Centre for Ecology & Hydrology

NATURAL ENVIRONMENT RESEARCH COUNCIL

CEH IMPLEMENTATION PLAN

PUBLIC VERSION
2006

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EXECUTIVE SUMMARY

1. The Implementation plan describes how CEH will deliver the Business Plan agreed by NERC Council at its meetings of 1 December 2005 and 8 March 2006.

2. The Plan sets out a vision overview and science plan, and the supporting infrastructure and management structure together with details of the Transition and Integration programme, budgets, and risk management.

3. CEH's vision is to be *the world-leading centre for integrated science in terrestrial and freshwater ecosystems.* To achieve this aspiration we will develop further our interdisciplinary teamworking within and between our core science programmes of biodiversity, biogeochemistry, and water; through our cross-cutting themes of climate change and sustainable economies; and by integrating our data through the environmental informatics programme.

4. The planned restructuring aims to create the best possible facilities for integrated research based on four sites: at Wallingford (the headquarters), Edinburgh, Bangor, and Lancaster. CEH will continue to be inclusive, building on existing partnerships with the top groups worldwide and forging new ones.

5. For the period 2006-2010, science outputs will be delivered through the twelve themes of our first quinquennial (Q1) programme. In addition, the new Ecology and Hydrology Funding Initiative provides a collaborative mechanism for funding Q1-based science initiatives with partners.

6. The following themes/sub-themes themes will be delivered through the Biodiversity programme:
    - Conservation and Restoration of Biodiversity
    - An Integrated Framework for the Sustainable Management of Biological Introductions: Alien Species and Emerging Diseases,
    - The Genetic Basis of Ecological Function
    - Detection and Attribution of Change in UK and European Ecosystems (with the Water programme)
    - Sustainable Monitoring and Management of Land Resources

7. The following themes/sub-themes will be delivered through the Water programme:
    - Water extremes
    - Quantifying processes that link water quality and quantity, biota and physical environment
    - Developing strategic data and knowledge at a catchment scale to enable the wiser management of the water environment
    - Detection and Attribution of Change in UK and European Ecosystems (with the Biodiversity Programme)

8. The following themes/sub-themes will be delivered through the Biogeochemistry programme:
    - Measuring and modelling trace gas, aerosol and carbon

- Recovery from acidification and eutrophication
- Quantifying the growing threat to plant and human health from ground level ozone
- Land-surface Feedbacks in the Climate System
- Sustainable Monitoring, Risk Assessment and Management of Chemicals

9. The Environmental Informatics programme is a single theme that provides a unified framework for information management within CEH, implementing standards in line with the NERC Science Information Strategy, and embracing emerging technologies such as the NERC Data Grid and the Semantic Web.

10. The science will be supported by a fit for purpose infrastructure comprising the Director's Office, Resource and Operations, and Knowledge Transfer. Most of these functions will be based at the Wallingford site with appropriate support at other sites for finance, computing, and facilities management.

11. Resources and Operations will be delivered through four sections:
    - Finance
    - People & Skills
    - Site facilities Management
    - Computer Support

12. The new Knowledge Transfer section will cover Information Services, Data Licensing & Intellectual Property Rights, and Business Development including public relations and press.

13. Transition and Integration is being delivered as a programme using PRINCE2 project management methodology, with a budget of £43.7M.

14. Implementation of the Business Plan will take approximately four years during which CEH will reduce from 600 full time equivalent (FTE) staff to around 450 FTEs within an operating budget of £16.3M core science budget and £12.4M commissioned research.[1]

[1] Budget at October 2004 prices

SECTION 1 – Vision overview

Implementation of the CEH Business Plan will take approximately 4 years starting from 1 April 2006. This section describes our aspirations for the future, building on all the positive work we have already done in changing CEH to a more joined-up science-led organisation. Our vision is to be ***the world-leading centre for integrated science in terrestrial and freshwater ecosystems***. What does this mean?

The science…
Environment is now a high priority on both political and public agendas. Indeed, there has never been a greater need and urgency for the science we do. The opportunity for CEH to develop the niche for integrated terrestrial and freshwater science is there and we intend to take it. For the next four years we will focus on delivering our first quinquennial (Q1) programme – with biodiversity, biogeochemistry, and water as our core programmes, and climate change and sustainable economies as cross-cutting themes, all under the unifying framework of an environmental informatics programme. We will also develop a new science strategy (our current one 'ends' in 2007) and prepare ourselves for the Q2 programme[2]. Many areas of our science are already internationally renowned. To become a world-leading organisation means developing further our teamwork, crossing disciplinary boundaries, integrating our data, and learning from each other. We have the building blocks in place. By joining up research areas to add value, fusing datasets and making them readily accessible, and working with the best partners, we can become a world-leading organisation. Environment is now a high priority on both political and public agendas. Indeed, there has never been a greater need and urgency for the science we do. The opportunity for CEH to develop the niche for integrated terrestrial and freshwater science is there and we intend to take it.

