Creation of Natural Assets Registers Using River Habitat Surveys

R&D Technical Report W1-041/TR

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Statement of Use
This report contains the results of a number of catchment wide River Habitat Surveys, and a discussion of how these results can be integrated into Area-based state of environment reporting and environmental management planning (based on the LEAP structure). Suggestions for best practice are made for utilising the valuable resource of River Habitat Survey data more widely as a cross-functional activity.

Keywords
River Habitat Survey (RHS), Natural Assets, Habitat Quality, Land Use, Channel Modifications, Local Environment Agency Plans (LEAPs)

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EXECUTIVE SUMMARY

The aim of this R&D project is to investigate the implementation of the River Habitat Survey (RHS) as a core activity to be included in Local Environment Agency Plans (LEAPs), through the creation of local 'Natural Assets Registers'.

Since the conception of the project, LEAPs have been largely replaced by Local Contributions, but the findings of the report are thought to be as relevant to the new framework.

The aims of LEAPs are to help identify, assess and solve local environmental issues. It is felt that RHS could be a useful tool to co-ordinate functional issues and propose a strategy for dealing with identified pressures, in the context of the wider catchment.

RHS and Geomorphological surveys were undertaken on a variety of river catchments. The data from each catchment were analysed and evaluated in terms of habitat quality and degree of modification. This report summarises the findings of eight catchment reports, and draws together the specific information that would be most relevant to LEAPs. Recommendations are made as to best practice for using RHS data in LEAP reporting.

Many of the RHS reports had aims and objectives which stood separate from this project, with the result that some had more in common with the corresponding LEAP than others. However, the data collected by RHS is standardised and therefore consistent, and can be queried and interpreted with the specific aim of informing issues within a LEAP.

RHS identifies channel, bank and marginal features that have positive and negative impacts on the river channel in terms of habitat quality. Specific data collected by RHS, which would be integral to LEAP assessments, includes information on: channel and bank modifications, land-use, valuable habitat features, erosion and deposition, and general pressures and impacts across the catchment. Ecological, geomorphological and amenity/landscape issues can be addressed at specific site or in the catchment context, and feed into a range of related programmes such as targeting UK BAP species.

RHS data can be used at many stages of the LEAP process to identify and prioritise issues, and then to inform and implement appropriate management actions, for example identifying appropriate reaches for river rehabilitation.

In situations where RHS surveys had been carried out prior to the formulation of the LEAP Action Plan, RHS has been successfully integrated into management plans and rehabilitation work (e.g. Ribble).

RHS provides a useful approach which could be used to inform many subjects of LEAP reports, particularly under the recently adopted EA themes of 'An enhanced environment for wildlife', 'Reducing flood risk' and 'Improved and protected inland and coastal waters'.

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- Environmental Research and Consultancy (ERC) for derivation of all map data and River Habitat Survey and Geomorphological Evaluation of the Glaze Brook Catchment

- The Environment Practice and Sankey NOW (Natural Assets Register for the Sankey Catchment)

GLOSSARY OF TERMS

BRITE – Better Regulation Improving The Environment

LEAP – Local Environment Agency Plan

UK BAP – UK Bio-diversity Action Plan

RQOs – River Quality Objectives

HQA – Habitat Quality Assessment

HMS – Habitat Modification Score

LNR – Local Nature Reserve

cSAC – candidate Special Area for Conservation

SSSI – Special Site of Scientific Interest

RIGS - Regionally Important Geological/Geomorphological Sites

SPAs - Special Protection Area

1 INTRODUCTION

The aim of this R&D project is to investigate the implementation of the River Habitat Survey (RHS) as a core activity through Local Environment Agency Plans (LEAPs), to be used on a national basis. In order to do this a methodology for using RHS for LEAPs was developed, and the approach is outlined below. A strategy describing how RHS could be linked into LEAPs was developed and linked into previous and current RHS projects.

The aims of LEAPs are to help identify, assess and solve local environmental issues and to produce a prioritised programme of integrated actions to improve the local environment. A review of the ways LEAPs operate was undertaken and several weaknesses were highlighted. These weaknesses included a lack of co-ordination for issues within a LEAP area and that these issues are function-related and do not always consider the catchment's requirements. It is felt that RHS is a useful tool to link functional concerns and catchment processes. It can help co-ordinate functional issues and propose a strategy for dealing with identified pressures, adapted in the context of the wider catchment.

2 TERMS OF REFERENCE

2.1 Aims and Objectives

To assess the use of River Habitat Survey (RHS), (Environment Agency, 1997) in creating a natural assets register for LEAPs in England and Wales. The term "natural assets" covers the habitats, landscape, wildlife and accessibility of water courses in the area in question.

2.2 Approach

RHS and Geomorphological surveys were commissioned and undertaken on a variety of river catchments. The following catchments were selected, within their respective LEAPs (Fig. 1):

- 1998 Sankey Brook, Sankey/Glaze LEAP
- 1999 River Calder, West Cumbria LEAP
- 1999 River Lune, Lune LEAP
- 1999 River Nadder, Hampshire Avon LEAP
- 2000 River Ribble, Ribble LEAP
- 2001 River Eden, Eden, Esk and Solway, LEAP
- 2002 Glaze Brook, Sankey/Glaze LEAP
- 2003 Goldrill Beck, Eden, Esk and Solway LEAP

The data from each catchment were analysed and evaluated in terms of habitat quality and degree of modification in line with the individual report aims. The key issues identified by these evaluations have been summarised in the following report. The corresponding LEAP Action Plan documents have been consulted in order to compare the issues identified during the LEAP process with problems identified in the RHS reports. The key issues that correspond to RHS objectives in each LEAP report have been summarised. A general discussion compares each RHS report and LEAP Action Plan, in order to identify the benefits and drawbacks of using RHS for LEAP assessments. Further recommendations are provided on best practice for using RHS for LEAPs.

