors	£54.29/day

Visitor spending in summer months is roughly double the amount spent in winter months (Figure 3.3). This is because of the number of visitors (Figure 3.4); spend per day is similar to that in winter. Figure 3.3 and Figure 3.4 both show the importance of public and school holidays for the tourism economy.

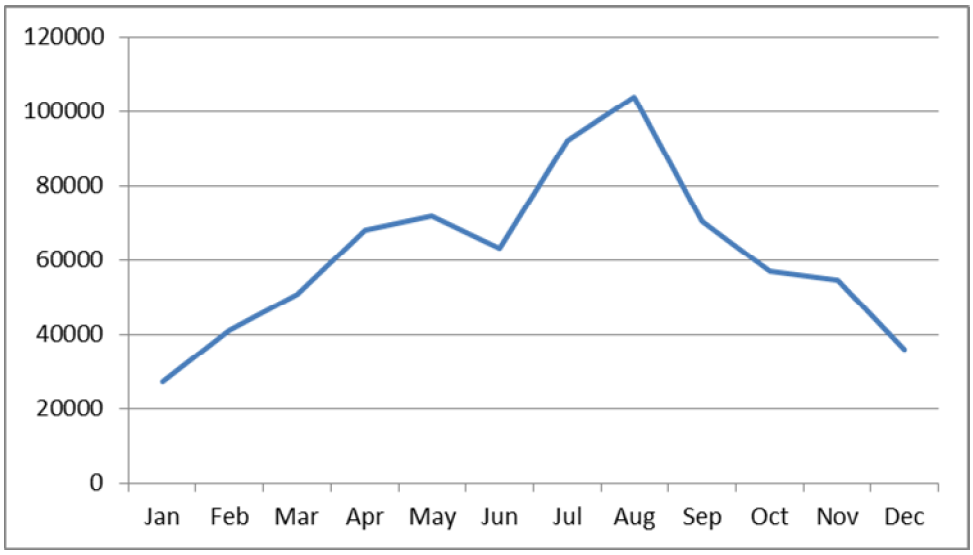


Figure 3.3 Seasonal variation in direct visitor spend (£k) (STEAM statistics 2011)

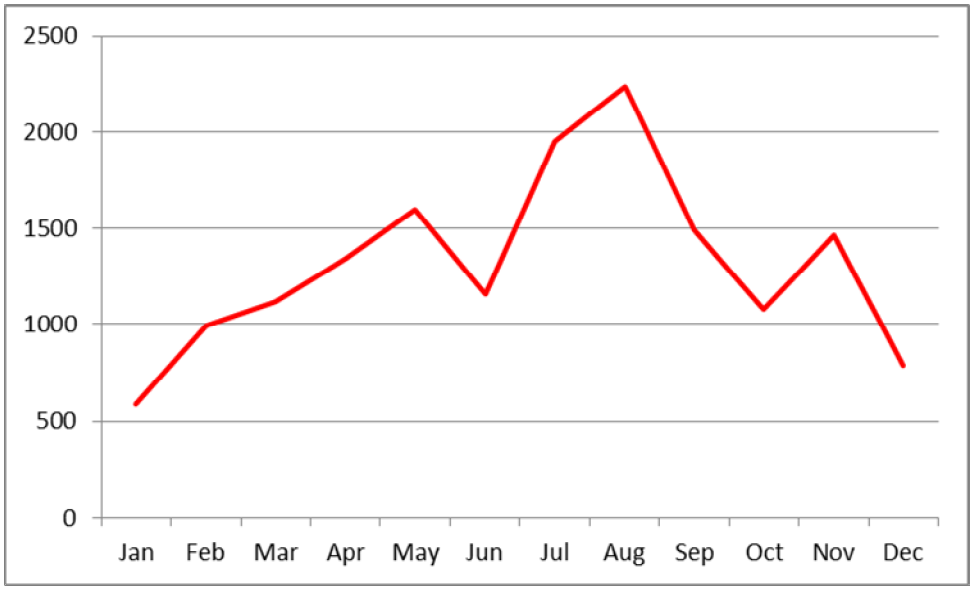


Figure 3.4 Seasonal variation in visitor numbers (k) (STEAM statistics 2011)

3.2 Lake use and land ownership

3.2.1 Overview

Windermere offers a variety of activities, ranging from cruises, water sports to lakeside activities. Lake dependent activities include use of powered and non-powered crafts, windsurfing, water skiing, canoeing/kayaking, swimming, diving, cruising, lakeside walking, wildlife watching, angling, cycling, horse riding, picnicking and outdoor pursuits.

3.2.2 Land ownership

Land on the eastern side of the shore is mostly privately owned. Large areas on the western shore are owned by the National Trust. Other major landowners include the Forestry Commission, UU, Cumbria Wildlife Trust and Cumbria Woodlands. The Western Shore project will improve access to the National Trust land on the western shore between Ferry House and Wray Castle. Popular picnic sites include Fell Foot Park, Borrans Park, Brockhole, Miller Ground, and the National Trust land.

3.2.3 Windermere Lake Cruises (WLC, pers. comm. 7th February 2013)

Windermere Lake Cruises (WLC) is a key visitor attraction on the lake, employing approximately 140 people in winter months and 170 people in summer months. The business is very seasonally dependent with a few days' takings in the summer being equal to a months' worth of takings in winter. School holidays are of particular importance. WLC owns five lakeside assets at Bowness, Waterhead, Lakeside, Brockhole and Wray Castle; boat access to which is dependent on water levels. A new 20m long jetty is proposed at Bark Barn as part of a proposed water bus service.

A reduction in wetted area of 35-40m from the shoreline, in addition to a reduction of water depths below 2m would affect navigation and the operation of the WLC cruises. This is most

likely to occur around Belle Isle in the central part of the lake between the north and south basins. When water depths fall below 2m, it is no longer possible to operate the Island Cruise (WLC and South Lakeland District Council. Pers. comm., 2010) and access to the piers at Bowness and Wray Castle are restricted (particularly from the south basin) as well as navigation between the north and south basins of the lake. All lake traffic is affected and constrained to narrow channels of the lake which also raises safety issues.

3.2.4 Other activities

There are walking and horse riding routes along the lakeside, including four 'Miles without Stiles' routes suitable for people with limited mobility. There are three bathing waters designated under the European Bathing Water Directive (76/160 EEC) at Windermere – Fell Foot, Miller Ground and YMCA Lakeside. However, swimming and paddling takes place in many places around the lake shore. Swimming is becoming increasingly popular with an annual long distance swim, cross lake swim and the Great North Swim (which in 2009 attracted 6,000 swimmers).

Outdoor centres bring many visitors to the lake, including the young and disadvantaged. There are six in the immediate area of Windermere: Tower Wood, Ghyll Head, Dale Head, Patterdale Hall, High Borrans, and Low Wood Watersports Centre. Another watersports centre is planned at Brockhole Visitor Centre in 2013. These centres are important contributors to the local economy.

A ferry operates every 20 minutes between Ferry Nab at Bowness and Ferry House at Far Sawrey. This is an important commuter/tourist route taking up to 18 vehicles on each trip. The journey cuts out an additional 10 miles by road and therefore helps to reduce congestion and pollution emissions. A new water bus service is also proposed. This will aim to connect more lakeside attractions, holiday accommodation centres, footpaths, cycle paths and links with local bus networks where possible. LDNPA has just finished a public consultation which will inform identification of water bus landing points.

3.2.5 Lake moorings

SLDC have 1080 moorings available on Windermere in 28 locations of which 801 are currently leased. Maps 1-3 (Appendix D) show the location of these areas. SLDC report that the average length of a boat is 8.02m (ranging from 4.26m to 10.97m) and the average draught is 1.34m. SLDC report that moorings would be at risk in 12 of the 28 mooring areas if water depths were to drop to less than 2m. These areas are highlighted on Maps 1-3 (Appendix D). SLDC report that in 1995/1996 temporary moorings were placed in White Cross Bay and East of Rampholme Island in order to accommodate vessels which had to be moved from their normal mooring site due to the drought conditions.

Figure 3.5 below shows the change in number of moorings leased since 1990. The data shows a fall in the number of leased moorings between 1990 and 1995. The number of moorings leased increased again from 1995, but reached 1990 levels only by 2004. Since 2004, the number of moorings used has remained relatively stable.

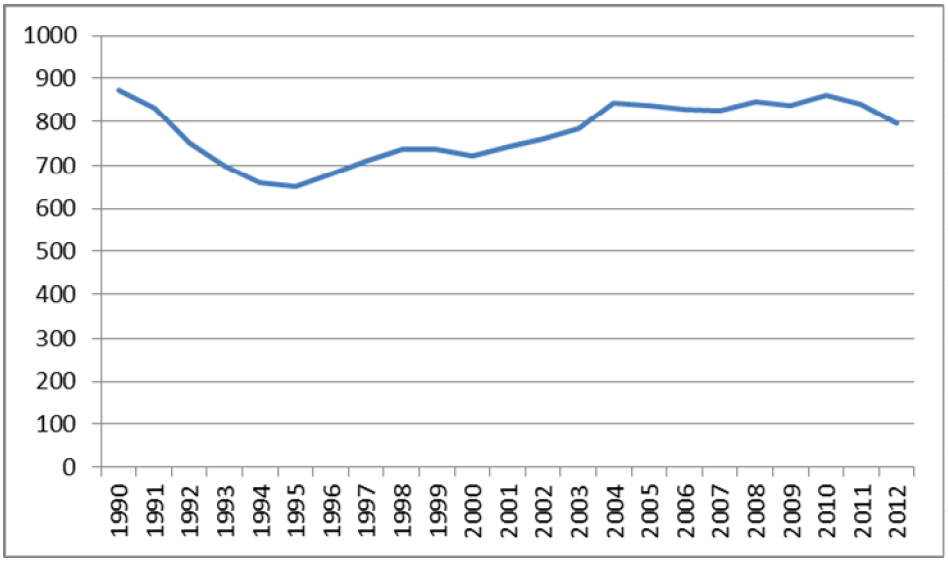


Figure 3.5 Historic change in number of moorings leased (SLDC 2013)

3.2.6 Jetties and slipways

Bowness is the focal point for water craft using the lake. There are marinas, boat yards and maintenance facilities, public and private jetties, and a number of swinging moorings. Waterhead also provides similar facilities but on a smaller scale. There are also c.100 private jetties around the lake, and several public jetties. These locations are shown on Maps 1-3 (Appendix D).

The main public slipway is located at Ferry Nab at Bowness. A public car park, toilet and shower facilities, public jetties, toilet pump-out, sailing dinghy and tender storage are all provided. Ferry Nab is the only public slipway available for powered and large boats. Small motor boats may launch from Waterhead. Sailing dinghies, canoes and rowing boats may launch from several areas on National Trust land, Rayrigg Meadow, and Beech Hill. The National Trust-owned Fell Foot Park at the southern end of the lake also provides a well-used public jetty, onshore boat and canoe storage, shower and sailing club facilities (LDNPA, 2011).

Windermere Lake Cruises jetties are described in Section 3.2.3.

Figure 3.6 shows the change in number of launches from Ferry Nab. This indicates that since 1990, there has been a considerable decrease in the number of powered craft launched. The Joint Annual Reports for Windermere indicate that this decrease is representative of the activity on the lake as a whole, rather than boats launching from elsewhere. The general decline is linked to high fuel prices and poor summer weather. However, the significant drop in 2005 is linked to the introduction of a speed limit on Windermere of 10mph for powered craft; plus a 6 mph limit for all craft at the northern and southern ends of Windermere, and in the central area between Bowness and Ferry House.

The number of non-powered craft on Windermere launching from Ferry Nab is low and does not appear to have changed much. Although no data is available from SLDC since 2005, SLDC report that the number of non-powered craft on Windermere has increased

significantly since the speed limit was introduced in 2005. This comprises an increase in canoeists/ kayakers, swimmers and dinghies.