Values…
The vision also means establishing a set of common values that we all work to. The greatest asset of CEH is our dedicated, high quality staff, both in science and in the supporting infrastructure. Currently there is a lot of uncertainty about the future. We are working hard to remove the uncertainty as quickly as possible. We want to move forward and become a research centre that everyone enjoys working for; an open and transparent organisation in which everyone feels valued and trusts each other; a centre that supports and attracts the best people at all levels and provides excellent career development for staff.

Structures…
The planned restructuring aims to create the best possible facilities for integrated research based on four sites. As always, CEH will be inclusive, building on existing partnerships with the best groups worldwide and forging new ones.

[2] Our future science programme may be structured differently from the Q1 programme depending on the outcome of NERC's Funding Allocation and Budgeting (FAB) project.

Our site at **Wallingford** will be the headquarters and the largest of our sites with ~240 full-time equivalent staff (FTEs). There will be five science sections (see section 4) contributing to the water, biodiversity, and biogeochemistry programmes, and to the cross-cutting themes of climate change and sustainable economies. Relocation of many staff from Dorset, Monks Wood and Oxford will create a broader set of disciplines that can interact more easily. The strong local partnerships with BGS and Met Office colleagues based at Wallingford, and with the Universities of Oxford and of Reading, will be strengthened.

Similar opportunities will be built on at **Lancaster**, our second largest site (~100 FTEs) located on the campus of Lancaster University. The three science sections (see section 4) will contribute to the cross-cutting themes of sustainable economies and climate change, and to the water programme. Our contribution to the Lancaster Environment Centre will be greatly strengthened by the introduction of new science areas such as chemicals in the environment from Monks Wood, and applications development in environmental informatics.

In Scotland, we will be based at our **Edinburgh** site (~75 FTEs). Here two sections will contribute to the biogeochemistry, biodiversity and water programmes. As staff join from Banchory and Monks Wood, we expect exciting new developments between programme interfaces such as in the role of biodiversity in biogeochemical cycles. Our strong links with the University of Aberdeen and the Macaulay Institute will continue through our contribution to the Aberdeen Centre for Environmental Sustainability (ACES), with studentships and collaborative projects involving all parts of CEH. Other links will develop such as with the Scottish Crops Research Institute.

In **Bangor** (~30 FTEs) we will have a new ‘green’ building, the Environment Centre Wales, shared with the University of Wales, Bangor. ‘Ecosystem science from catchment to coast’ will be the research focus of the single science section, contributing to all programmes and cross-cutting themes, and with the added skills of staff relocating from other sites.

Our **Headquarters** site, based at Wallingford, will house the offices of CEH Director, Director, Resource and Operations, and the Science Directors of Biodiversity, Biogeochemistry, Environmental Informatics, and Water. Most of the infrastructure support, including the sections for Computer Support, Finance, Knowledge Transfer and Business Development, and People & Skills (see section 3) will also be brought together there. At other sites there will be a member of the central finance team as well as computing support, section support and facilities management staff.

New sections…

One of the important differences of the future CEH from where we stand today will be an Environmental Informatics section that embraces all CEH (see section 2). This section will provide the platform for transforming access to data and

informatics tools within CEH, enabling datasets to be combined in novel ways to explore new research areas.

Another difference from today will be a Knowledge Transfer section that brings together Business Development, Data Licensing and Intellectual Property Rights, Information Services, and Public Relations (see section 3). Having these functions integrated in one section will enable us to be more proactive and strategic in all aspects of knowledge transfer, from identifying funding opportunities to promoting our activities.

Insights…

Hopefully this overview of our vision gives some insights into what it will be like working for the future CEH. It will be largely the same organisation, but a stronger, more focused research centre, with a worldwide reputation for innovative, relevant science. Getting there will be hard at times, but we aim to be a CEH that people enjoy working for and a CEH that helps improve the environment in which we live.

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SECTION 2 – Science

2.1. Background

The vision of CEH is to be *the world-leading centre for integrated science in terrestrial and freshwater ecosystems*. CEH is uniquely able to direct its resources towards tackling complex environmental problems and issues, and transferring knowledge to stakeholders. In this respect it is distinguished from all other UK-based environmental science organisations, as a world-leading centre for:

- detecting environmental change;
- attributing the cause of change to environmental factors and, in partnership with others, to social and economic drivers;
- producing solutions to environmental management problems that are based on a sound knowledge of ecological and hydrological processes.

Our Science Programme (Q1), 2006 – 2010, makes full use of CEH expertise, monitoring networks, facilities and data to provide unique input to the UK science base and knowledge transfer in support of UK policy and legislation, quality of life and industry. The science Programme provides fundamental input to the NERC and CEH Science Strategies focussing on major scientific challenges and the needs of government and industry. The objectives of our Science Programme necessarily stretch beyond these existing science strategies, however, to further enhance our capabilities in the prediction of environmental change and the development of solutions to mitigate and prevent change.

The Programme will be delivered under the new structure of CEH and takes full advantage of the improved scientific synergies that will ensue from the amalgamation of staff into the reshaped CEH. The basis of the Programme is our fundamental monitoring, data management, interdependent research and development activities. These are maintained and enhanced in line with stakeholder requirements. External customer funding will in many areas provide the opportunity for the extension of our research activities and enable us to add value to the core monitoring and observation activity. Many of the Programme deliverables will be achieved in partnership with national and international universities and research institutes.