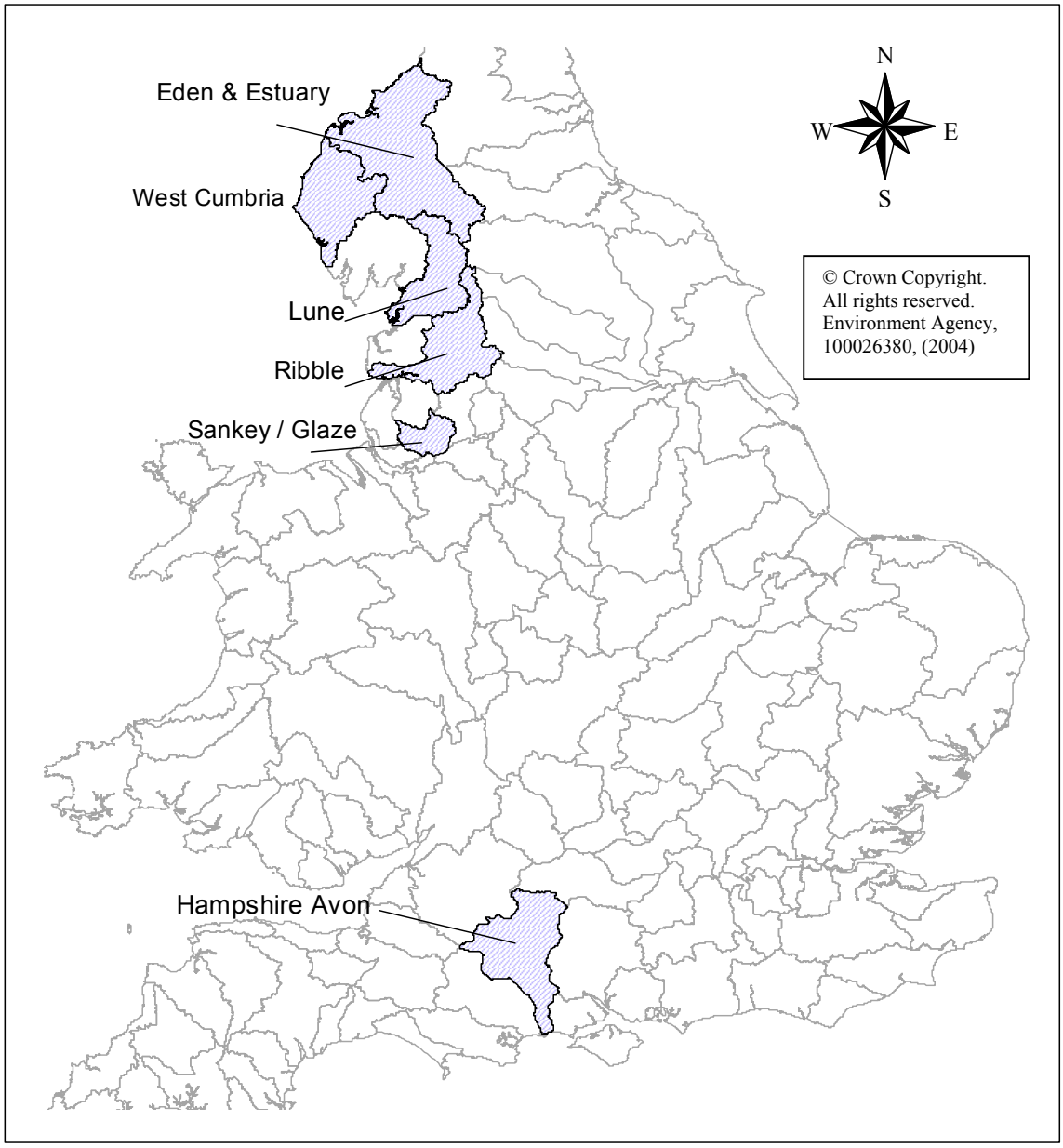

Figure 1: Location of LEAPs

2.3 Constraints

During the duration of this project the status of LEAPs as a core Environment Agency activity was phased out, and was replaced by an equivalent process called Local Contributions. The findings of this report should be equally relevant to this new structure. The replacement of LEAPs has led to a document shortage, especially the Eden, Esk and Solway LEAP where the Action Plan was unavailable.

Under the pre-BRITE structure the RHS team (based in North West Region) were called the 'Lead Region'; the aim being that other regions would adopt RHS following the

applications developed and promoted in NW Region. Therefore, the majority of RHS reports used in this study are focused in the North West of England.

3 RHS REPORT SUMMARIES

3.1 Natural Assets Register for the Sankey Catchment, 1998

3.1.1 Aims and objectives:

- Assess the landscape, ecological and geomorphological character of river corridors in the Sankey catchment.

- Identify and evaluate features and areas of local, regional or national significance by means of landscape assessment, RHS survey, wildlife species records.

- Identify and evaluate existing information and where anomalies occur, highlighting areas of opportunity and possible options for enhancement of wildlife habitats and landscape quality.

3.1.2 Survey strategies:

- Desk study and site appraisal for landscape character assessment.

- 125 RHS sites at 2km intervals (including non-main rivers). "Inter-reach" surveys using the sweep-up section of RHS proforma. Constraints and opportunities appraisal for river and floodplain restoration and enhancement.

3.1.3 Data analysis:

- Definition of Catchment Landscape Areas, river valley corridor 'macro river' types and river channel 'micro scale' types and identification of conservation, restoration or enhancement management strategies.

- Calculation of HMS and HQA scores from RHS survey data. Analysis of river features, channel vegetation, bankside trees and vegetation structure.

- Comparison of landscape areas to HQA scores.

- Analysis of public access to watercourses in terms of extent, quality and opportunities for improvement to access.

- Locating sightings of water voles, invasive plants and key river species, during surveys and from historical records.

- Analysis of which watercourses fail RQOs, and relationship between HQA and water quality.

- Integration of above to create catchment-wide recommendations, watercourse-specific opportunities and Focus Area Action Plans.

3.1.4 Summary of results:

- HQA is highest and HMS lowest in the Lancashire Coalfield villages and farmland landscape areas. In St Helens and Warrington, modification is greater and HQA lower due to the extent of urbanisation. The Mersey Valley farmland area also has low HQA due to agricultural 'impacts' on watercourses (e.g. bank and channel resectioning, embanking).

- Very few watercourses had quality of high enough status to be conserved; therefore restoration is appropriate to re-create typical features. Enhancement can take place to improve the most severely degraded streams.

- In terms of public access, agricultural areas suffered from poor access and a number of areas were highlighted where access could be improved as part of enhancement or restoration schemes. In urban areas, access was generally good although waymarking was reduced due to vandalism.

- The largest colony of water voles was found along a resectioned reach of Sankey Brook with low HQA scores, and no clear pattern was found as to their preferred locations. However more records have been made along reaches with less intensively managed woodland or scrubland and not in areas of agricultural or amenity grassland. There is a lack of overall biodiversity in the catchment.

- Himalayan Balsam and Japanese Knotweed are associated with urban areas, with agricultural areas having insignificant quantities.

- In terms of water quality, problems are posed by litter and flytipping, culverting and diffuse pollution. Historical land uses have contributed to contamination of some areas, combined-sewer discharges, minewater and leachate.

- Extensive resectioning along over 50% of rivers in the Sankey catchment contributes to a high percentage of significantly and extremely modified rivers; the few semi-natural rivers tend to be non-main river sites. There are no ecologically diverse (simple or complex) bank faces or tops along the whole of Sankey Brook.

- Habitat quality is slightly better than would be expected in a heavily modified catchment, mainly due to the presence of wooded areas. Sites which have high HQA should be considered as locally important conservation features, half of which are already in designated areas.

- RHS data was also used to identify modified sites with stream power appropriate for geomorphological rehabilitation.

- Focus Area Action Plans were created to draw together catchment-wide and watercourse-specific management options. These can target the specific issues raised in each key area of the catchment.

3.1.5 Issues raised in Sankey and Glaze LEAP Action Plan, 1997:

- Need for continued habitat improvement and protection, and to identify and prioritise stretches for enhancement and rehabilitation. Protection of reaches with natural variety (meanders, riffles and pools, bankside trees, woodlands, wetlands, grasslands).

- Water quality - 1996 Consultation report identified major stretches of Sankey and Glaze as failing RQOs (water quality).

- Culverts cause flood risk and loss of habitat by restricting flows of water and wildlife.

- Modifications: Channelised courses (straightened, over-deepened, reinforced/ resectioned banks, embankments) are found throughout the catchment. Toe revetments reduce marginal and channel habitats. Artificial/modified channels reduce physical variety in the channel, banks, and on adjacent land, leading to a loss of habitat and biodiversity. Rivers are less attractive and less valued, and require heavy maintenance, which can be problematic due to unstable banks.