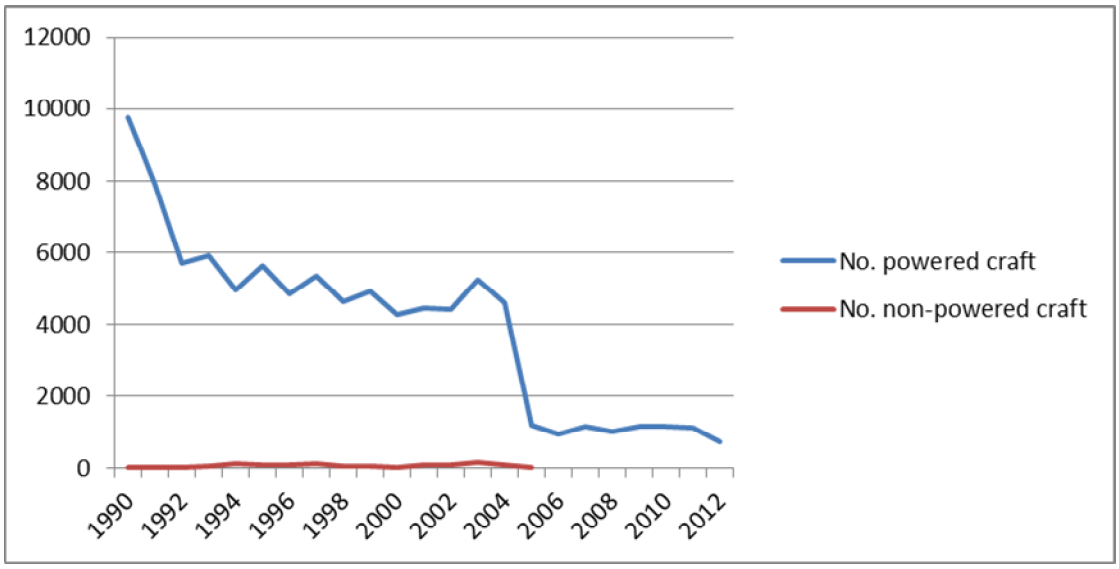


Figure 3.6 Historic change in numbers of powered and non-powered craft launched from Ferry Nab slipway on Windermere (SLDC)

SLDC has also indicated areas of jetties and slipways which would also be at risk if water levels were to drop below the level of Newby Bridge weir crest (Maps 1-3, Appendix D).

3.2.7 Registered boat users

Annual boat registrations are recorded in the Joint Annual Reports for Windermere. These report a decline in the number of boat registrations since 2000. The various factors reported are indicated by the arrows in Figure 3.7.

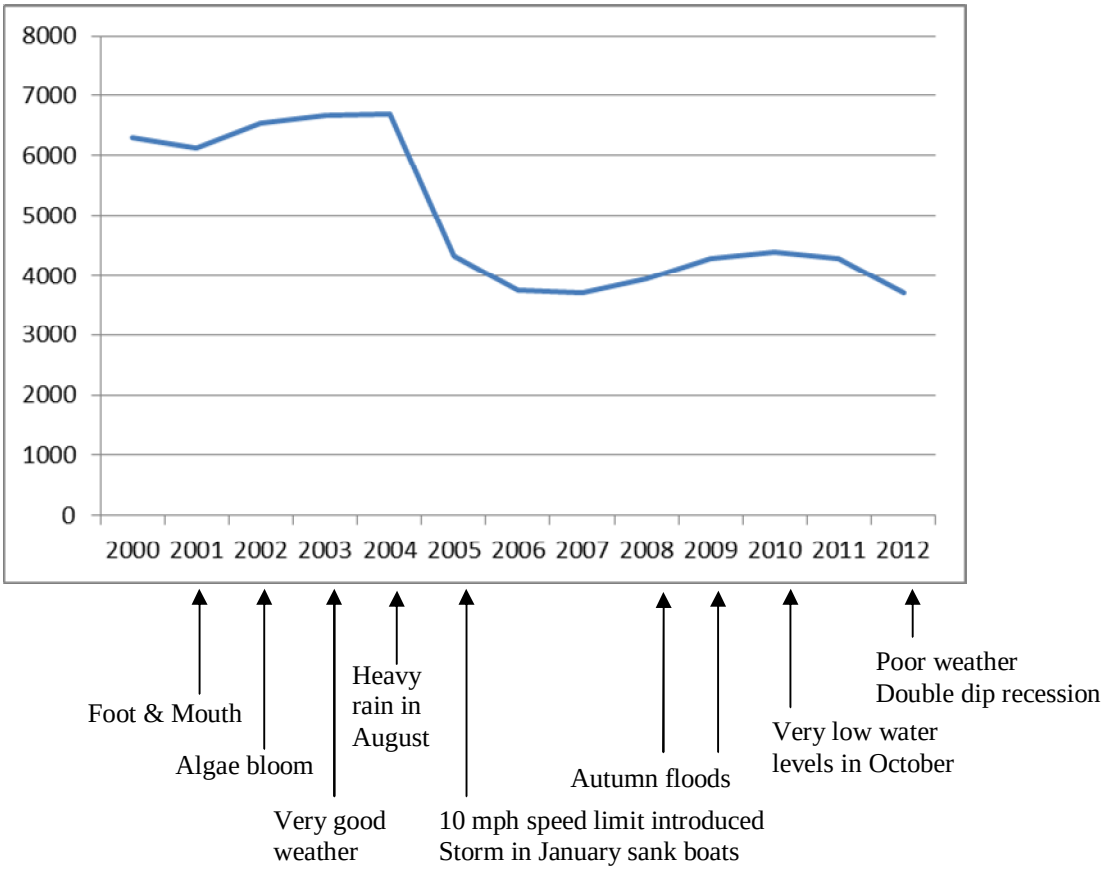


Figure 3.7 Historic change in numbers of boat registrations on Windermere (SLDC)

3.3 Stakeholder concerns

Key stakeholder concerns with relation to socio-economics, landscape and visual amenity have been identified through review of previous reports (Cascade Consulting, 2008, 2010 DP objections and 2012 Draft Statutory Drought Plan responses), and by initial discussions with WLC, Holker Estates, Cumbria Tourism, SLDC, Lake District National Park and National Trust.

3.3.1 Review of previous environmental reports

Windermere Drought Contingency Planning - Environmental Assessment Report' (2008) Cascade Consulting

This report notes that 'the economic and social well-being of the area is dependent on the quality of its natural environment' (p.122) and equally that 'abstraction makes a significant contribution to the provision of safe and reliable water resource for the regional North West' (p.122). The report concludes that 'Drought Permit scenario 1 does not have any major significant impacts that would be of relevance to the enjoyment of the area for recreation or visual amenity. Consequently there would be few socio-economic implications for tourism and the local impacts would be negligible' (p.122).

The report goes on to say that: 'However, with Drought Permit scenario 2 there may be summer drawdown of the lake to lower levels than have been experienced for many years

(potentially for up to a period of 2 months). In this event, there would be implications for recreational and commercial users (commercial wardens, ferry services and lake cruises, boating, watersports, swimming and angling) that may also affect the tourism industry. In this case there would be both direct (e.g. boat operator earnings) and indirect (e.g. accommodation) impacts that may have an influence on the local economy. Although relatively short lived, it may occur during the peak tourist season. In this case, there would be moderate impacts on the socio-economic infrastructure of Windermere' (p.122).

In summary, the report concludes that 'on balance, the benefits of providing reliable water resource to the North West of England are likely to outweigh the local impacts on tourism, leading to a major net benefit in the winter months and moderate benefit during the summer' (p.122).

Windermere Drought Permit Environmental Assessment - Environmental Report' (2010) Cascade Consulting

The 2010 report draws the same conclusion as the 2008 report stating that there may be some socio-economic impacts of scenario 1 upon the local community in terms of recreation and the visitor economy, but that these are likely to be negligible in relation to the overall economic benefits of further water abstraction for the community of the North West of England. It does not assess scenario 2. The report does not include any methodological description and does not describe the source of data which informs this conclusion other than it is based on data provided by LDNPA.

The scope and methodology of the sections dealing with Landscape and Visual Amenity is described in the following extract:

'At this stage it has been considered inappropriate to present a comprehensive landscape appraisal that would, for example, satisfy the Landscape Institute/IEMA Guidelines for Landscape and Visual Impact Assessment; Second Edition (2002). Such an appraisal would require a detailed study and preferably photographs of Windermere during previous periods of lake drawdown from which to ascertain the potential landscape and visual effects of different levels of shoreline exposure. The following assessment is therefore based on semi-quantitative analysis of the existing bathymetric survey of Windermere and simulation of the areas of shoreline exposure. A more detailed study could be undertaken if thought to be necessary by consultees.'

Conclusions on Landscape and Visual Amenity from these reports are as follows:

- Scenario 1: Water levels would remain within the normal drought envelope, and impacts on Windermere and the River Leven and their environs would be negligible.

- Scenario 2: Autumn/winter/spring drought (October to June): Only a slight effect on lake levels is anticipated, giving rise to minor and short-term landscape and visual impacts (below weir crest levels for only brief periods).

- Scenario 2: Summer drought (July to September): Under the worst case conditions, lake levels are anticipated to fall below Newby Bridge weir crest for up to 2 months to a maximum of 50cm below crest level, causing potential exposure of non-vegetated lake sediments (particularly on the more shallow sloping beaches / margins), artificial

structures and debris that would otherwise be submerged and not visible. Shallow areas of the lake margin and islands around the whole lake perimeter would become exposed as lake levels fall, particularly in bays such as Waterhead Bay and Lazy Bay, and headlands including Long Tounge. Given the sensitivity of the Windermere landscape, the resultant impact on landscape and visual amenity is considered to be high, particularly considering that such a drought would coincide with the holiday season and hence peak tourist usage. However, the low lake levels recover rapidly following periods of significant rainfall and landscape impacts would be limited to a temporary period.

3.3.2 Review of 2010 DP objections and 2012 drought plan responses

2010 DP objections

The concerns from the 2010 permit objections largely orientate around financial costs that could be incurred to individuals, local tourism businesses and the wider visitor economy if water levels fall. Newby Bridge weir crest is commonly stated as the level below which water levels will incur socio-economic impacts. However, different stakeholders, depending on the size of their boats, state different threshold points. The range of stakeholder concerns may be summarised as follows:

Direct costs

- Private boat owners are concerned that they will not be able to operate their boats when water levels fall below a certain level. They are concerned that costs could be incurred through damage to the keel of their boats if they come to rest on the river or lake bed[5]; and through a loss of recreation value if it is not possible to use their boats at all.
- Boat tour operators are concerned that they will not be able to operate their boats when water levels fall below a certain level. They are concerned that costs could be incurred through damage to the keel of their boats if they come to rest on the river or lake bed. They are concerned that costs could be incurred through a reduction in operable days (particularly during peak visitor season) due to a drop in water levels or due to increased concentration of boat activity on the lake which could restrict operations. This would lead to a direct loss in business revenue.
- A reduction in quality of the visitor experience, due to fall in water level and associated aesthetic and amenity value, due to a change in the lake appearance and its immediate environment.
- A fall in water levels could directly affect other recreational users, due to a fall in quality of the visitor experience e.g. anglers, canoeists, walkers. This may be due to concentration of water activities in a smaller area due to reduced water levels, lower access, or a drop in water quality; all leading to safety concerns.

Indirect costs

- A knock on cost to local accommodation providers, retail and restaurants and other tourist services if the number of visitors dropped, resulting in a decrease in business revenue.

[5] It should be noted that private financial costs are not necessarily an economic impact.

- A knock on cost to local residents if commuters/shoppers cannot travel by boat and so must travel the additional distance by road (bus, taxi or car) at an additional cost or inconvenience.
- Depending on the length of time and degree of direct costs incurred above, this could lead to a long-term reduction in visitor numbers to Windermere (over several years), if the quality of the visitor experience incurred a long lasting impact. However, this impact is less certain due to the international appeal of the wider Lake District area as a whole, of which Windermere is a part.

Suggested mitigation measures

Many of the 2010 permit objections expressed an understanding of the societal need to abstract water for human use, in particular for use by large urban conurbations and not just local users. As such, many of the respondents identified possible measures to mitigate the need for future of further abstraction permits and the impacts of these on users of Windermere. These comprised the need to:

- communicate to water users of the impacts of their consumption upon the landscape and habitats of the LDNP;
- encourage local businesses to use water saving devices and behaviours;
- reduce water leaks in pipe infrastructure;
- dredge the lake bed to improve navigation in times of low water levels;
- provide new temporary moorings for boat owners in times of low water;
- implement earlier hosepipe bans to mitigate the need to additional abstraction; and
- ensure a buffer water level in place above Newby Bridge weir crest prior to any additional abstraction.