CEH Science is organised within 3 core (discipline based) Programmes with 1 over-arching Environmental Informatics Programme. CEH science capabilities, however, are beyond discipline based activity. By maximising scientific flexibility and synergies within the Programmes CEH will address key environmental issues that cross disciplines and boundaries (physical and scientific); coordinate and facilitate large scale monitoring, survey and experimental investigation; and optimise the availability of our data to the scientific community as a whole.

Science outputs will be delivered through our Themes which form the basis of the Science Programmes. Some over-arching and integrating science activities in the areas of climate change impacts, for example, will be delivered through the Ecology and Hydrology Funding Initiative in collaboration with partners.

CEH science tackling interdisciplinary problems

Example 1; Ecological Status of Freshwaters

Successful implementation of the Water Framework Directive will require us to tackle significant scientific issues. Specifying reference conditions and defining good ecological and chemical status are examples of issues that will be investigated within the core Science Programmes. Beyond this, the assessment and analysis of pressures and impacts and the development of catchment management plans will require the integration of land use, soil, ecological and hydrological sciences and the 'joined-up' outputs of the Biogeochemistry, Biodiversity, Water and Environmental Informatics Programmes.

Example 2; Global climate change

The global carbon cycle, and in particular the emission and sequestration of carbon dioxide (the crucial greenhouse gas), is closely coupled to the biogeochemical cycling of nitrogen and the water cycle. The nitrogen cycle is even more perturbed than the carbon cycle, with two thirds of the fixed nitrogen entering the atmosphere resulting from human activity. The sequestration of CO_2 by vegetation, for example, is strongly influenced by the supply of nitrogen and water. Appropriate representation of these cycles and their interactions at microbial to landscape scales in Global Climate Models is essential to quantify feedbacks, most of which are currently excluded from assessments of effects of the radiative forcing of global climate. They are also needed for accurate scenario assessment (e.g. under the Kyoto Protocol). The dynamics of these processes are a focus of the biogeochemistry, water and biodiversity Science Programmes. Uniquely, by combining the work in all programmes we can make a significant contribution to global climate change research through integration and large scale understanding.

Example 3; Catchment to coast observatories

The goal of an integrated understanding of the whole catchment system, including land surface, surface-water, groundwater, estuaries and the coastal zone, remains elusive. Scientific effort both within and outside CEH has been targeted at individual components (or domains) within the catchment system. CEH, however, possesses the unique capability to bring together existing understanding of these domains, through combination of datasets and models. We will establish and coordinate 'catchment to coast' initiatives in England, Scotland and Wales. Working closely with other partners and stakeholders we will create linkages that will inform "integrated" catchment management.

Example 4; Sustainable Land-Use Change

The UK is dependant on its terrestrial and freshwater habitats and ecosystems to provide living, transport and recreational space as well as meeting our food, water, energy and mineral needs. CEH contributes to an extensive range of science monitoring and research activities to ensure that these competing needs can be met with minimal impact on UK flora and fauna, water quality & flood risk and chemical and environmental damage. For example, the Countryside Survey (CS2007), sponsored by a range of Government agencies but conducted by CEH, measures the way physical and biological aspects of the countryside are changing in the face of both natural pressures and those caused by human activity from the local to the national scale. Integrating these data with detailed analysis and experiments enables us to identify ways of conserving our terrestrial resources in line with UK, European and Global policy and in the management of conflicts that arise between the many users of our natural resources.

Example 5; Drivers of Biodiversity Loss and Change

There is now clear evidence of human-induced global warming, primarily through the emission of greenhouse gases such as carbon dioxide and methane. Further climate change seems inevitable, with a likelihood of more rapid change in the future. Reliable guidance on future climate change and how it interacts with other drivers of biodiversity change, such as pollution and changing land use, is now urgently required to inform policy decisions on adaptation and mitigation. CEH research will contribute to reducing the uncertainties by monitoring climate change impacts on ecosystems and by improving the modelling of land-surface feedbacks within climate models. The UK, in part through CEH, holds some of the best database records of species numbers, distributions, and seasonal behaviour (phenology) are changing and have changed in the past. These database resources, combined with our research capabilities, allow us to tease apart the relative contributions that different drivers make to the observed changes in UK biodiversity and to address current and future questions related to the effects of environmental change on the structure, function and management of ecosystems. Working in multi-agency programmes in the UK and Europe, we will provide quantitative estimates of the dynamics of ecosystem change in response to multiple pressures. These ongoing long term assessments of the stability and resilience of ecosystems will enable us to test models being developed to forecast and manage our future world.