3.2 River Calder RHS Evaluation, 1999

3.2.1 Aims and objectives:

- Assess the potential causes of an observed decline in salmonid fisheries quality in the River Calder system.

- Collect habitat information for the catchment and interrogate the data in terms of positive and negative salmonid habitat features.

- Compare RHS data with habitat data in the neighbouring catchment of the River Ehen, and to national RHS and fisheries data.

3.2.2 Survey strategies:

- Full RHS surveys at 54% coverage within the Calder Catchment at 1km intervals.

- 'Inter-reach' surveys between RHS sites, with selected elements from the RHS proforma.

- Fish survey data from the River Calder and River Ehen catchments including salmonid survey results from 1998 and 1993 respectively, and fisheries data from other rivers in the NW region.

3.2.3 Data analysis:

- Habitat characteristics and salmonid populations of the Calder were described and compared against those of the adjacent River Ehen. Habitats and fisheries of both

catchments were reviewed in a regional context, in terms of good and bad habitat characteristics for salmonid populations.

- Data collected was assessed using the national RHS database.

3.2.4 Summary of results:

- Despite similarities in fish populations, there are marked differences in habitats between the Calder and Ehen Catchments.

- A lack of suitable substrate for salmonid populations due to a coarse dominated system, with little silt deposition. Eroded material is mainly flushed out of the catchment.

- Land-use is identified as unsuitable for salmonid fisheries, being dominated by rough pasture, wetlands and moorland.

3.2.5 Issues raised:

- Gradient and morphology of the River Calder is reasonably suitable for salmonid populations, but less suitable for trout fisheries compared with the River Ehen.

- Land-uses between the two catchments are significantly different and may inhibit the robustness of the technique of comparing the data from both catchments.

- A general lack of spawning habitat and habitat suitable for salmon and trout fry and parr was identified, mainly due to substrate composition and proximal land-use.

- Poaching pressures were identified within the catchment.

- Habitat enhancement may lead to an improvement in fish populations, but gradient and rapid flow velocity may inhibit the success of any enhancement measures.

- Lack of other relevant data (including water data, macro-invertebrate survey data), to make a better assessment in the decline of fish populations.

3.2.6 Issues raised in West Cumbria LEAP Action Plan, 1999:

- Angling and fisheries interests are keen to undertake enhancement, including stocking programmes. The Environment Agency prefers habitat enhancement solutions as restocking has potentially significant genetic impacts on individual river populations. Mitigation restocking occurs only after a major fish kill, or if low fish populations are identified.

- Lower reaches of the River Calder have some of the most degraded river habitats in the LEAP area, associated with improved agricultural land, including agricultural land drainage schemes, and industrial construction.

- Land-use practices have been identified in causing: poaching and related release of fine sediment into the catchment; low levels of bankside vegetation; diffuse pollution from farmland; land drainage problems; and modifications to channels resulting in a lack of habitat diversity normally present in a natural river environment.

- The Calder Conservancy Committee commissioned a report by APEM on how to improve natural salmonid productivity in the catchment. Limiting factors were the river habitat, in particular the instability of spawning gravels. Recommended improvements included small-scale habitat improvement works. More significantly, the instability of the spawning gravels is believed to be due to the frequency and severity of flood events, partially caused by over grazing in the upper catchment.

- Catchment failed Water Quality Objective of RE1 (Ammonia) and potential issues arising from this where to be investigated.

3.3 Survey of River Habitats on the River Lune, 1999

3.3.1 Aims and objectives:

- Assess levels of modification and naturalness of fluvial processes, within the catchment.

3.3.2 Survey strategies:

- 103 RHS surveys undertaken in 1999, added to 37 baseline sites from 1994-96.

3.3.3 Data analysis:

- Summary statistics on flow features, substrates, tree features and bank profiles.

- HMS calculated and compared to baseline sites.

3.3.4 Summary of results:

- The Lune is a high energy upland system.

- HMS shows 70% of sites are predominantly unmodified and only 10% significantly or severely modified. This is about average compared to similar baseline sites. Highly modified sites are mostly in urban areas (bank reinforcements) and there are 12 major weirs and 1 culvert that may prevent fish migration.

- Main land-uses are agriculture and broad-leaved woodland, with tree features widespread within the catchment. Natural fish shelters such as undercut banks, boulders and tree roots are common.

- Substrates are generally coarse, with cobbles dominant and boulder/bedrock outcrops. Gravel/pebble substrates are rare, as are silt and sand. Flows are

characterised by high velocity features including waterfalls, cascades and rapids. Runs and riffles were present at many sites.

- Erosion is widespread; 91% of sites exhibited some erosion, 50% extensively. 74% of bank faces are bare. Erosion features do not seem to be related to land use, and appear to be natural. Widespread erosion could be expected in a predominantly unmodified catchment with little bank reinforcement.
- Salmonid habitat is good with a variety of features distributed across the catchment.

- River habitats appear of good quality, and processes are naturally driven. Agricultural land use may affect levels of runoff, within the catchment.

3.3.5 Issues raised in Lune LEAP Action Plan, 1998-2003:

- Protection and restoration of important habitat types and associated species; degradation of bankside habitat is an important issue. Poaching by livestock reduces bank vegetation and bank stability, thus promoting silt input to river.

- Sparse tree cover, especially along the main Lune.

- Japanese Knotweed and Himalayan Balsam are problems in the catchment, reducing overall biodiversity.

- Need to enhance otter habitat by increasing the number of trees, bank vegetation and wetlands.

- 1960s engineering along the River Keer had severely impacted river habitats; there is now a rehabilitation scheme to improve habitat variation. Many other rivers are affected in similar ways. Tipped debris as 'bank protection' is common.

- There is a lack of suitable fish spawning habitat. This can be improved by creating in-river structures and loosening compacted gravels or seeding and stabilising loose gravels.

- There is a lack of juvenile salmon habitat due to poor riparian vegetation and in-channel habitat, bank poaching, impact of structures on bed stability.

- Weirs and culverts have been identified, which inhibit fish distribution.

3.4 RHS Natural Asset Survey of the River Nadder (1999)

3.4.1 Aims and objectives:

- Natural asset survey of the River Nadder catchment.

3.4.2 Survey strategies:

- 27 full RHS sites (25% of catchment length) randomly selected and 129 "inter-reach" surveys.

3.4.3 Data analysis:

- Summary statistics on habitat features (flow, substrate, bank profiles, and modifications).

- HMS and HQA calculated and compared to similar sites in UK and LEAP area.

- Correspondence Analysis (CA) of spot check data (substrate and flow type) to analyse main habitat dimensions.

3.4.4 Summary of results:

- The Nadder is a moderate energy lowland system dominated by runs and glides.

- Land use is dominated by tall herbs, improved grassland and broad-leaved woodland. Wetland and suburban land uses are also common. Vegetation structure is usually simple or uniform due to extensive improved grassland.

- Substrates are generally gravel/pebble in equal proportions, with significant areas dominated by silt/mud or clay. Coarse sediments are absent.

- Bank reinforcements are prevalent, and bridges and weirs were found throughout the catchment.