Although objections and stakeholder comments generally focussed on concerns about socio economic impacts resulting from low lake levels. The following gave specific reference to landscape and visual issues:

1. The Friends of the Lake District (FOLD), July 2010:

Whilst not objecting to the application, FOLD noted that this was done, '...on the understanding that recognition is given to our serious concerns as set out, and on the expectation that a fundamental review is conducted post the drought...' The concerns referred to included issues of visual intrusion, and the lack of a comprehensive landscape appraisal process. FOLD stated: 'We note on page 108/109 of the Environmental Assessment report that "it is considered inappropriate to present a comprehensive landscape appraisal" at this stage as it would require a detailed study of previous drought situations. We accept that at this point in time this study could not be conducted within the timescale for decision on the Drought Permit application. However, we would suggest that following the publication of the National Park Landscape Character Assessment (LCA) in 2008, UU should commit to working with partners interested in landscape issues (ourselves, LDNPA, NE) to produce a comprehensive landscape appraisal during the next few months in order to inform any future drought situation. In addition, the immediate monitoring requirements (baseline, during the implementation of and after the DP) should include visual disamenity information whether the lake drops below the weir or not, so that this can feed into future studies. The information would then be more readily at hand and provide further detail on the issues relating to visual amenity/disamenity.'

2. Cumbria Tourism**,** July 2010:

CT objected to the application citing a number of concerns over potentially damaging consequences from abstraction and their effects on tourism, including: '...for the amenity and appearance of the lake and its immediate environment.'

During the scoping phase, Holker Estates also expressed concern about the impact of low water levels and poor water quality upon the River Leven salmon and trout stocks, which they consider to have plummeted in recent years (pers. comm., 2013). These are not due to DP operation, but any further impact because of drought operation needs to be considered in this assessment.

2012 Draft Statutory Drought Plan responses

Reponses received as part of the 2012 Draft Statutory Drought Plan consultation re-iterate the concerns about possible impacts of the DP as summarised above.

3.3.3 Summary of possible impacts

The visitor economy is likely to be impacted by additional water abstraction, allowed under a DP, if water levels are reduced below the crest height of Newby Bridge weir. The impact is more likely to occur if water depths fall below 2m in key areas around Bowness and Belle Isle. SLDC lake wardens have highlighted 12 mooring areas and numerous public and private jetties that would be at risk from low water levels. The impacts are likely to occur because the lake cruises, ferries and private boats may not be able to operate; and lake access is likely to be restricted for other lake users such as rowers, canoeists/kayakers, outdoor education centre activity, outdoor events, swimmers and anglers. This is likely to affect the visitor and lake user experience.

Any change in visitor or lake user activity and spend is likely to have repercussions upon the local visitor economy. This could affect lake shore businesses which supply lake related activities including cafes, restaurants, shops, accommodation providers, boat repair and maintenance, marinas, boat sales and chandleries and outdoor pursuit providers.

These impacts will be examined in more detail and quantified where possible in the environmental assessment report (Phase 2).

4 DATA REVIEW AND ASSESSMENT METHODOLOGIES

4.1 Lake level and exposure

As well as a review of available data from the EA and UU (Table 6-1 in section 6), the previous 2006 report has been reviewed and provides a comprehensive basis for updating the assessment of lake level and exposure. A key recommendation from that report is the reconciliation of lake level data from the two gauges at Calgarth and Newby Bridge.

Lake level monitoring is undertaken at Windermere by the EA at Far Sawrey (NGR: SD390956) and Newby Bridge Fish Sluice (NGR SD686642) (Map 1, Appendix A). Daily average lake level data were provided for the period January 1975 to December 2012 (Far Sawrey) and May 2010 to October 2012 (Newby Bridge Fish Sluice). These two data sources will be checked to ensure that the data are consistent (i.e. not necessarily being the same, but demonstrating similar trends) across the lake profile.

A bathymetry survey of the lake perimeter, at depths between the weir crest and one metre below the weir crest level, was undertaken for UU in 2004. The results of this survey will allow an assessment of lake bed exposure under different lake levels. To assess the impacts to local moorings around Windermere, the output lake levels computed from the UU Aquator model under the different scenarios will be assessed to determine the degree of lake bed exposure. It should be noted that the Aquator model is not specifically calibrated to produce storage levels (especially at Windermere), so this will need to be taken into account when analysing lake level results from the model.

During the first stakeholder meeting (SHG1) it was noted that during the dry 1995/96 season approximately 104 boats were considered at risk from stranding, which was approximately 10% of the boats on the lake. If available, photographs provided by the stakeholders from 1995/96 will be used to determine the approximate lake level during this event and compare to the proposed drawdown of the lake level by 0.5 m below the weir crest.

On the basis of the data reviewed as part of Phase 1, no new data collection is considered necessary for Phase 2, and the proposed level of detail for the Phase 2 assessment is still as follows:

Detailed study due to updating of socio-economic impacts.

4.2 River level/depth/velocity/flow; wetted width/area

As well as a review of available data from the EA and UU, the previous 2006 report has been reviewed as part of Phase 1 (Table 6-1).

Four representative sites on the River Leven were surveyed as part of the 2006 drought permit assessment (Map 1, Appendix A):

- D/S Newby Bridge (SD 36699 86394);
- U/S Backbarrow (SD 35546 85467);
- D/S Backbarrow (SD 35602 84521); and
- U/S Low Wood Bridge (SD 34701 83891).

These sites were chosen due to their ecological sensitivity and their potential for exposure of gravel areas suitable for salmonid spawning. These sections, areas of wide shallow flows, will show the most impact from any variation in flow conditions. However, following discussions with local EA officers during the site visit (Appendix C), it was identified that the previous location of cross-section 4 may no longer be the most suitable. The locations of the remaining cross-sections were visited and it was identified that due to the changes in the channel conditions and morphology following the floods in 2009, the survey cross-sections will need to be re-surveyed. It was also noted by the EA during the site visit that an additional (fifth) survey location would be beneficial, at a location closer to Newby Bridge weir, to cover an important fish spawning area. No additional gauging data have been made available by the EA elsewhere on the River Leven.

Following re-survey and flow gauging at each cross-section the hydraulic parameters of the channel will be assessed using the survey details. Transect data will include cross section area, wetted perimeter, wetted width and hydraulic radius, each calculated for a range river depths. Depth-discharge relationships will then be developed using Manning's equation. Gauging data will also provide information about the lateral distribution of depth and velocity across the transects, which will be used in the habitat analysis (Section 4.5).

The result of the hydraulic analysis will be a series of transforms between discharge and hydraulic parameters that can then be applied to the time series of flows resulting from Aquator modelling. This will establish hydraulic behaviour during drought periods for the different scenarios. It should be noted that the final Windermere waterbank agreement (Section 2.2.1) will need to be incorporated into the Aquator model.

On the basis of the data reviewed as part of Phase 1, re-survey of five cross-sections is required prior to the Phase 2 assessment. Apart from this, no other data collection is considered necessary for Phase 2, and the proposed level of detail for the Phase 2 assessment is still as follows:

Detailed study due to updating of river cross-sections.

4.3 Geomorphology (channel and sediment dynamics)

As well as a review of available data from the EA and UU (Table 6-1), the previous 2006 report has been reviewed as part of Phase 1.

The 2006 study considered geomorphological changes arising from changes to lake levels in Windermere, and from changes in hydraulic behaviour in the River Leven. Impacts were considered moderate or minor, and temporary, being limited to potential short-term exposure of, or changes to river substrates and suspended loads. These would be quickly reversed with the resumption of higher river flows. Use of the water bank is also likely to further reduce impacts if these are used to flush substrates and remove sediment accumulations.

Since the 2006 report was produced, a fluvial audit of the Windermere catchment (not including the River Leven) was carried out in 2009, focussing on riverine inputs of fine sediment and phosphorus to the lake (Jacobs, 2009). A geomorphological investigation of the southern end of Windermere, Newby Bridge weir and the River Leven was also carried out

by the EA between 1999 and 2005, including addition of gravel in an important salmonid spawning area on the River Leven immediately downstream of Newby Bridge weir.

Data collected since production of the previous 2006 report will be critically reviewed and compared against river flow data (Section 4.2) in Phase 2 to determine if they would change any conclusions of the previous report, but no detailed data re-analysis is proposed.

On the basis of the data reviewed as part of Phase 1, no new data collection is considered necessary for Phase 2, and the proposed level of detail for the Phase 2 assessment is still as follows:

Moderate study, applying latest datasets.

4.4 Water quality and water temperature

As well as a review of available data from the EA and UU (Table 6-1), the previous 2006 report has been reviewed as part of Phase 1.

Potential impacts on water quality and temperature were previously assessed against the EA's General Quality Assessment (GQA) system rather than Water Framework Directive (WFD) environmental quality standards. Therefore, some updates to the water quality assessment are considered necessary, focussing on comparison of recent data against WFD classification status and the WFD Directions (2010), in line with the latest Defra and EA guidance (Defra (2011) and EA (2011)).

For this project, monthly water quality data collected between 2003 and 2012 were provided by the EA for a total of six locations (Map 1, Appendix A). This dataset comprises data from three locations in Windermere, one location on Troutbeck (a tributary of Windermere), and two locations on the River Leven:

- Trout Beck at Windermere (SD 39624 99876);
- Windermere at Coatlap Point (SD 39316 95951);
- Windermere South Basin (SD 38230 91552);
- Windermere North Basin WFD (NY 38031 01003);
- River Leven at Newby Bridge (SD 36909 86364); and
- River Leven at Low Wood Bridge Haverthwaite (SD 34498 83600).

On the basis of the data reviewed as part of Phase 1, no major data collection is considered necessary for Phase 2, although details of the WFD typology (and associated WFD standards) for the River Leven and Windermere will need to be obtained from the EA. Potential changes in concentrations of WFD physico-chemical elements, specific pollutants and priority substances will be re-calculated in Phase 2 based on data from the sites listed above. The assessment will take into account the proposed DP scenarios, and the potential magnitude, timing and duration of DP implementation. Water quality data from both the River Leven and Windermere during previous dry and/or hot periods will be included in this assessment in order to assess the potentially exacerbating effects of high temperatures in combination with low flows. The proposed level of detail for the Phase 2 assessment is still as follows:

Moderate study, applying latest datasets.

4.5 River and lake habitats

As well as a review of available data from the EA and UU (Table 6-1), the previous 2006 report has been reviewed as part of Phase 1.

For this project, River Habitat Survey (RHS) data were provided by the EA for three locations on the River Leven (Map 2, Appendix A):

- Survey ID 175, SD3550084700 (17/05/1994);
- Survey ID 19756 SD3683686435 (07/11/2007); and
- Survey ID 25039 SD3456483693 (02/07/2009).

Some data were also provided for tributaries of Windermere, but are not included here as they are not of direct relevance to this project.

The 2006 EAR assessed changes in natural conditions, normal abstraction conditions and drought scenarios similar to those to be examined in this update study. Effects on lake levels in Windermere were considered, as were changes in levels and wetted area at four representative locations downstream on the River Leven. Changes were assessed for spring/ summer, and autumn/winter periods, and noted potential effects from raised, as well as reduced, levels and flows. The 2006 report therefore provides quite comprehensive consideration of these important properties of the aquatic habitat, and the impacts were generally considered either moderate or recoverable.

As described above (Section 4.2), however, the cross-section data collected for the previous report are considered unlikely to be still representative of the river channel. Re-survey of five cross section locations has therefore been recommended in Section 4.2. Given that this re-analysis is required, we recommend that this is extended to include two optional additional analyses identified at the outset of the project; i.e.

- inclusion of hydraulic behaviour during the 2010 low flow period; and

- inclusion of additional hydraulic variables. In particular, lateral variation in velocity and depth will be analysed to establish changes in terms of fish habitat preferences, and wetted perimeter is also considered to provide an improvement on wetted width in describing changes to benthic habitat space. Froude number has been shown to have utility in discriminating between habitat types.