Example 6; Environment and Health

CEH science has traditionally been used to evaluate changes to the natural world, but there is now a growing trend to use our science to underpin the links between the natural environment and human health. Direct links include strategies to monitor and reduce exposure to pollutants, including ozone or particulates in the atmosphere and nitrate in drinking water, pathogens such as cryptosporidia in drinking water or mycobacteria in soils and the control of biting insects such as Blandford fly as well as other insect vectors of disease. Indirect effects on human health include those arising from climate change such as

mosquito problems in south east England, and more liver flukes from increased growth of aquatic plants. CEH also provides expertise in risk assessment and risk perception. As human activity, travel, climate and land use change all impact our environment the risk from invasive species and the threat of emerging disease increase. Understanding and predicting the routes of invasion are key objectives for assessing health risks to humans. Our input and knowledge of the ecology of disease vectors and non-human hosts and the epidemiology of diseases allow policy makers and the public to make informed decisions on the links between human health and the environment.

Example 7: An integrated data portal

CEH manages significant datasets arising from long-term survey and monitoring work, as well as the outputs of its science programme delivery. The development of a new portal will provide CEH scientists with the ability to find and work with information relating to digital, paper and object resources in a fully-integrated manner. Provision of GIS and other analytical tools will allow datasets to be combined, presented, manipulated and interpreted according to the needs of the science. External users will also have controlled access to CEH data holdings, and opportunities will be explored for online licensing and supply of data.

2.2 Centralised Facilities

Under the new structure, chemistry and engineering facilities will be centralised to one location. Inorganic/organic chemistry, radiochemistry and the Stable Isotope Facility (SIF) will be focused at Lancaster with all analytical staff grouped into a single Section. As far as possible, all samples requiring routine analysis will be transported to Lancaster, following local stabilisation/extraction if appropriate.
A single workshop facility will be located at Wallingford to service the engineering needs of the organisation. In addition a central facility for physical archives will be established at Lancaster. Library facilities will remain distributed at each of the 4 sites.

2.3 Programme Structure

Biodiversity Programme

Biodiversity is threatened by physical change (land use, habitat degradation & fragmentation, over-exploitation, pollution and climate change) and biological change (invasive species and emerging disease). This research programme aims to understand how biodiversity influences ecosystem function and, in turn, how ecosystems habitats, species, populations and genes are threatened by global change. Greater understanding will enable us to determine the consequences of biodiversity loss, mitigate threats to biodiversity loss and ensure a sustainable environment. Implementation of the Convention of Biological Diversity (CBD), including the UK Biodiversity Action Plan (BAP), and a raft of EU legislation (e.g. Birds, Habitats, Water and the proposed Soils Framework Directives plus the Common Agricultural Policy) means that an increasingly wider stakeholder community are required to assess and minimise the impacts of their activities on biodiversity and ecosystem function. CEH is ideally positioned to provide research-based advice to these stakeholders to meet their legislative responsibilities. The Programme comprises 3 Themes and 1 element of each of the Climate Change and Sustainable Economies cross-cutting Themes with sub-themes and key objectives detailed below.

Theme BD01 – Conservation and Restoration of Biodiversity - *aims to determine the baseline patterns of organism distributions, monitoring how these are changing through time and experimentally verifying and quantifying the causes and consequences of change.*

BD01.1 Distributions and abundance of taxa

- Provision of a world class repository to monitor the changing status of UK biodiversity
- Develop new automated systems for data entry, checking and credibility
- Improved linkage of biological records to environmental data
- Enhanced quality and quantity of volunteer recording and its dissemination through the National Biodiversity Network (NBN).

BD01.2 Trends and drivers of change among taxa

- Advance the range of UK & EU headline indicators of Biodiversity change
- Develop and improve methods for monitoring quality of habitats and ecosystems.
- Identify the drivers of the changing distributions and abundances of taxa
- Develop understanding of the impact of single and multiple drivers on biodiversity

BD01.3 Population and community processes

- Determine long-term dynamics of major taxonomic and functional groups by investigating population processes

- Develop models to describe dynamics and predict consequences of environmental change
- Understand abiotic, biotic and colonisation processes that allow communities to establish and persist

BD01.4 Management of species and ecosystems

- Assessment of the attributes and functions of restored vs natural systems
- Investigation of how stable/resilient restored systems are to environmental perturbation
- Develop and implement sustainable solutions for the conservation of threatened habitats and species
- Establish long term distributed experiments across UK gradients

Theme BD02 - An Integrated Framework for the Sustainable Management of Biological Introductions: Alien Species and Emerging Diseases - *aims to provide insights into the diverse processes by which organisms and/or their genes expand their natural habitat range.*

BD02.1 Pathways of entry and traits of successful biological introductions

- Characterise the genetic structure of invasive species at different scales
- Investigate host/population characteristics affecting pathogen transmission
- Discriminate between the relative importance of pathways vs traits
- Develop monitoring/indicator frameworks for biological invasions
- Test robustness of existing risk assessment tools and develop spati-temporal models for invasions by a range of taxa

BD02.2 Species and ecosystem vulnerability to invasions

- Develop epidemiological models of invasion for both host-pathogen and invader-habitat relationships
- Develop molecular techniques to understand species vulnerability to pathogens and their distribution in the environment (esp. cryptic infections)
- Describe the local (habitat) and regional (landscape) factors determining ecosystem vulnerability to invasions