- Sites on tributaries are more modified than the main river. No sites were found to be severely modified, and just under half are predominantly unmodified.

- HQA scores for the Nadder are favourable compared to other Hampshire Avon sites, with a high proportion of special features such as debris dams, flush and water meadows. However 40% of sites are of below average quality compared to UK baseline sites.

- Erosion is active at only 25% of sites, mostly in the upper reaches. This suggests sediment enters the system from other sources. Most depositional features are stable and vegetated.

3.4.5 Issues raised in Hampshire Avon LEAP report, 1998:

- Deteriorating river conditions in Avon catchment, attributed to low flows. Loss of spawning and incubation habitat for brown trout and other fish.

- River restoration schemes have been planned at a number of sites including Barford on the River Nadder.

- Need to improve spawning medium and migration conditions for salmon, and to optimise channel morphology for different salmon life stages.

- Actions can be taken in an attempt to promote UK BAP species and improve habitats.

- Integrated river basin management to look at water quality and quantity, physical environment, flood control, recreation and wildlife.

- Additional responsibility of EA to protect the environment, as the area is a cSAC.

- Possibility of using dry channels to route floodwater and therefore enhance use of the floodplain.

- Water level management plans to balance a range of activities for flood defence, agriculture and conservation.

3.5 River Ribble RHS Evaluation and Geomorphological Study, 2000

3.5.1 Aims and objectives:

- To provide continuous information on the habitats found within the catchment and to highlight any areas of specific habitat importance with particular reference to fisheries value, otters, water voles and sand martins.

- Analysis of the data gathered to provide sound management options to maintain areas of good habitat and enhance areas of low habitat quality.

- To analyse the data collected from both the RHS and Geomorphological Surveys, and produce a series of recommendations for reducing erosion within the catchment.

- To present data on grazing pressure, human access, fencing condition and pollution inputs to assess potential and actual impacts on the system.

- To enable the efficiency and cost effectiveness of future management strategies to be maximised by identifying and targeting erosion 'hotspots'.

3.5.2 Survey strategies:

- Full RHS Survey at 25 % coverage of randomly selected sites within the catchment.

- Geomorphological Survey detailing the extent and stability of depositional features and sources of erosion; grazing pressures, human access, fencing condition, animal occurrence and evidence of pollution.

- An "inter-reach" survey recording land-use, artificial features and features of special interest.

3.5.3 Data analysis:

- Geomorphology data was scored to produce a quantitative index of erosion and deposition.

- HQA and HMS scores where calculated from RHS data and compared to sites of similar characteristics from the UK Baseline Network.

- A score for fine sediment sources and bank sensitivity to erosion for each RHS site.

- Stream Power proxy (based on discharge, slope and water width) calculated for each RHS site.

- Habitat suitability for selected species was calculated by identifying habitat characteristics considered important for each species using published literature. These characteristics were selected from RHS sites and compared with actual occurrences of each species.

3.5.4 Summary of results:

- Habitat variables considered favourable for salmonid fisheries were high within the Ribble, indicating that it has high fisheries potential. The main inhibiting variables were coarse substrates (including bedrock), poor tree cover and low water depths.

- A large number of weirs within the mainstem Ribble constitute a major obstacle to the migration of salmonids and may also act as gravel traps, thus limiting gravel spawning grounds, within the catchment.

- The extent of silt deposition within the catchment was highlighted as a potential problem. However, silt deposition is not specifically targeted by the RHS or Geomorphological Surveys and maybe susceptible to underestimation. Most fine sediment eroded from the catchment is transported out of the catchment. Agricultural land-use may have a significant impact of the level of erosion in the catchment.

- Grazing pressure is intense, causing a high level of poaching along the river banks. This pressure is the result of poor levels of fencing.

- A significantly greater percentage of semi-natural sites and less significantly modified sites were identified than the baseline site network, with no severely modified sites.

- Invasive plant secies: Himalayan Balsam extensive, but Giant Hogweed rare.

- Phosphate input.

3.5.5 Issues raised in Ribble LEAP Action Plan, 2000:

- Detrimental enrichment of waters leading to eutrophication and the decreasing quality of fisheries river habitat.

- High levels of erosion and widespread areas of erosion, increased due to land management practices e.g. intensive grazing. Possibly leading to excessive sedimentation harming spawning grounds.

- Channel modifications preventing downstream conveyance of gravels to replenish spawning grounds.

- Man-made barriers prevent fish from reaching available spawning grounds, thus affecting the mixing of populations of the same species and isolating some species from entire regions of the river network.

- Landscape changes, especially due to changing agricultural practices, have badly affected the amount and diversity of riverbank wildlife, leading to increased bank erosion, the spread of invasive plants, e.g. Giant Hogweed, Himalayan Balsam and Japanese Knotweed, and increased siltation.

- Enhancement and conservation of otter, water vole and white clawed crayfish populations as well as other UK BAP species.

- The need for river landscape, conservation, restoration and enhancement.

3.6 River Eden RHS Evaluation and Geomorphological Study, 2001

3.6.1 Aims and objectives:

- To determine the state of the environment within the Eden and sub-catchments and identify the main pressures on the system in order to derive sound management options

- Evaluate the habitat quality and geomorphological features within 5 sub-catchments and a section of the mainstem of the River Eden.

- Provide baseline information on the existing habitat conditions using repeatable techniques of RHS (50%) and geomorphological bolt-on (100%).

- Identify areas of valuable habitat quality and illustrate the reasons for the high habitat quality. Identify areas of poor habitat quality and the causes of the pressures impacting upon habitat quality.

- Evaluate the 'naturalness' of the geomorphological processes operating within the study area, with particular attention to sediment sources, transfer and sinks.

Determine the causes of accelerated erosion and assess the environmental impact of these sediment sources upon habitat quality.

- Identify areas in need of restoration/rehabilitation, and provide a set of sound management options based upon the results of the analysis undertaken.

3.6.2 Survey strategies:

- Full RHS Survey at 57 % coverage of randomly selected sites, within the catchment.

- An "inter-reach" survey recording land-use, artificial features and features of special interest.

- Geomorphological Survey detailing the extent and stability of depositional features and sources of erosion; grazing pressures, human access, fencing condition, animal occurrence and evidence of pollution.

3.6.3 Data analysis:

- Summary statistics providing a general overview of the study area, compared to sites of similar type in Cumbria, NW region and UK baseline sites.

- HQA and HMS scores where calculated from RHS data and compared to sites of similar type from the UK Baseline Network.

- HMI scores calculated and the sub-scores analysed to assess the main pressures upon the study area.

- Dominant flow-types and channel substrates were spatially analysed for their habitat importance.

- Geomorphology data was scored a quantitative index of erosion and deposition; Strahler stream order; pressures: fencing quality.

3.6.4 Summary of results:

- The River Eden and its sub-catchments have a higher proportion of features that are rare within the county, regional and national context e.g. wetlands; bogs.

- High intensity grazing pressures are leading to substantial accelerated erosion, mainly due to poaching of the banks. Effective fencing seems to be lacking within the catchment. An assessment of fine-grained sedimentation within the study area, particularly in gravel beds, needs to be undertaken.