On the basis of the data reviewed as part of Phase 1, re-survey of five cross-sections is required prior to the Phase 2 assessment. Apart from this, no other data collection is considered essential for Phase 2, and the proposed level of detail for the Phase 2 assessment is still as follows:

Detailed study, applying latest datasets.

However, it is recommended that the habitat analysis be extended to include hydraulic behaviour during the 2010 low flow period and additional hydraulic variables as detailed above.

4.6 Macro-invertebrates

As well as a review of available data from the EA and UU (Table 6.1), the previous 2006 report has been reviewed as part of Phase 1.

For this project, macroinvertebrate data were provided by the EA for one location on the River Leven and four locations on Windermere (Map 2, Appendix A):

- River Leven U/S Low Wood Bridge, Haverthwaite (SD 34544 83669) 2002-2012;
- Windermere North CPET Site (SD 39220 95840) 2002;
- Windermere South CPET Site (SD 38394 91758) 2002;
- Windermere Invertstony1 (SD 38283 90111) 2004-2005; and
- Windermere Invertveg1 (SD 38297 90152) 2004.

Invertebrate monitoring was also undertaken by UU at four sites on the River Leven and two sites on Windermere in spring, summer and autumn 2010:

- Windermere north basin (NY 36860 01988);
- Windermere south basin (SD 38283 90111);
- River Leven U/S Low Wood Bridge, Haverthwaite (SD 345 836);
- River Leven D/S weir at Newby Bridge (SD 369 863);
- River Leven at Old Backbarrow (SD 355 854); and
- River Leven at Backbarrow (SD 356 845).

The 2006 report considered potential impacts on macro-invertebrate communities and specific species (*Stenelmis canaliculata,* a Red Data Book vulnerable species) on the Windermere lake shore. Impacts of Scenario 1 were considered negligible. Impacts of Scenario 2, on *Stenelmis canaliculata* were, however, considered moderate to major because of potential reductions in lake levels between March and September.

The 2006 report also assessed potential impacts on benthic macro-invertebrate communities, and those of exposed riverine sediments in the River Leven. Impacts of Scenario 1 were considered temporary and/ or negligible. Under Scenario 2, impacts were considered negligible for most of the year, and of minor beneficial impact during the summer months. This was due to the maintenance of river flows under the operation of the drought permit at higher levels than would naturally be experienced in the river during drought conditions (Cascade, 2006).

Potential impacts on White Clawed Crayfish (*Austropotamobius pallipes*) were also evaluated. These were considered negligible for Scenario 1, and of negligible or minor beneficial impact (the latter in the summer months) for Scenario 2. Again, this minor beneficial impact was due to the maintenance of river flows under the operation of the drought permit, which was predicted to reduce the severity and duration of extreme low flows in the summer months (Cascade, 2006).
Since 2006 new lake margin/littoral invertebrate surveys have been undertaken by UU and CEH. Given the significant potential impacts on lake margin dwelling *Stenelmis canaliculata*, specific attention will be paid to interpreting these recent data, focussing on the response to effects of the 2010 dry period and the period of subsequent recovery. This will be undertaken

in Phase 2 via qualitative interpretation of the recent data in order to check that the conclusions of the previous report remain valid. Based on the latest Defra and EA guidance (Defra (2011) and EA (2011)), it is also recommended that the assessment explicitly address potential impacts on WFD status for this WFD biological element.

Based on the previous report, impacts on the River Leven are considered less likely, but the new monitoring data available includes coverage of the 2010 low flow period, which provides a useful update to the dataset.

On the basis of the data reviewed as part of Phase 1, no new data collection is considered necessary for Phase 2, and the proposed level of detail for the Phase 2 assessment is still as follows:

Moderate study, applying latest datasets.

4.7 Fish

As well as a review of available data from the EA and UU (Table 6-1), the previous 2006 report has been reviewed as part of Phase 1.

The River Leven is an important salmon and sea trout fishery, and is also the route via which migratory fish gain access to Windermere and its associated tributaries. The Rivers Leven, Brathay and Rothay are also important spawning and juvenile nursery areas for these species and are considered to contain genetically distinct salmon stocks. During the scoping phase, Holker Estates also expressed concern about the impact of low water levels and poor water quality upon the River Leven salmon and trout stocks, which they consider to have plummeted in recent years (pers. comm., 2013). These are not due to DP operation, but any further impact because of drought operation needs to be considered in this assessment.

Potential risks to Atlantic salmon and sea trout in the River Leven and Lake Windermere, associated with the proposed DP scenarios, include:

- disruption of upstream migration and spawning (adults);
- disruption of downstream migration (post spawners, smolts);
- modification of habitat (through changes in wetted area, flow characteristics, temperature, and water quality; with consequences for fish distribution, feeding, predation, growth and survival of juvenile and resident salmonids and coarse fish); and
- disruption of angling quality and value (through changes in availability or accessibility of fish, flow changes and resultant fishing opportunity and demand).

Potential additive effects of other environmental variables such as temperature and low dissolved oxygen must also be considered, together with changes in the passability of in-river structures and flow sensitive cross sections to upstream and downstream migrating fish.

Based on the latest Defra and EA guidance (Defra (2011) and EA (2011)), it is also recommended that the assessment explicitly address potential impacts on WFD status for this WFD biological element. Output from the fish impact analysis will also inform the likelihood of any changes in WFD ecological status occurring as a result of the proposed DP.

Given that fish populations exhibit naturally large variation in size and structure, quantitatively predicting the impact of seasonal changes in flow using fish density data would require an extensive and long-term fish survey programme. Rather than use fish density data, Phase 2 will therefore utilise the relationships between river flow and ecologically relevant aspects of physical habitat developed in Section 4.5 and, for longitudinal movement (incl. migration) an assessment of passability will be based on outputs from Section 4.10. The assessment will therefore focus on hydraulic behaviour at the transects identified in Section 4.5 and the structures in Section 4.10. For many studies, APEM would recommend augmenting transect analysis using a fisheries habitat walkover survey to capture spatial variation. However, in this case, the EA have been able to clearly identify cross sections of particular fisheries value, and therefore the spatial component is not considered necessary.

For salmonids and some coarse fish, hydraulic changes will be assessed against known habitat requirements or preferences from published scientific literature, with consideration to seasonal variation in flow requirements and flow variability, to ensure that full life cycle responses are evaluated. Other prominent fish species within the River Leven include bullhead, eel, roach and stickleback, with flounder, stone loach, perch, dace, minnow and lamprey (potentially brook, river and sea lamprey) all present in lower numbers based on electric fishing data received from the EA (Table 6-1). Lamprey ammocoetes are considered unlikely to be affected by reduced velocities and consequent fine sediment deposition, but they may be affected by increased velocities under supported flows (Scenario 2), or by reductions in wetted perimeter, which may disproportionately affect marginal silt habitats. These aspects of hydraulic behaviour will therefore also be assessed at the cross-section locations. Passability of in-river structures under different flow regimes will also be considered for upstream and downstream migrating eel and lampreys.

Windermere also hosts a population of Arctic charr (along with Atlantic salmon, trout and a variety of coarse fish species). Although predominantly a deep water species, Arctic charr utilise marginal gravel substrate around the lake shore, along with the inflowing tributaries, as spawning habitat. The effect of drawdown of lake level on reproductive success will therefore be considered for the different scenarios.

On the basis of the data reviewed as part of Phase 1, no new data collection is considered necessary for Phase 2, aside from that recommended in Sections 4.5 and 4.10. The proposed level of detail for the Phase 2 assessment is still as follows:

Detailed study of impacts on fish including upstream and downstream migration covering all lifestages.

4.8 Macrophytes, marginal vegetation and aquatic lake flora in Windermere

As well as a review of available data from the EA and UU (Table 6-1), the previous 2006 report has been reviewed as part of Phase 1.

For this project, macrophyte data were provided by the EA for two locations on the River Leven (Map 2, Appendix A):

- River Leven D/S Weir at Newby Bridge (SD 36900 86300) 2005 & 2006; and

- River Leven U/S Low Wood Bridge, Haverthwaite (SD 34544 83669), 2005, 2006, 2009 & 2010.

Data were also provided for six sections of Windermere (shore, wader and boat surveys, north basin only) as part of a Site Condition Assessment carried out on 25/08/2008. A Lake Habitat Survey (LHS) was also undertaken by UU on Windermere in 2010.

To undertake a moderate study, it is proposed to assess existing status by applying these latest datasets against WFD standards. Where possible this will be achieved via UKTAG Lake Assessment Methodologies[6].

Potential impacts of lake level changes on macrophyte populations will be assessed based on predicted changes in shoreline area exposure. The relative risks associated with implementing a DP during different seasons will also be assessed and potential monitoring and mitigation measures highlighted.

Inference of impacts of lake drawdown will be based predominantly on predicted loss of aquatic habitat in the shallow margins (Section 4.1) where changes in water levels are critical to respective species success. Some inference will be necessary in that it may not be possible to quantify the potential impact of other effects (e.g. water quality change, natural community change, climate change etc.) on macrophytes. This may lead to some uncertainty in conclusions regarding DP impacts for this element.

A qualitative discussion of potential impacts will be included based on these existing data, experience at other similar sites, published literature and the findings from other areas of the study.

On the basis of the data reviewed as part of Phase 1, no new data collection is considered necessary for Phase 2, and the proposed level of detail for the Phase 2 assessment is still as follows:

Moderate study, applying latest datasets.

4.9 Otter, wading birds, wildfowl, water voles, great crested newts and riverine birds

Given that only a minor level of study is anticipated for these aspects, and that the previous report identified no or negligible impacts on these receptors, an appropriate level of detail for this study is considered to be a brief check of the presentation of these aspects in the previous report and a short review of new/recently collected datasets such as the Fifth Otter Survey of England (2009-2010) and information from local wildlife trusts.

No new data relating to the above receptors were available from NE or the EA, but on the basis of the information reviewed as part of Phase 1, additional data may need to be collected from Cumbria Wildlife Trust during Phase 2 (if such data are available). The findings of the previous report will be reviewed in light of any new data, and comments made on the validity of the conclusions of the previous report.

[6] UKTAG Lake Assessment Method MACROPHYTES (LAKE LEAFPACS) ISBN 978-1-906934-20-0

The proposed level of detail for the Phase 2 assessment is still as follows:

Minor study.

4.10 River structures

4.10.1 Overview

A review of the previous report (Cascade Consulting, 2006) as part of Phase 1, identified that with the exception of Newby Bridge weir, river structures were not explicitly considered, and no anecdotal information regarding structures were available from previous droughts. The following major weirs were identified in Cascade (2010), although no NGRs were available:

1. Newby Bridge weir – This is the boundary between Windermere and the River Leven. It is ~0.8m above bed level. The weir includes a fish pass, fish sluice, flood sluices and a flood relief channel. The fish sluice supports flow to the river when lake levels are below weir crest level.
2. Newby Bridge EA flow gauge weir – ~0.5m above bed level which accommodates an EA hydrometric station.
3. Backbarrow village weir – A low weir with no apparent purpose. Potentially a barrier at low flows.
4. Ironworks weir – A large weir, ~8m above bed level, situated above a natural bedrock cascade system. The weir was used by the former Backbarrow Ironworks. A screened-side off-take channel on the right bank is used as a hydropower scheme and returns water to the Level immediately downstream of the cascade system. The bedrock cascade, although forming a natural fish pass, may be impassable at low flows.
5. Split flume weir – A low angled weir of ~0.5m above bed level with no obvious purpose.
6. Hydropower weir – A large weir, ~3m above bed level. The weir provides water to a hydropower scheme and returns water to the Leven ~800m downstream of the weir. Fish pass facilities provided by the weir may be impassable at low flows.

Given the requirement to specifically assess river structures as part of this update study, a site visit was undertaken in February 2013 to identify and assess structures on the River Leven downstream of Newby Bridge weir. During the site visit a number of weir structures were observed along the length of the River Leven (Figure 4.1).