BD02.3 Drivers, impacts and management of invasions

- Risk assessments of invasives' impact on above and below ground diversity of native species, ecosystem services and functions
- Assessment of the relative effectiveness of existing approaches to quantify ecosystem impacts of invasives
- Experimental assessment the role of environmental drivers on invasive species performance
- Production of risk indices that combine both the range and abundance of the biosecurity threat in relation to the habitats where it might occur

Theme BD03 - The Genetic Basis of Ecological Function – *aims to develop and implement molecular monitoring tools to understand population processes and diversity.*

BD03.1 Molecular ecology

- Develop and exploit molecular approaches to characterise ecosystem function, e.g. identify niche-responsive genes
- UK distribution and variation in soil microbial diversity and function
- Develop links between above and below ground diversity
- Develop novel molecular taxonomic markers, data bases and systems for environmental monitoring

BD03.2 Ecology of host parasite interactions

- Tests of the links between host-parasite interactions and trade-offs in natural populations
- Develop novel markers to investigate disease incidence, distribution and impact in natural environments
- Develop monitoring tools to assess functional traits and their genetic variation in natural and invasive species

BD03.3 Molecular evolution and bioinformatics

- Advance molecular assessment and taxonomy to assess and predict population processes and diversity
- Provide data systems for capture and storage of environmental metadata
- Enhance understanding of the genetic basis of evolution and adaptation

Theme CC01A - Detection and Attribution of Change in UK and European Ecosystems - *aims to maintain CEH long-term monitoring and attribute causes to observed trends.*

CC01.1 Environmental Change Network (ECN)

- Co-ordination and development of extended UK and European LTER Networks
- Continuance of central ECN (UK) survey and database
- Assessment of the relative effects of natural and anthropogenic pressures on terrestrial ecosystems

CC01.3 UK Phenology Network

- Assessment of the relative effects of natural and anthropogenic pressures on phenological processes
- Development of UK Phenological Observatory linking Earth Observation and in situ measurements

CC01.4 Isle of May Long-Term Study

- Collaboration and data integration to resolve the trophic interactions affecting sea bird population dynamics

- Data-based assessments of the relative effects of natural and anthropogenic pressures on coastal ecosystems

<u>Theme SE01A – Sustainable Monitoring and Management of Land Resources</u> - *aims to advance knowledge of the stock of, and change in, land-related natural resources and provide policy-relevant advice on land management actions.*

SE01.1 An Improved Land Cover Map (LCM)

- Produce a new LCM, integrated with OS Master Map
- Enhanced knowledge of the structure of key habitats and provision of associated ecosystem services (e.g biodiversity)
- Data management of satellite imagery for land cover

SE01.2 Countryside Survey 2007

- Integrated assessment of ecosystem services (e.g. soils: Millennium Ecosystem Assessment)
- New data management and access tools for the whole NERC community

SE01.3 Land Use Change

- Prescriptions for sustainable rural land management under CAP reform
- Initial assessments of the UK capacity for renewable energy production
- Assessment of biofuel crop impacts on biodiversity

Water Programme

Water is essential to Earth's life support systems. Identifying the processes governing water quantity and quality is critical to maintaining healthy freshwaters with respect to ecology, adequate water supplies, reducing risk of flooding and supporting sustainable sources of energy. The Programme comprises 3 themes with sub-themes and key objectives as detailed below.

Theme WA01 – Water extremes - aims *to advance knowledge of extreme water regimes and to develop methods for their prediction, including risk assessment*.

WA01.1 New methodologies to quantify floods, flows and droughts

- Flood and drought risk assessment on a spatially consistent basis
- Assessment of land management/development impacts on extremes
- New approaches for flood and drought forecasting over a range of timescales

WA01.2 New methodologies to solve the ungauged site problem

- Parameter-sparse methods for ungauged site river flows
- Enhanced process representation in modelling capabilities in data-sparse conditions

WA01.3 Quantification of uncertainties, trends and risk of extremes

- Attribution of trends in floods and droughts
- Probabilistic expression of future risk under stationary and non-stationary conditions

WA01.4 Ecological responses to extremes

- Understanding impacts of water extremes on freshwater habitats and populations
- Assessment of ecological thresholds

WA02 - Quantifying processes that link water quality and quantity, biota and physical environment - aims *to measure, model and predict hydrological, sediment and chemical fluxes in water, their impact on the biota and reciprocal interactions among components of freshwater ecosystems*.

WA02.1 Hydrological processes

- Development of new techniques for estimating water fluxes in lowlands at different scales
- Monitoring, modelling and prediction of hydro-ecological processes for characterisation and management of wetland functioning
- Development of new models of water movement within the hyporheic zone

WA02.2 Hydrochemical and sediment processes

- Quantification of sediment and hydrochemical (P, micro-organics) fluxes to rivers and lakes
- Source attribution of sediment, P and micro-organics within catchments

WA02.3 Physico-chemical processes and effects on freshwater biota

- Development of new techniques to measure and predict ecological response in lakes and rivers to physical and chemical perturbation
- Development of a mechanistic understanding of how biological responses control ecological distribution
- Development of process understanding in order to model and forecast the rate and extent of ecological recovery

WA02.4 Biological interactions

- Understand the importance of genetic and taxonomic diversity in controlling ecosystem function in freshwaters
- Determine the importance of trophic interactions in freshwater ecosystems and assess the potential for managing freshwater systems by biomanipulation
- Assess the importance of bottlenecks in the development of viable populations of freshwater biota

Theme WA03 - Developing strategic data and knowledge at a catchment scale to enable the wiser management of the water environment - *aims to deliver systems, tools and methodologies that integrate data, science understanding and analytical methods to support catchment science and management*.