- River modification is low throughout most of the catchment, excluding mainstem Eden, which along with the Eamont, is the most impacted by permanent modifications. Reduction of hard engineering bank protection methods and replacement with soft engineering methods would lead to more natural channel banks and greater biodiversity.

- Habitat quality issues are predominantly poor bank vegetation structure and a lack of tree cover. Flow type and channel substrate diversity are high within the study area.

- Geomorphologically, the catchment exhibits processes and characteristics of a healthy natural river system. Eroding cliffs and bed scour are the most important erosion features. Sidebars and mid-channel bars are the most important depositional features within the study area.

- Maintenance of existing areas of high habitat quality and targeting of areas with low habitat quality for priority rehabilitation.

- Removal of urban debris from channel, and invasive species from the banks needs to be carried out.

3.6.5 Issues raised in Eden, Esk and Solway LEAP Environmental Overview, 1999:

- The need for the protection and management of internationally important wildlife sites, especially on the River Eden.

- The need for the protection and enhancement of the area's biodiversity.

- The need for information to manage spring salmon in the River Eden.

- River Restoration and conservation.

- Demand on water resources during prolonged dry weather causing possible adverse environment impact.

- Adverse impact or rural land use.

- The use of rivers as recreational areas is also a highlighted issue, due to the number of rivers of national and international importance for nature conservation. Increases in public access need to be assessed in terms of potential impact on the river system.

3.7 River Habitat Survey and Geomorphological Evaluation of the Glaze Brook Catchment, 2002

3.7.1 Aims and objectives:

- To provide information and baseline data on the river habitats in the Glaze Brook catchment using standard RHS methods and the geomorphological audit, to assess the distribution and intensity of geomorphological processes, notably erosion and deposition.

- Identify areas of high habitat quality and the factors contributing to it.

- Identify areas of low habitat quality and the causes of the pressures resulting in low habitat quality.

- Evaluate the 'naturalness' of geomorphological processes, especially with respect to sediment sources, transfers and sinks.

- Identify areas suitable for restoration/rehabilitation.

- Investigate the distribution of water voles in relation to availability of suitable habitat.

- Provide sound management options based upon the results of the analyses undertaken.

3.7.2 Survey strategies:

- RHS Field Survey: 46 sites, 41 of which were selected randomly, 5 selected non-randomly for a specific purpose.

- Geomorphological Survey of 500m reaches, comprising a total length of 75km of survey, detailing the extent and stability of depositional features and sources of erosion; sediment sources, transfer and sinks; grazing pressures, human access, fencing condition.

- An "inter-reach" survey recording land-use, artificial features and features of special interest.

3.7.3 Data analysis:

- HQA and HMS scores were calculated for each RHS site and compared with randomly selected baseline sites from England and Wales after 1995 and all RHS sites in NW region after 1995. Rare features were checked for at national, regional and local levels for sites of similar type.

- RHQ scores were developed and calculated by incorporating a measurement of distance from benchmark sites, HQA and HMS.

- Geomorphological data were analysed in three ways:

    - Reach by reach description throughout the catchment
    - Assessment of characterisation by channel-type (network order)
    - Statistical summaries of processes across the whole catchment.

- Data for water vole habitats including visual observations made during RHS and Geomorphology surveys; Survey by Clear Glaze Partnership 1999; and habitat data from RHS database.

3.7.4 Summary of results:

- High habitat quality was identified, typically in the upper parts of the catchment, associated with woodland land-use, trees, diverse flow types and low numbers of modifications.

- The majority of the catchment is of low habitat quality, mainly due to absent or infrequent bank and channel features, absent or low diversity in channel vegetation and the paucity of riparian trees. High levels of modification were also identified, including resectioned banks and/or channels, and extensive culverts. These modifications severely impact on river habitat diversity and fragmentation.

- Pressures impacting on the catchment were identified as agricultural land-use and housing. These land-uses have led to extensive modifications to reduce flood risk.

- Erosion processes were dominated by toe scour of fine sediments, eroding cliffs, poaching and slumping. Poaching is mainly associated with livestock grazing and low fencing quality.

- Over-siltation is recognised in some areas, particularly where channels flowed into wetlands or larger water bodies, but was assessed to be due to natural deposition processes.

- Ground works, found frequently within the catchment, were identified as potential problematic sources of fine sediments to the catchment.

- Water voles were found in scattered populations within the catchment with two main clusters.

3.7.5 Issues raised:

- Rehabilitation of 'poor' RHQ sites, especially between sites of moderate – good quality.

- Culverting – opposition to further culverts and a strategy to restore surface channels where possible.

- Protect existing habitat features of value and sites of 'good' RHQ.

- Improve fencing quality in order to reducing livestock grazing pressures on river banks and reduce the input of fine sediments into the channel by poaching.

- Enhancement of riparian vegetation to favour water voles.

- Minimise abstraction and increase controls on ground work sites close to the channel.

- Remove invasive species from the catchment.

3.7.6 Issues Raised in Sankey and Glaze LEAP Action Plan, 1997:

- Culverts causing a flood risk, poor water quality and loss of habitat by preventing or impeding the free flow of water and wildlife along watercourses.

- Maintenance problems caused by unstable banks.

- Extent of channelised and over-managed watercourses creating loss of habitat and amenity.

- Intensive cultivation of land to the edge of watercourses increases the risk of pollution and loss of habitats. A buffer zone between land-use and bank top can provide important wildlife habitat, and can stabilise the banks against excessive erosion.

- Threats to the habitats of Great Crested Newts

- Invasive species.

- The presence of blue-green algae.

3.8 Goldrill Beck RHS and Geomorphological Evaluation, 2003

3.8.1 Aims and objectives:

- Evaluate habitat quality and geomorphological features to identify pressures on the system and derive options for future management.

- Identify reaches where river habitat quality is high and reasons for their value, and reaches where habitat quality is poor and what pressures are reducing habitat potential.

- Evaluate to what extent natural geomorphological processes occur in the catchment, with particular attention to sediment sources, transfers and sinks. Determine causes of accelerated erosion or unexpected deposition and assess whether there is an impact on habitat quality.

- Identify areas with rehabilitation potential and suggest sound management options based on results of the analysis.

3.8.2 Survey strategies:

- 50% catchment coverage of 70 randomly selected 500m RHS sites.

- Geomorphological survey covering 100 % river length in the catchment (70km).

3.8.3 Data analysis:

- RHS data were analysed by comparing the data from Goldrill Beck to other sites on the RHS database, and calculating indices for habitat quality and channel modifications. Substrate, flow and feature diversities were also investigated.

- Data from the geomorphological survey were used to identify areas of natural or enhanced erosion and deposition in the catchment, and to investigate the impact of land use on the naturalness of fluvial sediment processes.

- The findings of the two sections were then brought together to identify sites for potential enhancement or rehabilitation, and suggestions for catchment-wide management strategies.

3.8.4 Summary of results:

- The Goldrill Beck catchment has a variety of rare features in terms of wetlands, woodland features and waterfalls, but less so in depositional features (which may reflect the upland nature of many of the streams).

- The highest habitat quality reaches in the catchment are usually located in the headwater tributaries, while poor habitat quality is predominant along the main stretches of Goldrill Beck and Grisedale Beck.

- Flow and substrate types are varied, providing a wide range of potential habitats, but low scores are recorded for bank features, thereby limiting habitat quality.