Based on available data from the site visit, the locations of structures 1 and 2 in the list above are known, and based on their descriptions it has been assumed that structures 4 and 6 correspond to Backbarrow weir and Ainsworth Dam respectively, although this cannot be confirmed due to the lack of NGRs in the above list. However, the locations of structures 3 and 5 in the above list were not identified during the site visit (possibly due to high flows obscuring these smaller structures) and thus are still unknown.

The Phase 2 assessment will determine whether channel connectivity is maintained at these structures under the DP scenarios. Survey details of some of these structures will be required to establish depths of flows over the structures during the modelled drought scenarios. It is recommended that any such surveys are carried out under low flow conditions wherever

possible, and that the locations and details of structures 3 and 5 in the above list are investigated at the same time.

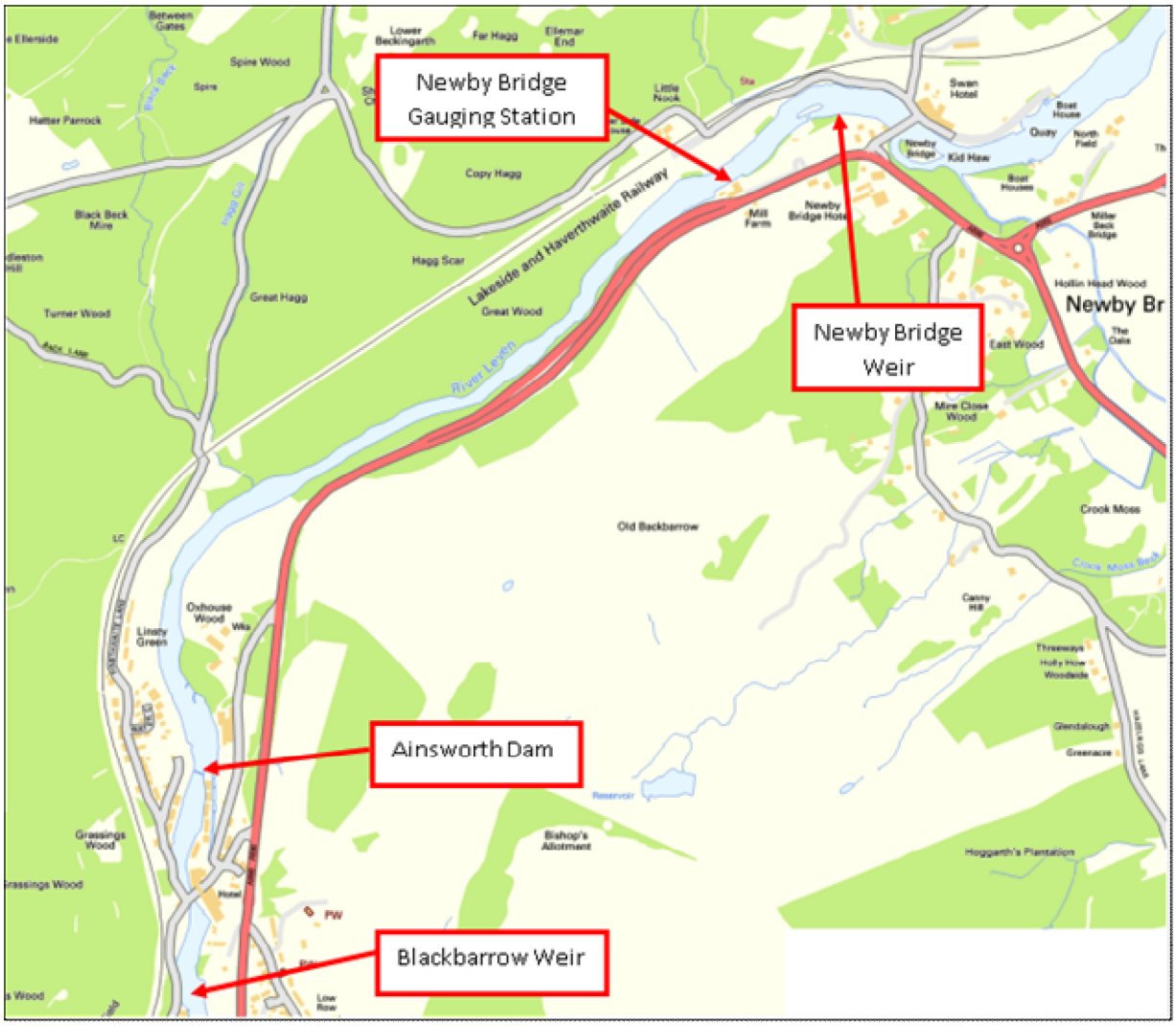


Figure 4.1 Location of major river structures on the River Leven

4.10.2 Newby Bridge Weir (SD 36832 86410)

Newby Bridge weir (Figure 4.2) was built in the 1930s and forms the downstream control to water levels in Windermere. It was raised in 1972 by 6 inches to allow more water to be impounded for Lake Windermere. The weir includes a fish sluice on the right bank, which through operation by the EA is able to release water from Windermere to the River Leven when water levels fall below the weir crest height.

The weir crest height has been surveyed to 39.144 mAOD and no new survey of the weir crest is required.

Newby Bridge weir with flood sluice on left bank.

Fish Sluice on right bank of Newby Bridge weir.

Figure 4.2 Newby Bridge Weir

4.10.3 Newby Bridge Gauging Station (SD 36587 86274)

The gauging station at Newby Bridge is approximately 300m downstream of Newby Bridge weir. The weir comprises of a compound crump weir with a low central notch and two flanking crump crests (Figure 4.3). A rating equation for the gauging station has been supplied by the EA, the rating has been in use since the weir's installation in 1971 and takes the form Q = C(h-a)^b as follows in Table 4-1.

Given that a rating equation has been provided for the gauging station compound weir, this can be used to determine depths, negating the need for a survey.

Table 4-1 Environment Agency Rating Equation for Newby Bridge Gauging Station

Min Stage (m)	Max stage (m)	C	b	a
0.124	0.673	6.7844	1.2829	0.032
0.673	0.913	42.6883	2.876	0.241
0.913	1.983	37.5775	2.2596	0.275

Figure 4.3 Newby Bridge Gauging Station Compound Weir

4.10.4 Ainsworth Dam (SD 35601 85220)

Ainsworth Dam is a concave weir spanning the full width of the channel, just upstream of Backbarrow (Figure 4.4). There is a larinier fish pass structure on the right bank and an offtake for the amenity purposes for the adjacent hotel, with an overflow back into the river. The local EA officers identified that the owner of the structure is unknown as they have been trying to contact the owner about damage to the structure following the floods in 2009. This may be a problem for gaining permission to survey the structure.

Ainsworth Dam looking upstream

Ainsworth Dam looking towards left bank with fish pass visible on the left of the photo

Figure 4.4 Ainsworth Dam on River Leven

4.10.5 Backbarrow Weir (SD 35585 84794)

Backbarrow weir lies adjacent to the Backbarrow hydro-electric power (HEP) scheme on the right bank of the River Leven, just downstream of Backbarrow (Figure 4.5). The weir is a concave structure spanning the full width of the River Leven. The channel downstream consists of large boulders making the flow highly turbulent.

Figure 4.5 Backbarrow Weir

On the basis of the data reviewed as part of Phase 1, new data collection is considered necessary for Phase 2 (comprising surveys for those structures which are accessible and for which no data are currently available). The proposed level of detail for the Phase 2 assessment is as follows:

Detailed study with regards the balance between lake levels and river flows due to the weir at the outflow of Windermere and the related operation of the fish sluices. Inclusion of downstream structures as part of the consideration of how the DP affects river flow.

4.11 Archaeology

Cascade Consulting (2006) concluded that there were no known water level dependent archaeological/cultural heritage features on Windermere or the River Leven, and that impacts on cultural heritage were therefore considered to be negligible. No new data relating to archaeology were available from the EA, although geological details relating to sediment deposits at Low Wray Bray SSSI were provided by NE. On the basis of the data reviewed as part of Phase 1, additional data may need to be collated from English Heritage for Phase 2.

A brief check of the presentation of these aspects in the previous report and a short review of new/recently collected datasets will be carried out in Phase 2. The proposed level of detail for the Phase 2 assessment is still as follows:

Minor study.

4.12 Socio-economic and community impacts

4.12.1 Overview

Windermere stakeholders were asked to inform the methodology for the socio-economic impact assessment at a meeting with the Project Stakeholder Group on Thursday 7th February 2013. Present at the meeting, as well as members of the project team and UU, were representatives of South Lakeland District Council (SLDC), Centre for Ecology & Hydrology, Windermere Lake Cruises (WLC), Lake District National Park Authority (LDNPA), Friends of the Lake District (FOLD), Holker Estates, Windermere Lake Users Forum and South Cumbria Rivers Trust. Subsequent discussions have also been held with the project team, UU, Cumbria Tourism, WLC and Windermere Lake Users Forum regarding data availability.

This analysis will focus on understanding the breadth and depth of likely impacts on the visitor economy and lake users of Scenario 2. However, it is anticipated that the assessment is likely to focus on Scenario 2 as it is likely to have a greater impact. Socio economic impacts on the River Leven are anticipated to be limited to effects on angling, which is dealt with in Section 4.15.

The socio-economic impact assessment will therefore focus upon:

- an understanding of how lake users and residents are likely to be impacted;
- the likely impact of Scenarios 1 and 2; and
- a monetary assessment of the impact of the DP Scenario 2 upon the visitor economy.

Impacts will be presented within the context of the size and value of the visitor economy to the Windermere catchment as a whole, and take heed of the dependency of the local economy upon tourism.

Objectives of the socio economic assessment will therefore be:

- to understand the impact of changes in a) water levels, b) area of exposed lake shore and c) water quality under Scenario 2 upon users of, and visitors to, Windermere;
- to understand the knock on impacts of these changes upon the local visitor economy;
- to provide a monetary valuation of the impact of these changes upon the local visitor economy, and present this within the context of the importance of tourism to the local economy of Windermere and surrounding area;
- to describe, and if possible, monetise the benefit of water abstraction under the permit in providing a readily available and secure water supply to householders and businesses in the North West of England.

The assessment of impacts will comprise:

1. a monetary assessment of impact on the *local visitor economy;*
2. a qualitative assessment of impact on *other lake users*; and
3. a qualitative assessment of impact on *North West households and businesses.*

4.12.2 Local visitor economy

Impacts on the local visitor economy will be based on a tourism impact assessment methodology, reflected by the following equation:

[Local economic impact = change in visitor numbers x change in average visitor spend (£) x Gross Value Added (GVA) ratio (profit and wages from visitor spend) x multipliers (supply chain impacts)]

The calculation will be based on visitor numbers and spend provided by Cumbria Tourism and WLC. A monetary range will be provided to reflect the sensitivity of the figures to a range of assumptions. This will include assumptions about the duration of the low water levels due to the DP, the percentage of visitor spend lost due to WLC being unable to operate, and time of year.

Consultation with stakeholders will inform the assumptions about the change in visitors or visitor spend associated with the DP scenarios. As far as possible, these will be based on local stakeholder knowledge and past experience.

The following evidence and assumptions will be used to inform the assessment:

- Water depths of less than 2m in the channel to the west of Belle Isle will be assumed to stop the operation of WLC cruises (based on historic evidence from 2010, informed by SLDC lake wardens). [This may also apply to lakeside access points – to be determined from the water level modeling]
- Depths of less than 2m in the channel to the west of Belle Isle will be assumed to last for a) 1 week and b) a month, during January and July. This will give a range of possible impacts.
- The number of visitors impacted will be assumed to be equal to the average daily number of 'carrying' numbers in January and July (to be provided by WLC). It is assumed that the 'carrying' numbers include no repeat visitors. WLC report that in winter months, the ratio of staying visitors to day visitors taking a WLC cruise is 80:20 and in summer months 70:30.
- The average spend per day of visitors will be i) lost and ii) decreased by 20%. Average spend per day is estimated to be £12.15 for day visitors and £54.29 for staying visitors in 2011 (from Cumbria Visitor Survey 2012).
- The proportion of visitor numbers affected (based on WLC numbers as a proportion of visitors to South Lakeland from STEAM statistics) will be applied to direct and indirect revenue (defined as income derived from visitor spend). This will then be aggregated to estimate the local economic impact and presented in the context of the overall value of the local visitor economy.