Development and operation of the freshwaters data collections

- Maintenance of operational National River Flow Archive (NRFA)
- Up-graded National Invertebrate Database
- Enhanced NRFA functionality with quality and ecological data

Long term monitoring

- Maintenance of long-term hydrochemical and ecological monitoring at key sites
- Establishment of new catchment-to-coast observatories

Catchment scale modelling and assessment

- Assessing the magnitude and variability of flows, and fluxes of nutrients and pollutants, to the coastal zone
- Large scale applications of tools for policy support

<u>Theme CC01A - Detection and Attribution of Change in UK and European Ecosystems</u> *- aims to maintain CEH long-term monitoring and attribute causes to observed trends.*

CC01.2 Lake Ecosystems

- Maintenance of Lake Ecosystems database
- Data-based assessments of the relative effects of natural and anthropogenic pressures on lake ecosystems

Biogeochemistry Programme

The overall objective of the programme is to identify the cause of changes in atmospheric composition, the ecological effects of pollutants and cost-effective control measures. Closely related components of the science of the Climate Change and Sustainable economies programmes are included within this programme including the partitioning of water and energy fluxes over terrestrial surfaces for Climate Change and the ecotoxicology of air and soil contaminants. The Programme comprises 3 Biogeochemistry Themes together with 1 element from each of the climate Change and Sustainable cross-cutting Themes with sub-themes and key objectives as detailed below.

Theme BG01 - Measuring and modelling trace gas, aerosol and carbon – *aims to quantify emissions, atmospheric processing and deposition of major pollutants and simulate their pathways through the environment using process based models.*

BG01.1 UK nitrogen and sulphur compounds

- Maintaining UK concentration and flux networks
- Provision of UK budgets, maps and trends
- Development and application of Long Range Transport Models
- Synthesis and interpretation of UK and European air chemistry data to identify the responses to controls on emissions.

BG01.2 Carbon

- Assessment of carbon budgets at catchment scale
- Development of dynamic model of carbon biogeochemistry
- Compilation, validation and assessment of UK Greenhouse Gas Inventory

BG01.3 Nitroeurope NEU advanced flux network, fluxes pools and budgets

- Inferential N fluxes and C interactions
- Landscape verification of N fluxes
- Dynamic modelling of nitrogen biogeochemistry
- Uncertainty assessment of European N and GHG emissions
- Field and European scale modelling of N and C fluxes

BG01.4 Metals

- Maintain a UK network of aerosol and precipitation samplers to quantify the fate of metals emitted in the UK.
- Provision of UK budgets of 30+ metals in precipitation and air.
- Identify the sources and sinks of UK metal emissions.
- Provide policy advice and mitigation options based on the field measurements and application of long range transport models.

BG01.5 Aerosols

- Measurement of the composition, and quantification of the emission and deposition fluxes of aerosols, both natural and anthropogenic, and their precursors

Theme BG02 - Recovery from acidification and eutrophication - *aims to quantify impacts of nitrogen deposition and acidification in the UK on terrestrial ecosystems, the trends with time and provide policy support to Defra, United Nations Economic Commission for Europe (UNECE) and the European Commission.*

BG02.1 Linking Nitrogen Deposition and Biodiversity

- Identify effects, thresholds and critical load functions for nitrogen effects on semi-natural vegetation in the UK using a combination of long term, large scale field experiments at UK sites (Pennines, Scottish Borders) and survey data including Countryside Survey.
- Quantify the effects of N deposition in the UK on semi-natural plant communities, soils and freshwaters.

BG02.2 Critical Loads

- Assess recovery to date of UK ecosystems from acid deposition and eutrophication from observations.
- Apply dynamic models of nitrogen biogeochemistry to assess the effects of future deposition patterns on terrestrial ecosystems and prospects for recovery.

Theme BG03 - Quantifying the growing threat to plant and human health from ground level ozone – *aims to quantify the effects of ozone on semi-natural ecosystems in the UK and the interactions with climate change.*

BG03.1 Field Studies of Ozone Effects on Semi-Natural Vegetation

- Assess the effects of ozone on semi-natural vegetation from a combination of large scale, long term field studies using field fumigation techniques and solardomes.
- Quantify the current and future responses of vegetation to ozone.
- Management of International Convention on Pollution (ICP) Impacts of Air Pollution on Vegetation Programme

BG03.2 Measuring and Modelling Ozone Exchange and effects at country scales

- Quantify the deposition of ozone on vegetation using field measurements of fluxes by micrometeorology
- Modelling of ozone fluxes and up-scaling to the UK