- Channel modifications affect many sites in the upland floodplains, with reinforced walls and flood embankments the most common alterations along with small areas of urban land-use.

- Some level of erosion was recorded at most geomorphological survey sites. The highest erosion rates are due to natural processes and do not seem to impact on the river system by causing sedimentation or over-siltation.

- Poaching was identified and contributed to erosion at some sites, caused largely by grazing livestock and often associated with poor fencing quality.

- Deposition is dominated by coarser sediments and is concentrated in the upland valley floors, appropriate in the context of a high-energy river system such as the Goldrill Beck. Finer sediments are flushed through the system, and deposited further downstream or in lakes.

- The total proportion of erosion compared with deposition suggests that erosion is approximately 2.7 times greater in the study area, therefore the catchment, as a whole, is a net producer of sediments.

- Possible sites for enhancement works were selected along the main channels of Goldrill and Grisedale Becks, due to the low habitat quality and relatively high modification of these reaches.

- Catchment management strategies include; improving fencing or providing natural barriers along river banks; removing invasive plant species and urban debris, and protecting high habitat quality areas.

3.8.5 Issues Raised in Eden, Esk and Solway LEAP Environmental Overview, 1999:

- The need for the protection and management of internationally important wildlife sites, especially on the River Eden.

- The need for the protection and enhancement of the area's biodiversity.

- The need for information to manage spring salmon in the River Eden.

- River Restoration and conservation.

- Demand on water resources during prolonged dry weather causing possible adverse environment impact.

- Adverse impact or rural land use.

- The use of rivers as recreational areas is also a highlighted issue, due to the number of rivers of national and international importance for nature conservation. Increases in public access need to be assessed in terms of potential impact on the river system.

4 DISCUSSION AND COMPARISON BETWEEN RHS REPORTS AND LEAP DOCUMENTS

4.1 Comparison with West Cumbria LEAP Action Plan, 1999

The RHS evaluation report supports assessments made within the West Cumbria LEAP Action Plan, that fish populations are under threat in the River Calder partly due to the lack of suitable substrate. This unsuitability is two-fold. Firstly, due to the steep gradient of the catchment, and the consequent rapid flows, flashy flood regime and local geology, the substrate is dominated by cobble and boulder substrates. Secondly, that proximal land-use is not suitable for spawning grounds, being dominated by moorland, rough pasture and wetlands, and the low occurrence of broadleaf woodlands (important in terms of nutrient input into the channel). Sediment input to the catchment due to poaching is also highlighted as a problem for potential spawning grounds. The occurrence and magnitude of poaching within the catchment is captured using the RHS survey. The report also concludes the need for localised habitat enhancement, despite the difficulties associated with implementation. Water quality data was highlighted in the RHS evaluation report as vital for the assessment of the salmonid reduction, and this data was unavailable at the time of the report. The LEAP Action Plan highlights some of the problems associated with water quality within the Calder Catchment, and thus, justifies the need for further analyses.

4.2 Comparison with River Ribble LEAP Action Plan, 2000

Many issues raised in the LEAP Action Plan can be addressed using RHS. RHS and specifically an 'inter-reach' survey will highlight the extent of channel modifications and land use including all man-made barriers in the catchment and their impact on channel continuity. Assessments of these can provide sound management plans both for the catchment generally and specially targeted areas. RHS can identify suitable habitat variables for individual species, and assess the presence or absence of these features within the given catchment/reach. Sound management plans/rehabilitation works can be derived from RHS assessments targeted for individual species/habitats.

The results and conclusions of the River Ribble RHS Evaluation and Geomorphological Survey support many of the issues raised in the River Ribble LEAP Action Plan. Conversely, many of the issues raised in the LEAP Action Plan can be investigated using the RHS approach, when combined with an 'inter-reach' survey. The state of fisheries habitat can be assessed in terms of river morphology, but not water quality. Channel barriers, modifications and land use are all assessed within RHS, as well as invasive species.

4.3 Comparison with Sankey/Glaze LEAP Action Plan, 1997

RHS identifies location, size and impact of culverts in a channel system. RHS can also identify actively eroding banks and the possible causes, providing information on the importance of banks in terms of habitat diversity. Information on modifications likely to affect habitat quality is recorded by RHS. Collaboration with flood defence can lead to

sound enhancement and restoration management schemes reducing modifications and increasing habitat diversity. RHS can identify the occurrence of wetlands, and less specifically ponds near river channels, along with pressures within the catchment which may help identify potential protection strategies. RHS data on landuse and banktop vegetation structure can help address issues with extensive cultivation raised in the LEAP. RHS creates a clear inventory of important natural habitat features, including those identified as important in the LEAP (meanders, riffles and pools, bankside trees, woodlands, wetlands, grasslands).

The Glaze Brook report provides information that is relevant to many of the issues raised within the LEAP Action Plan. The Sankey Natural Assets register is a step further than a conventional RHS study, in that information has been gathered from a wider range of sources. The resulting details on land management areas, water quality and public access and recreation render it a more similar document to a LEAP in terms of information content, and the idea of Focus Area Plans is one that could potentially fit in with the structure of LEAPs.

4.4 Comparison with Lune LEAP Action Plan, 1998-2003

RHS records poaching, eroding cliffs, bank vegetation, and discrete silt deposits and could be used to investigate specific sites further, where poaching and bank stability were identified as problems in the LEAP. Sparse tree cover was also an issue identified by the LEAP; RHS collects data on tree cover and could therefore be useful, however the results of the 1999 RHS survey conflict with the LEAP statement, having found generally good tree cover and associated features. In terms of provision of otter habitat, RHS could be used to show where creation of these features is practical/where some habitat already exists and could be enhanced. Some of the LEAP findings conflict with RHS data, for example, gravels were not predominantly recorded by RHS, and were not identified as being compacted; RHS suggested the fast flows would probably mobilise gravels too easily. The identification of habitat modifications also appears to be different to the findings of RHS.

In this case, the RHS report was more focused on geomorphology/erosion and less related to LEAP themes than others. However, it also highlights a need to identify areas of conflicting conclusions between LEAP statements and RHS analyses.

4.5 Comparison with Hampshire Avon LEAP Action Plan, 2000-2005

The LEAP identified a major issue in the catchment as being prolonged drought conditions and low flows, leading to enhanced deposition of fine sediments and associated deterioration in fish spawning habitat. This was also picked up on by RHS, although gravel pebble substrates were common. The RHS report suggested there is a substantial amount of sediment being inputted indirectly, probably from extensive areas of agricultural improved grassland. The LEAP report identified the need for catchment management strategies extending to the land as well as the river channel. Specific river rehabilitation schemes were also highlighted, although concerns are raised in the River Avon cSAC strategy (Wheeldon, 2003) that the low energy nature of rivers in the Avon area are highly sensitive to any modification. Small scale enhancement works are more appropriate, and RHS could be used to help identify sites which could benefit from this

type of management, for example areas where gravels have been infilled by fine sediments.