Alternative assumptions will be made for private boat users based on discussions with key businesses and SLDC lake wardens. This will also use data from LDNPA for the number of registered boat users. Care will be taken not to incur any double counting with the above. This will be based on an analysis of the vulnerability of areas of moorings and jetties (public and private) to a drop in lake levels, beyond the operable depth of water required for average draughts.

4.12.3 Other lake users

The impact on other lake users will be captured via a short survey conducted by email to representatives of each type of lake use. The Windermere Lake Users Forum has offered to facilitate this.

The email survey will take care to ask survey respondees to comment on the impact of the DP only, and not natural drought conditions, and will aim to gather the following information:

- location and seasonality of different types of lake related activity;
- the numbers of residents and visitors involved in the activity;
- the opportunity to review maps showing the areas of the lake most likely to be affected by Scenario 2;
- how different activities are likely to be affected (assumptions about what water levels affect different users is anticipated to vary);
- how effects on use are likely to impact on local residents and the visitor economy (i.e. the knock on impacts and their likely duration);
- how users are likely to respond to the activity (i.e. will they go elsewhere etc?); and
- possible mitigation and adaptation options to explore.

The survey will be tailored to each type of activity to ensure that the required information is collected. The survey will be conducted after water level modelling (Section 4.1) has been completed so that the respondees can comment in respect to the most likely affected areas of the lake.

Separate to the survey above, willingness-to-pay values will be used to represent the economic impact (including effects on indirect uses such as water quality, biodiversity, etc.) for key users groups such as anglers and residents. However, it will not be possible to aggregate this to the level of the local economy due to a lack of data on numbers of users in each category.

Most of the 2010 DP objections were concerned specifically about impacts upon visitor numbers and local business revenue. However, economic impact is concerned with both impacts priced in markets (by change in the flow of money through the local economy), but also by non-market impacts (impacts on consumer benefits e.g. loss of aesthetic value or recreational experience).

Two example studies presented below look at the change in economic value (market and non-market) associated with a reduction in river and lake water levels for catchments in England. These data were sourced from the Environmental Valuation Resource Inventory. Prices quoted are adjusted to 2013.

For the River Darent in Kent, respondents were asked to state the total amount they would be willing to pay (WTP) to maintain or improve flow levels in 40 low-flow rivers in the UK and then to state what percentage of the total they would be willing to spend on the River Darent. The mean WTP (£) per year to achieve an environmentally acceptable regime for the River

Darent was £9.67[7] for residents, £4.23 for visitors and £4.62 for non-users. An aggregated estimate of net economic impact is not available (Willis and Garrod, 1995).

For the River Ouse, households in the vicinity of the river were willing to pay £6.48[8] per household per year to increase water levels in the river by 5cm in order to alleviate abstraction demands in the summer months. Equally, they were willing to pay an additional £4.00 per household per year, £9.38 per household per year and £20.97 per household per year, to avoid drops in water level of 5cm, 45cm and 100cm respectively (Economics for the Environment Consultancy Ltd and Centre for Social and Economic Research on the Global Environment, 1998).

It should also be noted that the Windermere stakeholders have raised a number of concerns about the impact on the visitor economy and lake users of the *process* of applying for a DP order. As this is a policy impact, and is not the impact of the implementation of the permit, in accordance with BIS Impact Assessment guidance[9], this will not be reported in the assessment (Phase 2).

4.12.4 North West households and businesses

Impacts on North West households and businesses will be estimated based on a range of willingness to pay (WTP) values given by a representative sample of households and businesses in the North West of England to avoid interruptions to supply (Eftec, 2007). This will be applied to the number of households and businesses that benefit from abstraction from Windermere under the DP to mitigate the effects of drought.

Note that it will not be possible to compare the local economic impacts to the regional economic value of the water resource due to the different methods used. The analysis will therefore not estimate the net economic impact of the DP. Instead, this analysis will provide an indication of the local economic impact of further water abstraction under the DP, within the context of the dependence of the local economy upon tourism.

On the basis of the data reviewed as part of Phase 1, some additional data collection is considered necessary for Phase 2 (Table 6-1), and the proposed level of detail for the Phase 2 assessment is still as follows:

Detailed study.

4.13 Landscape and Visual Amenity

The current proposal is that this section is limited to a minor study, consisting of a refresh of what has been produced in previous environmental reports. This would simply involve following the format of the 2008 template, and updating it as necessary in line with newly available information including the updated hydrodynamic data and figures which are to be produced as part of the wider environmental assessment. This update will be produced by a Chartered Landscape Architect. The landscape assessment will be reliant on the same bathymetric data and figures that formed the basis of the 2008/2010 assessment, although it

[7] Uplifted using CPI from 1993 prices by factor of 1.54
[8] Uplifted using CPI from 1998 prices by factor of 1.38
[9] BIS (2011) 'Impact Assessment Toolkit'

will be based on updated hydrological data (Sections 4.1 and 4.2). No site visits will be undertaken, and no new visual / photographic / physical surveys, or additional illustrative material will be provided, unless photographs of previous drought events are available from stakeholders.

The scope of the landscape assessment would not constitute a comprehensive appraisal in accordance with the Landscape Institute/IEMA Guidelines (April 2013)*, but is instead limited to a brief desk based study outlining the likelihood of significant landscape and visual impacts. This approach proved acceptable within previous drought permit assessments (i.e. the 2008 and 2010 reports).

On the basis of the data reviewed as part of Phase 1 the proposed level of detail for the Phase 2 assessment is as follows:

Minor study.

4.14 Other abstractors (including HEP)

Summary details of licensed abstractions along the River Leven were given in the previous report (2006) and are presented in Table 4-2. No further details of licenced abstractors on the River Leven were available from the EA (Table 6-1). The assessment (Phase 2) will need to identify that under a reduced hands-off flow of 95 Ml/d there will still be sufficient flow within the River Leven to meet the required abstractions.

No details of abstractors from the lake itself were provided by the EA in Phase 1, although a further request for details of abstractors (including grid references and a level (mAOD) of the abstraction) will be made to the EA in Phase 2 (Table 6-1). Where available, these details will then be used together with an assessment of the lake exposure under Scenario 2 (lake level drawdown of 0.5m below the weir crest (Section 4.1)), to ensure that their abstraction can be maintained.

Table 4-2 Licenced Abstractions from the River Leven

Licence Nr	Location	Max daily abstraction (Ml/day)	Purpose
26 73 701 011	River Leven @ Backbarrow	864	Amenity throughflow
26 73 709 012	River Leven @ Backbarrow	0.982	Hydro-power generation
26 73 709 010	River Leven @ Low Wood, Haverthwaite	5550.066	Hydro-power generation

NB These abstractors all return flow to the river immediately downstream.

During Phase 2, a brief assessment of the potential impacts of the proposed scenarios on abstractors and HEP schemes will be undertaken. In addition to the Phase 1 review and consultation, details of any third party abstractions will be requested from the EA. For any lake abstractions the level of abstraction points will also be required as their efficiency could be affected by a fall in lake levels.

On the basis of the data reviewed as part of Phase 1, some additional data collection is considered necessary for Phase 2 (Table 6-1), and the proposed level of detail for the Phase 2 assessment is still as follows:

Minor study.

4.15 Fishing groups

The previous report (Cascade Consulting, 2006) identified negligible effects on angling on the River Leven, but potentially moderate impacts associated with angling on Windermere under Scenario 2. However, potential effects on angling and knock-on effects on tourism, recreation, socio-economics and community were not the main focus of the previous report.

The previous report also described angling on the River Leven as being controlled by two associations - the Upper and Lower Leven Fisheries, which cover the river from Greenodd (the tidal confluence with the Crake) to Newby Bridge weir. Above this point a small public fishery is found at the foot of Lake Windermere (the Nickle) and some angling also takes place on the smaller lake tributaries, the River Brathay and the River Rothay (Environment Agency, 1997).

Although net catches may benefit from low flows (and possibly additional effects associated with a DP) this is unlikely to be the case for rod anglers. It is important to recognise that, under natural extreme low flows, fish movement (and hence the availability of fish for capture) may be limited and fishing conditions may become difficult as a result. The impact of the proposed DP scenarios on angling will, therefore, only be concerned with impacts above and beyond those already experienced as a result of natural low flows during drought events. It should also be noted that Windermere will be considered as well as the River Leven.

This aspect of the overall impact assessment is closely linked to other aspects of the study. For example, the assessment of impacts on angling and fishing groups will make use of investigations described previously for lake and river levels (Sections 4.1 and 4.2), geomorphology (Section 4.3), changes in availability of functional habitats (Section 4.5) and obstacles to fish migration (Sections 4.7 and 4.10).

In addition, anecdotal information will be gathered from local angling groups as part of the stakeholder consultation process. Should corresponding records of flows/sluice operation and catches be available, this information will also be considered.

Angling groups are likely to be important stakeholders in relation to development of appropriate mitigation measures (i.e. in relation to waterbank and sluice operation) and the results of this assessment will therefore be an important consideration in assessments of impacts on tourism, recreation, socio-economics and community (Section 4.12).

On the basis of the data reviewed as part of Phase 1, some additional data collection is considered necessary for Phase 2, including gathering of anecdotal information from local angling groups as part of the stakeholder consultation process.

The proposed level of detail for the Phase 2 assessment is still as follows:

Detailed study, with links to key ecological sections, use of sluices and balance with lake users.

4.16 Cumulative and in-combination effects

The main cumulative and in-combination effects are likely to be due to sequential operation of the two proposed DP scenarios. The previous assessments include brief consideration of cumulative effects and conclude that the cumulative effect of Scenario 1 is to protect the river at the expense of the lake, while that of Scenario 2 is to protect the lake at the expense of the river.

UUs Aquator model will be used to model the baseline and drought scenarios, providing river flow and lake volumes in each instance. The long term impact of the modelled conditions will be assessed in the context of river section and lake survey data collected and collated as part of this update study.

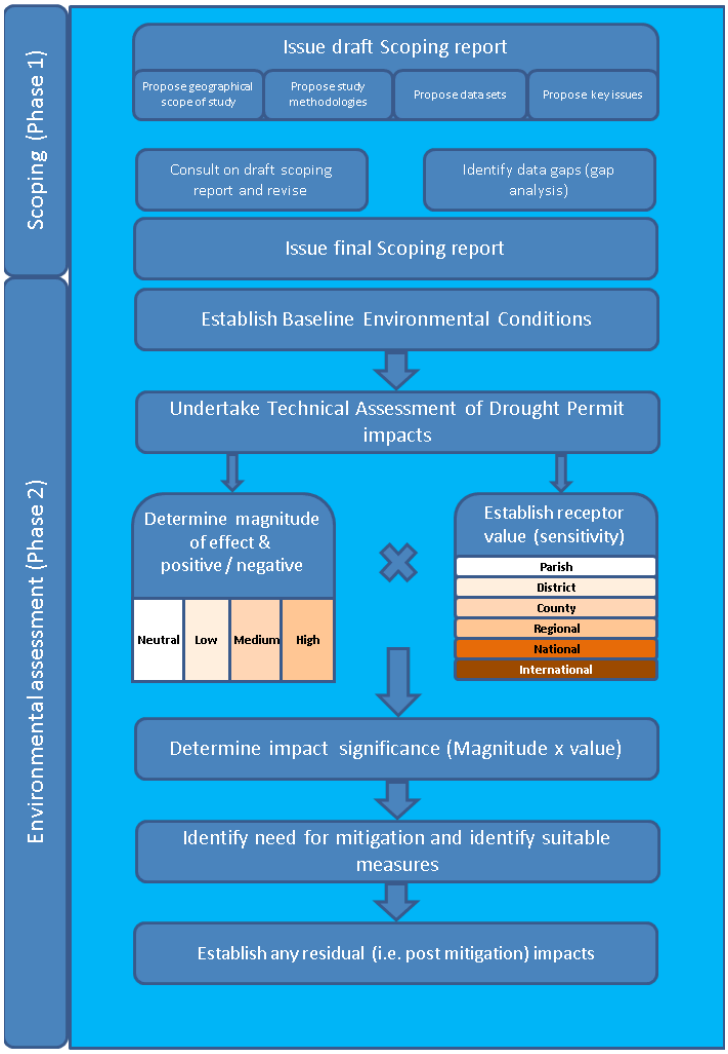
Beyond the effects of the two Windermere DP scenarios it will be necessary to consider the combined effect of any other possible DPs or orders in the area, as well as potential in-combination effects with other abstractors on the River Leven or Windermere. Potential in-combination effects on ecological receptors of low water levels or flows as well as poor water quality and high temperature will also be considered in Phase 2.