Theme CC01B. Land-surface Feedbacks in the Climate System - *aims to quantify land-surface feedbacks in the climate system through energy, water and carbon cycle feedbacks, and improve the representation of the key processes in land-surface and Earth System models.*

CC01.5 Datasets for land-surface science

- Gridded estimates of fluxes across W. Africa
- Global and regional datasets for forcing and validation of JULES
- Datasets of forest fires and other disturbances from remote-sensing
- Datasets of vegetation phenology from remote-sensing

CC01.6 Development of the Joint Unified Land Exchange Scheme (JULES) land-surface model

- Coordination of JULES community activity
- Modularisation, code maintenance and development of interfaces to Earth System Models
- Improved treatment of hydrological and soil biogeochemical processes
- Incorporation of interactive nitrogen cycling

CC01.7 Land carbon cycle feedbacks on climate change

- Coupled land carbon cycle-climate modelling including uncertainty analysis
- Assessment of sensitivity of Tropical and Boreal forests to climate change

CC01.8 Land-surface feedbacks through energy and water cycles

- Quantification of feedbacks between the water and energy exchange at the landscape scale and the response to expected changes in climate.
- Assessment of the impact of improved land-surface descriptions on the simulation of water energy and carbon exchange in Africa.

Theme SE01B - Sustainable Monitoring, Risk Assessment and Management of Chemicals – *aims to advance knowledge of the movement and effects of chemicals in food chains and provide policy-relevant advice on chemical risk assessment and management.*

SE01.4 Monitoring and predicting the distribution of chemicals in terrestrial and freshwater ecosystems

- Delivery of Predatory Bird Monitoring Scheme
- Detection and attribution of trends in old and new chemical problems
- Prediction of the spatial distribution of chemicals in the UK
- Assessment of estimated risk from known effects data
- Development of new informatics tools for data management and interrogation

SE01.5 Exposure, Effects and Risks of chemicals

- New models to estimate bioavailability and predict foodchain transfer
- Predicting mixture effects

SE01.6 Management, Mitigation and Remediation

- Reducing exposure to toxic chemicals
- Solutions for land remediation and waste management
- Assessment of remediation potential

Environmental Informatics Programme

The information developed through CEH's long-term monitoring and survey activities and research, requires the provision of appropriate tools for data analysis, integration, distribution and presentation. Information also requires long-term curation to enable it to form the basis of future research, both within CEH and the broader scientific community. The Environmental Informatics Programme will provide a unified framework for information management within CEH, raising standards in line with the NERC Science Information Strategy and embracing emerging technologies, such as the NERC Data Grid and the Semantic Web. Where new infrastructure is required, EIP will work in partnership with others to develop systems of benefit to the broader NERC and natural environment community. The Programme comprises 1 Theme (EI01) with sub-themes and key objectives as detailed below.

EI01.1 An integrated framework for the long-term management of CEH's environmental data

- Establishment of a unified Environmental Information Centre
- Provision of data management expertise and support in the form of data-standards and data-modelling expertise from the EIC and scientific information systems development.
- Provision of appropriate data storage facilities (with CCS)
- Development of CEH contribution to NERC Data GRID (with CCS)

EI01.2 Data archaeology and capture of corporate knowledge

- Provision of metadata management systems
- Provision of resource-discovery tools

EI01.3 A secure environment for the curation of CEH's physical archives, integrated with CEH digital data archives

- Review of CEH physical collections and provision of appropriate storage facilities
- Expansion of remit and skills base of CEH library team to facilitate the management of physical archives
- Establishment of policies and guidelines for management of archives within CEH projects

EI01.4 A defined commercial policy for exploitation of CEH data holdings

- Establishment of CEH Data Licensing Team
- Provision of clear flow-lines for data and license provision
- Development of standard licensing terms for provision of CEH data products
- Exploration of use of eCommerce solutions for provision of CEH data

EI01.5 A geospatial gateway providing comprehensive access to CEH spatial and temporal data

- Provision of CEH-wide tools for temporal/geospatial integration of CEH data assets

- Provision of web-based tools for use of CEH data holdings by third parties

EI01.6 Evaluation and/or development of domain ontologies for semantic integration of environmental data

- Participation in projects/consortia to develop/adapt domain ontologies for semantic integration
- Development of tools for ontology/reference data development and distribution, combined with tools for data mapping and integration

EI01.7 The support and development of CEH corporate and science project Web sites and implementation of Web standards for these sites

- Provision of support and development of corporate Web sites .
- Development of Web standards for corporate and science based web sites. Apply these standards to existing project based web sites.
- Provision and maintenance of Web interfaces to CEH science data and information systems system
- Provision of support and development of science project Web sites.
- Ensure that corporate standards are applied consistently to all CEH sites

EI01.8 Provision of an integrated reference service linking CEH library, archives, samples and digital data as an institutional repository

- Maintainance and development of the CEH Library Service
- Creation of an institutional repository for management of CEH reference materials
- Development of tools and methods to allow referencing of data and materials held within the CEH institutional repository