4.6 Comparison with Eden, Esk and Solway LEAP Environmental Overview, 1999

RHS can and has been used to highlight areas of conservation value via its Habitat Quality Assessment (HQA) Scoring system. Areas can be compared to other sites nationally, regionally or on a LEAP/catchment scale. This data can then can be used to back Special Protection Areas (SPAs), Special Areas of Conservation (cSAC), Riverine SSSIs and Regionally Important Geological/Geomorphological Sites (RIGS). RHS has been used to highlight key habitat variables for several species (Otter, Water Vole, Freshwater Pearl Mussel and the Native Crayfish). Once habitat variables have been determined RHS can then be used to predict suitable habitats for such species and highlight how potentially suitable habitats may be enhanced/created. The fact that limited resources are available can be overcome because the data collected by RHS can be used for a multitude of species and is relatively inexpensive when compared to other surveys. RHS surveys and analysis can be carried out by consultants or available Agency staff.

Several fisheries projects have used RHS to evaluate Salmonid habitats, by assessing the reasons for apparent declines in Salmonid fisheries and suggesting appropriate management techniques for fisheries. The geomorphological aspect of RHS can highlight areas of erosion or deposition and explain why the processes are occurring and whether they are natural or anthropological. This can then help determine the location and type of erosion control. Habitat Modification Scores (HMI) can be calculated to determine the level of modification to a site and appropriate restoration/enhancement techniques can be applied by comparing the site to similar rivers in a more natural state from the baseline network.

5 BENEFITS AND DRAWBACKS OF USING RHS FOR LEAP ASSESSMENTS

5.1 Benefits

There are many benefits to be gained from using RHS techniques for LEAP assessments.

RHS identifies channel, bank and marginal features that have positive and negative impacts on the river channel in terms of habitat quality, including:

- Channel and bank modifications
- Land-use
- Habitat features of value – e.g. channel shading; substrate diversity; flow-type diversity
- Erosion and deposition processes and features, and naturalness of processes
- Pressures and impacts on catchment, including invasive species, which can threaten biodiversity

A quantitative assessment of river habitat quality is also provided by the HQA and HMS calculations. Data on specific habitat features can be used for targeted species (e.g. UK BAP species) in terms of the occurrence of desirable and undesirable habitat features.

All this information can be used at stages of the LEAP process to identify issues and prioritise and implement actions

5.2 Difficulties

Many RHS reports have been produced for specific purposes and can be highly focused on geomorphological/erosion issues. These reports are therefore less related to LEAP themes, than the more general RHS assessments of river catchments. The level of coverage of issues relating to RHS varies between LEAPs, mainly according to identified biodiversity and land-use pressures. However, the type of data collected by standard RHS survey techniques is thorough in its coverage of general habitat quality and river modifications, so that it can be studied in order to provide a good overview of the state of the river catchment in question.

In some circumstances, RHS has recorded data that conflicts with statements made in the corresponding LEAP report (e.g. River Lune). In these cases, there is a need to identify the most reliable dataset, and the causes of mismatch, perhaps due to local perceptions.

RHS does not survey water quality, which can have an important impact on species and habitat. Water quality is a major issue raised in many of the LEAP Action Plans, primarily from the point of view of human usage and not its adverse effects on biodiversity. However, RHS can be coupled with water quality surveys, to provide a better understanding of the pressures and impacts on a river site. This approach is especially relevant to the EC Water Framework Directive.

6 BEST PRACTICE FOR RHS IN LEAP ASSESSMENTS

The following section discusses the most beneficial approaches to using RHS data in assets management and catchment appraisals, with special regard to LEAP documents. The analysis of the RHS reports included here has highlighted the usefulness of RHS data, especially when combined with other survey techniques. In the reports included here, 'inter-reach' surveys, geomorphological audits, fisheries data and landscape analysis have all been combined with RHS data to varying degrees, in order to provide an overall appraisal of the river or to answer a specific question. In both cases, RHS has proved valuable and complements LEAP documents for each specific catchment.

In situations where RHS surveys have been carried out prior to the formulation of the LEAP Action Plan, RHS has been successfully integrated into management plans and rehabilitation work (e.g. River Ribble). The majority of LEAPs were already at the first annual review stage when this project was commissioned. The best time to implement RHS is during the consultation process where issues are highlighted by the different function representatives. RHS can then be applied to confirm/evaluate the extent of such issues and suggest/prioritise management options.

Complete RHS surveys are best combined with 'inter-reach' surveys, in order to assess catchment wide trends and modifications (e.g. River Nadder), and the geomorphological survey to more rigorously assess deposition and erosion within the catchment (e.g. River Ribble, River Eden and Goldrill Beck). RHS often needs to be coupled with other data, e.g. fisheries or water quality data, if addressing a particular question such as a decline in fisheries habitat (e.g. River Calder). When combined with fisheries data or water quality data (from GQA), the use of RHS is enhanced.

Integration of RHS into a more extensive catchment appraisal, particularly with multi-scale landscape analysis and considerations of public access, can be used to define management strategies based on Focus Areas where watercourses exhibit different characteristics and pressures, e.g. Sankey Natural Assets Register.

RHS and any supplementary data can be combined to identify specific pressures, impacts and opportunities for improvement that can be targeted on either a catchment wide scale or to individual sites. It is in this area that RHS proves its most powerful, especially with regard to the creation of river management plans and specific issues identified within a LEAP Action Plan.

7 CONCLUSIONS

Overall this report has highlighted the usefulness of RHS in LEAP assessments. RHS is a useful tool for LEAPs in that it:

- Can provide a general overview of a quality of rivers within a LEAP area.
- Highlights and supports problems/issues identified within the LEAP area and allows assessments of the scale of the problem.
- Provides focus on where action could be directed, in terms of opportunities for habitat improvements and management strategies.
- Allows monitoring and future appraisal of management strategies.
- Data can be visually represented by mapping in a similar fashion to many LEAPs (for example see Figure 2a (LEAP map) and 2b (RHS data).

Where RHS data had been collected and reported on prior to the finalising of the LEAP Action Plan (e.g. River Ribble), the data showed good agreement with perceived local knowledge, allowing a more quantified approach to the formulation of management strategies. Where RHS data were collected post LEAP Action Plan, the data again usually showed good agreement with issues raised within the Action Plan, after the consultation process. In some cases it provided a more accurate and quantifiable picture of the problems.

Therefore, RHS provides a useful approach which could be used to inform many subjects of LEAP reports, particularly under the recently adopted EA themes of 'An enhanced environment for wildlife', 'Reducing flood risk' and 'Improved and protected inland and coastal waters'. These themes are part of the EA Corporate Strategy for 2002-2007, and will be achieved through national initiatives and Local Contributions, which have largely replaced LEAPs. The findings of this report are equally relevant to the new structure of Local Contributions and can be used to inform environmental overviews and target actions at a range of scales.