5 PROPOSED PHASE 2 ASSESSMENT FRAMEWORK

5.1 Overview

A flow chart for the environmental impact study incorporating the scoping process (Phase 1) and environmental assessment (Phase 2) is shown in Figure 5.1. The impact significance is derived from the impact magnitude and the value of the receptor. Definitions of impact magnitude and receptor value are outlined in Table 5-1 and Table 5-3 respectively. These are adapted from Guidelines for Ecological Evaluation and Assessment (IEEM, 2006) and were suitably adapted for this assessment of the DP application.

Figure 5.1 Flow chart outlining the environmental impact study process



5.2 Impact magnitude

Impact magnitude is the degree of change that the impact causes or is considered to cause compared to the baseline. Factors such as spatial extent, duration, reversibility, timing and frequency are considered in determining magnitude. In order to determine the degree (or magnitude) of change created by a certain effect, an indication of the existing baseline level and its variations (temporal and spatial) also need to be determined. Note that magnitude of

effect can be positive as well as negative, and where positive effects are predicted, these will be identified in the assessment.

Table 5-1 and Table 5-2 provide a description of the quantification of magnitude with a general description of the meaning of each 'level' of magnitude, as well as a description of its definition.

Table 5-1 Description of magnitude of effects – negative impacts

Magnitude of effects	Description	
High	A large change.	The species / population is likely to be killed / destroyed by the effect under consideration.
Medium	A change that is noticeable.	Some individuals of a species / population may be killed / destroyed by the effect under consideration and the viability of a species / population may be affected.
Low	A change which may only just be noticeable.	Some individuals of a species / population may be killed / destroyed / displaced by the effect under consideration but the viability of a species / population will not be affected.
Neutral	No change.	No net change.

Table 5-2 Description of magnitude of effects – positive impacts

Magnitude of effects	Description	
Low	A change which may only just be noticeable.	Some individuals of a species/population may benefit through enhanced performance. This may be manifested directly through improved hydraulic regime or water quality, or indirectly through elevated prey availability. Overall population performance of pre-impact baseline species is not likely to be impacted.
Medium	A change that is noticeable.	Measurable biological response to change such as enhanced growth, recruitment success and/or biodiversity.
High	A large change.	Significantly quantifiable improvement in population performance of pre-impact baseline species (e.g. increased recruitment and carrying capacity resulting in overall population growth). Such improvements may also be complemented by enhanced biodiversity

5.3 Value of receptor

For the purposes of this assessment receptors are valued using the following geographical scale, supplemented by descriptions provided in Table 5-3:

- international;
- national;
- regional;

- county/metropolitan;
- district/borough;
- parish/neighbourhood; and
- negligible.

Impacts may be considered on receptors which are themselves adverse for the environment e.g. invasive or non-native species. Where this is the case, the changes to the invasive or non-native species are regarded as part of the impact itself, and the impact is expressed in terms of the ecological receptor.

Table 5-3 Descriptions of receptor value

Value	Description
International	• An internationally designated site or candidate site (Special Protection Area (SPA), proposed SPA (pSPA), Special Area of Conservation (SAC), candidate SAC (cSAC), and/ or Ramsar site). • A sustainable area of a habitat listed in Annex I of the Habitats Directive or smaller areas of such habitat which are essential to maintain the viability of a larger whole. • Sustainable population of an internationally important species or site supporting such a species (or supplying a critical element of their habitat requirement). • UK Red data book species that is listed as occurring in 15 or fewer 10 km squares in the UK, which is of unfavourable conservation concern in Europe or of uncertain conservation status or global conservation concern in the UK BAP. • Species listed in Annex IV of the Habitats Directive • Sites that support 1% or more of a biogeographic population of a species.
National	• A nationally designated site (e.g. SSSI, ASSI, NNR, Marine Nature Reserve) or a discrete area which meets the selection criteria for national designation (e.g. SSSI selection criteria). • A sustainable area of a priority habitat identified in the UK BAP or of smaller areas of such habitat, which are essential to maintain the viability of the whole. • Sustainable population of a nationally important species or site supporting such a species (or supplying a critical element of their habitat requirement) i.e.: o Species listed on Schedules 5 and 8 of the Wildlife and Countryside Act (1981). o Other UK Red Data Book species. o Other species listed as occurring in 15 or fewer 10km squares in the UK. o Sites supporting 1% or more of a national population.
Regional	Sites/ populations which exceed the County-level designations but fall short of SSSI selection guidelines, including the following: • Sustainable areas of key habitat identified in the Regional BAP or smaller areas of such habitat, which are essential to maintain the viability of the whole. • Population of a species listed as being nationally scarce which occurs in 16-100 10km squares in the UK. • Population of a species listed in a Regional BAP or relevant Natural Area on account of its regional rarity or localisation. • Sites supporting 1% or more of a regional population.
County / Metropolitan	Some designated sites (including SINCs or SNCIs, County Wildlife Sites, Sites of Metropolitan Importance). • A viable area of habitat identified in the County BAP. • Sustainable populations of the following species: • Species listed in a County/ Metropolitan "red data book" or BAP on account of its rarity/ localisation in a county context. • Sites supporting 1% or more of a county population.
District / Borough	Some designated sites (Local Nature Reserves, Sites of Borough Importance). • Viable areas of habitat identified in a district/ borough BAP. • Sites/ features which are scarce within the District/ Borough or which appreciably

Value	Description
	enrich the District/ Borough habitat resource. • Sustainable populations of the following species: • Species listed in a District/ Borough BAP on account of its rarity/localisation in a district context. • Sites supporting 1% or more of a district/ borough population.
Parish / Neighbourhood	Sites/ populations which appreciably enrich the District/Borough habitat resource (e.g. moderately species-rich hedgerows).
Negligible	No significant ecological value

5.4 Impact significance

The determined level of magnitude (Table 5-1), combined with the value of the receptor (Table 5-3) enables the significance of the impact to be determined (Table 5-4). Impact significance provides a consistent means of expressing impacts, which in turn, inform the nature and extent of mitigation measures required to offset the impacts. The determination of impact significance, both pre and post mitigation, also provide a transparent means for regulators to understand the impacts of a DP in the event that the permit is applied for.

Table 5-4 Impact significances as derived from measures of feature value and impact magnitude

Impact magnitude	Value of Feature					
	Inter-national	**National**	**Regional**	**County/ Metropolitan**	**District/ Borough**	**Parish/ Neighbour-hood**
High Negative	Critical	Major	Major	Major	Moderate	Moderate
Medium Negative	Major	Moderate	Moderate	Moderate	Minor	Minor
Low Negative	Moderate	Minor	Minor	Minor	Minor	Minor
Neutral	Negligible	Negligible	Negligible	Negligible	Negligible	Negligible
Low Positive	Negligible	Negligible	Negligible	Negligible	Negligible	Negligible
Medium Positive	Critical	Major	Moderate	Moderate	Minor	Minor
High positive	Critical	Major	Major	Major	Moderate	Minor

The ecological impacts may be either positive or negative but fall into one of the following categories of magnitude:

- **Critical**: a complete and irreversible effect on the numbers of species present and/or complete and irreversible loss or alteration of habitats;
- **Major significance**: an extensive and irreversible effect on the numbers of species present and/or extensive and irreversible loss or alteration of habitats;
- **Moderate significance**: a measurable effect on the numbers of species present or loss/alteration of habitats, which is extensive, affecting beyond the immediate area surrounding the site of the proposed scheme;
- **Minor significance**: a measurable effect on the numbers of species present or loss/alteration of habitats, which is restricted to the local area surrounding the site of the proposed scheme; and
- **Negligible**: no measurable effect on the numbers of species present or loss/alteration of habitats.

Impacts will also be considered in the context of the WFD, which provides qualitative descriptions for each biological quality element in each surface water category (i.e. river, lake, transitional water or coastal water) and for each ecological status class. The different classes represent different degrees of disturbance to the quality elements relevant to the category of water concerned.

The degree of disturbance to each quality element is assessed against a "reference value or set of values" for that element. A reference value for a biological quality element is a value identified from the range of values the quality element may have when subject to no or only very minor alteration as a result of human disturbance (i.e. when it is in a reference, or high status, condition). UKTAG recommends that reference conditions should reflect "a state in the present or in the past corresponding to very low pressure, without the effects of major industrialisation, urbanisation and intensification of agriculture, and with only very minor modification of physico-chemistry, hydromorphology and biology" (UKTAG, 2008).

The qualitative definitions of ecological status are as follows:

- **Good**: none of the biological quality elements can be more than slightly altered from their reference conditions;
- **Moderate**: one or more of the biological elements may be moderately altered;
- **Poor**: the alterations to one or more biological quality elements are major; and
- **Bad**: there are severe alterations such that a large proportion of the reference biological community is absent.

For the purposes of WFD classification, whether or not a particular element meets these definitions is assessed against various numerical metrics.

6 DATA REVIEW AND GAP ANALYSIS

A summary of known data sources for each study aspect is presented in Table 6-1 below for easy reference. This summary and gap analysis is based on the detailed data reviews described in Section 4. Outstanding data gaps (including datasets which will be required for the Phase 2 assessment) are flagged in red text.

Table 6-1 Available Data

Data type	Location(s)	Dates	Comments
Lake level and exposure			
Windermere bathymetry data	Data surveyed to 1m below weir crest	2004	Obtained for Phase 2 assessment of lake exposure and lake level impacts.
Photos of Lake exposure	Photos showing shoreline exposure during a drought	1995/96	To be provided by stakeholders for Phase 2 to inform lake level impact assessment.
Daily lake level data	Far Sawrey (SD 390 956)	01/01/1975 – 6/12/2012	Complete record with suspect values between 15/2/2001 – 27/06/2001
Windermere level in metres AOD (Liverpool)	Calgarth pumping station (SD 395 995)	30/10/00 - 30/12/12	N/A. Data up to 2005 seem reasonable, subsequent to this there are gaps in the data and there seems to have been a datum shift. Station history data would be useful.
Windermere pumped flow (Ml/d)	Windermere	11/10/93 – 30/12/12	3,398 days when 0 was recorded. Gaps in data 23/3/94; 4/2/95, 27/6/95; 5/7/95; 6/10/95; 17/8/97; 30/10/97; 14/11/97; 20/06/05 – 23/06/05; 20/12/06 – 24/12/06; 30/12/06 – 02/01/07.
Volume / level data for Windermere	Windermere	2004	Required to convert Aquator volume output to levels. Data is available for levels below the weir crest but still required for levels above the weir crest.
River level/depth/velocity/flow; wetted width/area			
Daily river levels	Newby Bridge Fish Sluice (SD 686 642)	30/05/2010 – 21/11/2012	Complete record.
Daily river flows	Newby Bridge Gauging Station (SD 367 863)	01/01/1939 – 6/12/12	Complete record with suspect values between 27/11/2010 – 01/01/2011 Level record since 1939 from four different sites at Newby Bridge. All flow records from 1939 to 1974 combined into a single sequence. Since 5/5/71 Compound Crump profile weir. Full-range. Just d/s of Windermere (for which earlier level data are available): highly regulated, compensation flows (occasional very low flows (e.g. autumn 1972) when u/s fish pass closed); major abstractions for public water supply from Windermere.
Survey of fish sluice to mAOD.	Newby Bridge Fish Sluice	31/10/2012	N/A
Aquator modelled daily historical timeseries river	Windermere and River Leven	1927-2010	To be provided by UU for Phase 2.

Data type	Location(s)	Dates	Comments
flows and lake volumes			
River cross-section surveys (x5) and surveys of river structures	River Leven cross-section surveys of 5 key river sections and river structures	2013	To be carried out before Phase 2 so hydraulic relationships for each section can be derived.
Current meter gaugings	At least one current meter or ADCP gauging at each key cross-section or structure.	2013	To be carried out at the same time as the cross-section surveys before Phase 2 to calibrate the derived hydraulic relationships.
Geomorphology (channel and sediment dynamics)			
Fluvial Audit	Windermere catchment (not including the River Leven)	2009	Focussed on riverine inputs of fine sediment and phosphorus to the lake (Jacobs, 2009).
EA Geomorphological Investigation	Southern end of Windermere, Newby Bridge weir and the River Leven	1999 - 2005	Included addition of gravel in an important salmonid spawning area on the River Leven immediately downstream of Newby Bridge weir.
Water quality and water temperature			
Monthly water quality data	Trout Beck at Windermere (SD 39624 99876) Windermere at Coatlap Point (SD 39316 95951) Windermere South Basin (SD 38230 91552) Windermere North Basin WFD (NY 38031 01003) River Leven at Newby Bridge (SD 36909 86364) River Leven at Low Wood Bridge	2003-2012	WFD Typology and Good Status Boundaries still required for each water body within the study area for Phase 2.

Data type	Location(s)	Dates	Comments
	Haverthwaite (SD 34498 83600)		
River and lake habitats			
River Habitat Survey (RHS) data	Survey ID 175, SD3550084700 Survey ID 19756 SD3683686435 Survey ID 25039 SD3456483693	17/05/1994 07/11/2007 02/07/2009	N/A
A Lake Habitat Survey (LHS) was also undertaken by UU on Windermere in 2010.	Windermere	2010	N/A
River cross-section surveys (x5)	River Leven	2004	Surveys did not include water velocity measurements and are likely to be un-representative of the river channel following the 2009 floods. It is recommended that these locations and one additional location be re-surveyed as part of the assessment so hydraulic relationships for each section can be derived.
Invertebrates and Macro-invertebrates			
Macroinvertebrate data and biotic indices	River Leven U/S Low Wood Bridge, Haverthwaite (SD 34544 83669) 2002-2012 Windermere North CPET Site (SD 39220 95840) 2002 Windermere South CPET Site (SD 38394 91758) 2002 Windermere Invertstony1 (SD 38283 90111) 2004-2005	2002-2012 2002 2002 2004-2005	Expected scores still required for Phase 2.

Data type	Location(s)	Dates	Comments
	Windermere Invertveg1 (SD 38297 90152) 2004	2004	
Macroinvertebrate data and biotic indices	Windermere north basin North Basin (NY 36860 01988) Windermere south basin (SD 38283 90111) River Leven U/S Low Wood Bridge, Haverthwaite (SD 345 836) River Leven D/S weir at Newby Bridge (SD 369 863) River Leven at Old Backbarrow (SD 355 854) River Leven at Backbarrow (SD 356 845)	2010 (spring, summer and autumn)	Expected scores not calculated, but could be calculated based on environmental data.
Atlantic salmon and sea trout and other fish			
EA Electric Fishing Surveys (drought)	River Leven: Low Wood (SD3454283663) Newby Bridge (SD3673486413) Far End of Island (SD3650086200) Linsty Green (SD3554885427)	2009	N/A

Data type	Location(s)	Dates	Comments
	120m u/s White Water (SD3558585096) D/s Backbarrow Turbines (SD3560084900) 50M u/s Backbarrow. Bridge A (SD3559884511) 200m u/s Gauging Weir – (SD3670086400) Chaplin 1A – (SD3637086125) Chaplin B1 (SD3623485950)		
EA Electric Fishing Surveys	River Leven: Low Wood (SD3454283663) Newby Bridge (SD3673486413) Far End of Island (SD3650086200) Linsty Green (SD3554885427) 120m u/s White Water (SD3558585096) D/s Backbarrow Turbines (SD3560084900) 50M u/s Backbarrow. Bridge A (SD3559884511) 200m u/s Gauging Weir – (SD3670086400)	1992-2004 and 2010	N/A

Data type	Location(s)	Dates	Comments
	Chaplin 1A – (SD3637086125) Chaplin B1 (SD3623485950)		
Lave net fishery report	River Leven	1952-2011	N/A
Rod fishery report	River Leven	1958-2011	N/A
Egg deposition report	River Leven	2001-2011	N/A
CEH Paper: Arctic Charr	Windermere	2008	N/A
CEH Paper: Northern Pike	Windermere	2008	N/A
Frost (1965) 'Breeding habits of Windermere charr .....' giving details of spawning grounds	Windermere	1965	Required for Phase 2.
Macrophytes, marginal vegetation and aquatic lake flora in Windermere			
Macrophyte surveys	River Leven D/S Weir at Newby Bridge (SD 36900 86300) River Leven U/S Low Wood Bridge, Haverthwaite (SD 34544 83669).	2005 & 2006 2005, 2006, 2009 & 2010	N/A
Site Condition Assessment	Six sections of Windermere (shore, wader and boat surveys, north basin only)	25/08/2008	N/A
Lake Habitat Survey (LHS)	Windermere	2010	N/A
Otter, wading birds, wildfowl, water voles, great crested newts and riverine birds			
Fifth Otter Survey of England	England	2009-2010	Additional information required from Cumbria Wildlife Trust for Phase 2.

Data type	Location(s)	Dates	Comments
River structures			
Site visit	River Leven	07/02/2013	Photographs and locations of river structures have been obtained. Survey details of some structures still required for Phase 2 to establish depths of flows over the structures during the modelled drought scenarios. Surveys of Newby Bridge weir and gauging station not required.
Archaeology			
Geological details relating to sediment deposits	Low Wray Bray SSSI	N/A	Additional information required from English Heritage for Phase 2.
Socio-economic and community impacts, tourism/recreation, fishing groups			
2008 Annual Business Inquiry (ABI) Data (workplace) data – a survey of the number of workplaces and their size (in terms of employees) broken down by sector	Windermere area	2008	N/A
2011 Business Register and Employment Survey (BRES) – an employer survey of the number of jobs held by employees broken down sector.	Windermere area	2011	N/A
SLDC STEAM Report 2011	South Lakeland	2011	N/A
Cumbria Visitor Survey 2012.	Cumbria	2012	N/A
Annual boat registrations recorded in the Joint Annual Reports for Windermere	Windermere	1990-2012	N/A
Previous reports	Windermere and River Leven	2006, 2008, 2010	N/A

Data type	Location(s)	Dates	Comments
2010 drought permit objections and 2012 drought plan responses Evidence available online from similar studies.		2010, 2012 Various	
Initial discussions with WLC, Holker Estates, Cumbria Tourism, SLDC, Lake District National Park and National Trust.	Windermere and River Leven	2013	N/A
Hydrological and bathymetric data and figures that will form the basis of the drought permit environmental assessment report (Phase 2) for this study.	Windermere	2013	Required in Phase 2. As described in the proposed method of assessment for the socio-economic aspect of the study, maps showing areas where there will be a reduction in wetted area and/or water depth due to the drought permit scenarios will be sent with a questionnaire to lake users so that they can judge how and in what way they could be impacted. Maps showing areas where there will be a reduction in wetted area and/or water depth due to the drought permit scenarios will be an output of the lake level and exposure assessment.
Aesthetics/landscape			
Hydrological and bathymetric data and figures that formed the basis of the 2008/2010 drought permit environmental assessment reports.	Windermere	2008/2010	N/A
Hydrological and bathymetric data and figures that will form the basis of the drought permit	Windermere	2013	Required in Phase 2.

Data type	Location(s)	Dates	Comments
environmental assessment report (Phase 2) for this study.			
Other abstractors (including HEP)			
Abstraction data	Location and daily license value for 3 sites on the River Leven currently available. List of all 3rd party abstractors required.	N/A	For Phase 2 there is a requirement to confirm the absence of any other 3rd party abstractions that could be impacted by the proposed DP scenarios within the study area. A list of these abstractors is required from the EA.

7 SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

The objectives of Phase 2 of this project are to update the existing EAR including the following main aspects:

- update previous the environmental assessment with updated and new data for both DP scenarios, particularly from the 2010 drought, and ensure that any existing aspects are still current and fit for purpose;
- significantly update the socio-economic impacts element of the assessment to include the potential impacts on tourism, lake users etc; and
- consider mitigation measures in greater detail and in liaison with stakeholders, particularly relating to lake users and the options for use of the fish sluices/waterbank (and the relative balance of impacts).

The ecological aspects of the project have been studied in detail for previous reports in 2006, 2008 and 2010 and the level and extent of previous assessments were considered acceptable, with the exception of potential impacts on fish in Windermere and the River Leven. There is a need to significantly update the previous socio-economic element of the assessment. Therefore resources for this "refresh" project have been focussed on updating the socio-economic and fisheries elements (including detailed consideration of river levels and flows, and lake level and exposure, which will underpin the updates to the socio-economic and fisheries elements of the assessment).

A summary of the issues to be included in the study was presented in Table 1.1, including comments on the anticipated level of study required to update the previous reports, for both scenarios. Based on the data review and gap analysis undertaken in Phase 1 (this report), it is recommended that all of these aspects proceed to Phase 2, with assessments to be undertaken at the proposed level of detail. No changes in the proposed level of detail are recommended.

There are some outstanding data gaps identified in this report and summarised in Table 6-1. It is recommended that these gaps be filled at the start of Phase 2 by obtaining the relevant datasets.

Following the three week consultation on this report (Phase 1 Scoping Report) it is recommended that the study progress to Phase 2 (Environmental Assessment), with the aim of producing a draft EAR for discussion in Autumn 2013. Following consultation with the PSG and SHG the aim is to submit a final EAR for sign-off by the relevant authorities in Feb/Mar 2014.

8 REFERENCES

APEM (2004) Cross Section Report – Rivers Eamont and Leven. Report No. UU 759

APEM (2010a) Fluvial Geomorphological Audit – Rivers Eamont and Leven. Report No. 411218.

Atkins Global (2005). Hands-off Flows for cSAC rivers: Phase 2. Methodology Report. Environment Agency North West Region.

Cascade Consulting (2006) United Utilities Windermere Drought Contingency Planning Environmental Assessment Report.

Cascade Consulting (2008) United Utilities Windermere Drought Contingency Planning Final Environmental Assessment Report.

Cascade Consulting (2008) United Utilities Windermere Drought Study Data Review.

Cascade Consulting (2010) United Utilities Windermere Drought Permit Environmental Assessment Report.

Defra (2011) Guidance for drought orders and drought permits. Defra, May 2011. http://www.defra.gov.uk/publications/files/drought-permits-drought-orders.pdf

EA (2011) Water company drought planning guideline. Environment Agency, June 2011. http://publications.environment-agency.gov.uk/PDF/GEHO0311BTOJ-E-E.pdf

Economics for the Environment Consultancy Ltd and Centre for Social and Economic Research on the Global Environment (1998) '"Valuing Preferences for Changes in Water Abstraction from the River Ouse" University College London and University of East Anglia.

(Eftec, 2007) 'PR09 WTP Customer Survey' report.

ESI (2012a), Drought Permit Environmental Assessment Report: River Derwent at Ambergate and Derwent Valley Reservoirs. Report No. 60083j R1

Frost, W.E. (1965) "Breeding habits of Windermere charr *Salvelinus willughbii*, and their bearing on speciation of these fish". Freshwater Biological Association

Lake District National Park Authority (LDNPA) (2011). Windermere Management Strategy 2011.

Landscape Institute/IEMA (2002). Guidelines for Landscape and Visual Impact Assessment; Second Edition, 2002.

SNIFFER (2012) Ecological indicators of the effects of abstraction and flow regulation; and optimisation of flow releases from water storage reservoirs.

The River Basin Districts Typology, Standards and Groundwater threshold values (Water Framework Directive) (England and Wales) Directions 2010 http://archive.defra.gov.uk/environment/quality/water/wfd/documents/2010directions.pdf

UKTAG (2008) Recommendations on surface water classification schemes for the purposes of the water framework directive

United Utilities (2009) Water Resources Management Plan.

Willis K. G. & Garrod G. D. (1995) 'The Benefits of Alleviating Low Flows in Rivers' *Water Resources Development, Vol. 11, No. 3*)

9 APPENDICES