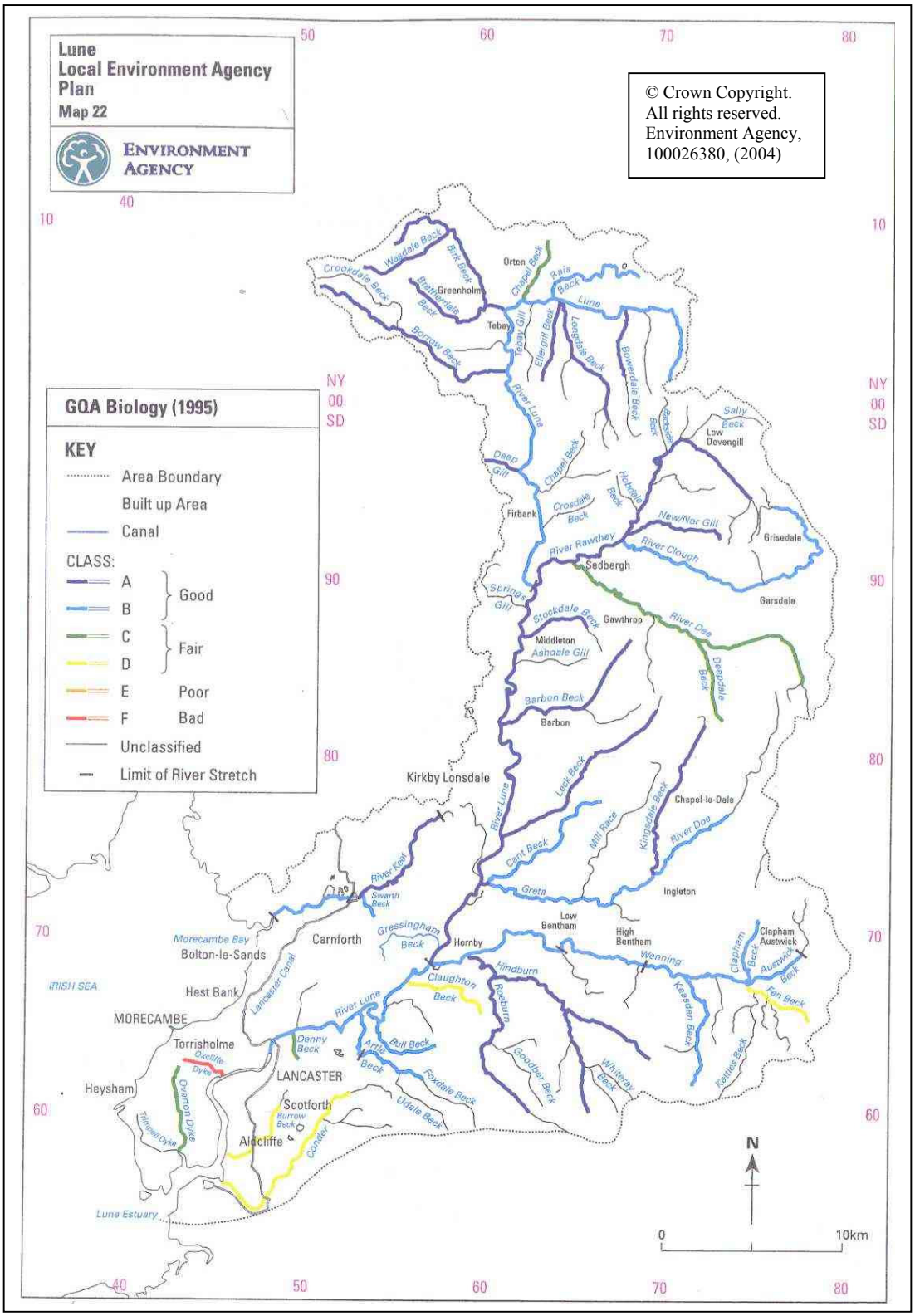

Figure 2a: Biology GQA in Lune catchment (source; Environment Agency, 1998. Lune Local Environment Agency Plan, Action Plan 1998-2003)

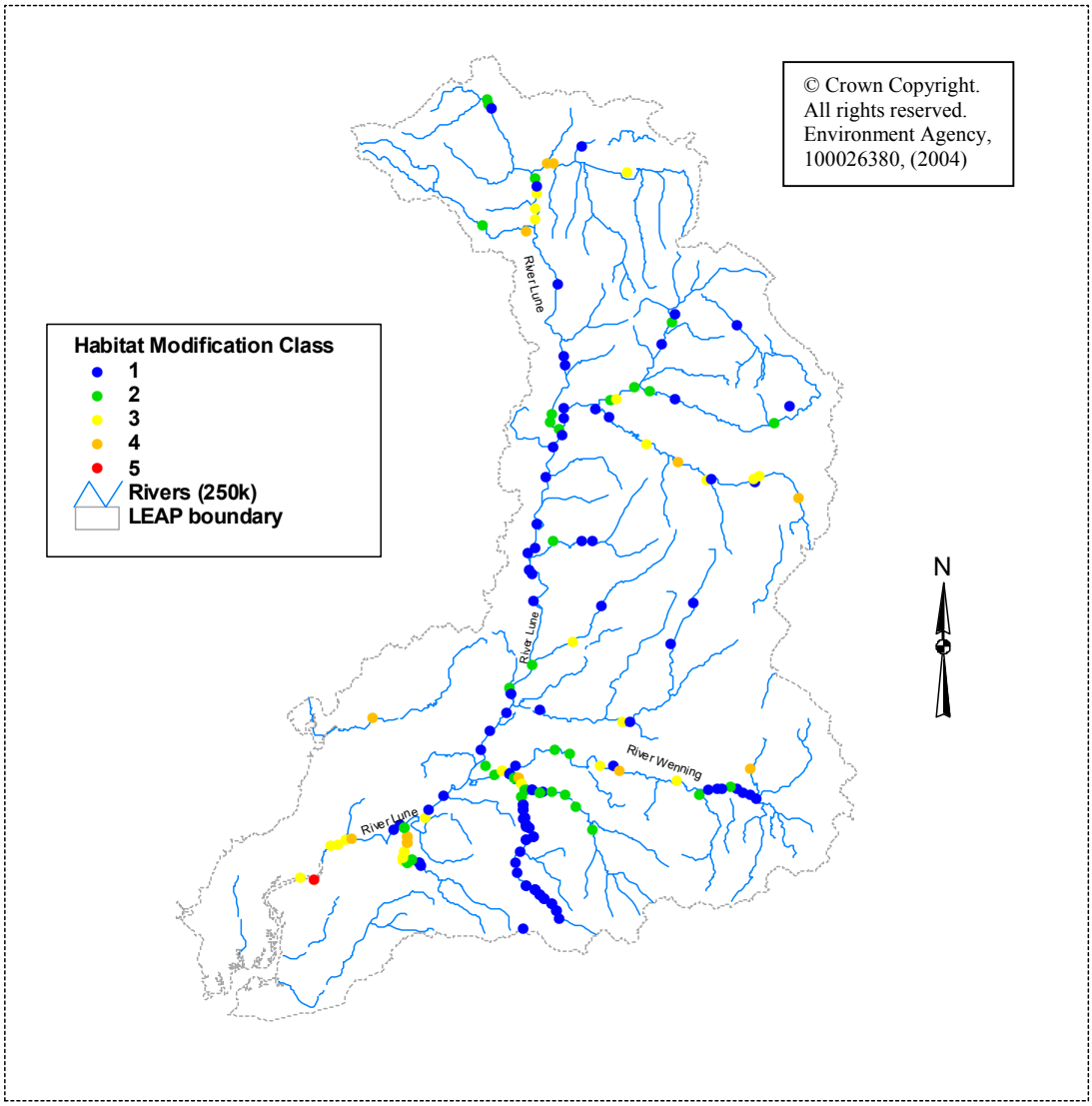

Figure 2b: RHS Habitat Modification Class at all River Lune sites

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