2.4 Key Monitoring Activities

Biological Records Centre 40+ years UK species distribution records

- 40+ years working with voluntary societies for data acquisition
- 40+ years mapping change in UK species distributions
- Stakeholder and user data bases on the changing status of UK biodiversity

UK Phenology Network

- 8+ years phenological records
- Continue to recruit new recorders to expand records
- Continue to preserve & incorporate historical data records

Invasive species

- Monitoring of non-native species to identify pathways of entry and patterns of spread
- 10+ years commercially important invasive species records

Land Cover Map

- 15+ years satellite data & analysis of change in land use

MOORCO (Linking above and below ground biodiversity in moorland ecosystems. With Macaulay Institute)

- 25+ years records development of woodland in moorland ecosystems
- 15+ years records experimental manipulations

Dorset Heathland

- 10-30+ years rare & BAP species (smooth snake, Dartford warbler, insects, Marsh gentian) records
- 30+ years toad breeding records
- 7-40 years conservation & restoration records

Restoration projects

- 10+ years heathland restoration for BAP species records
- 10-30 years calcareous grassland restoration for BAP species records
- 15 years landscape scale restoration records (inc BAP species)
- 10+ years salt marsh restoration
- 10+ years manipulative experimental data for grazing impacts & nutrient inputs across a range of habitat types

ECN Moor House, Wytham and Cairngorms

- 7+ years climate & atmospheric variables
- 7+ years surface water chemistry & soil attributes
- 7+ land use/site management and ecology

Isle of May seabirds

- Continue 33+ years of breeding records for 5 seabird species
- Continue 33+ years of food quality records

NERC Environmental Bioinformatics Centre

- Extend and coordinate UK and International metadata facility for genomics, bioinformatics and ecological information systems

Countryside Survey 2007

- 20+ years extended time series monitoring and survey of the State of the UK Environment.
- Integrated Ecosystem Assessments to provide measurement of trends in ecosystem resources and services to assess progress in sustainable management including evaluation of soil function under different land uses
- Stakeholder and user-accessible database

Plynlimon catchments

- Continue 35+ year flow record at main outflows
- Continue 35+ year record at key raingauges and AWSs
- Continue 30+ year stream chemistry record at key sites

River Frome, Bere stream and Tadnoll Brook

- Continue 40+ year water chemistry record

Long-term monitoring of Loch Leven, Scotland

- Continue 38+ year water chemistry record
- Continue 38+ year ecological record

Lowland agricultural (Pang and Lambourn) catchments

- Maintain key flow, chemistry, recharge and atmosphere flux sites
- Maintain 40+ year record from Wallingford meteorological station

The Cumbrian Lakes Database

- Continue 60+ year physico-chemical record
- Continue 60+ year phytoplankton, zooplankton and fish records

Scottish (Tay) catchment to coast observatory

- Establish new monitoring platforms in conjunction with partners

English (Ribble) catchment to coast observatory

- Establish new monitoring platforms in conjunction with partners

Welsh (Conwy) catchment to coast observatory

- Establish new monitoring platforms in conjunction with partners

Nitrogen deposition

- Continue to provide estimates of nitrogen deposition in the UK at 5 km x 5 km scale, including UK budgets
- Continue monitoring NH_3, aerosol and cloud NH_4^+, NO_3^-, gaseous HNO_3 at a UK network of rural stations.

Heavy Metals

- Monitor 27 metals in precipitation and aerosols at 15 UK rural sites,

Acid deposition monitoring

- Continue to monitor the long term trends in concentrations and deposition of all ions contributing to acidification in the UK. The programme includes gaseous monitoring of acid gases and wet and cloud deposition.

Predatory Bird Monitoring scheme

- Continue 90+ analysis of raptors for a range of pesticides, rodenticides and mercury.

Carbon flux monitoring

- Monitor the carbon fluxes into and out of Auchencorth Moss and Moor House catchments

European Super Site (Edinburgh based)

- Operate one of 2 supersites in the UK to monitor the concentration and composition of trace gases, aerosols and precipitation in compliance with EMEP Protocols, including SO_2, NO_x, O_3, NH_3, HNO_3, HCl, VOCs, carbonyls, Hg, Heavy metals in aerosols and precipitation, major ions in aerosols and precipitation, aerosol mass (including black carbon).

Ozone monitoring

- Continue operation of UK rural ozone network sites at Edinburgh and Auchencorth
- Continue ozone flux monitoring at rural sites at Easter Bush and Auchencorth
- ICP Vegetation Programme – monitoring impacts of ozone on crops and natural vegetation

Nitrogen enrichment of catchments

- Low level monitoring of N enrichment of 3 long term catchments in Wales (Plynlimon, Beddgelert and Lly Llagi)

Recovery of catchments from acidification

- Low level monitoring of sites and associated research of Acid Waters Monitoring Network sites (in collaboration with UCL).

2.5 Key Datasets

Key datasets managed within the science programmes including

- National River Flow Archive
- Environmental Change Network
- Biological Records Centre
- Predatory Bird Monitoring Scheme
- Countryside Survey

Key legacy datasets managed within CEH Designated Data Centres including

- National Water Archive
- Environmental Information Centre

SECTION 3 – INFRASTRUCTURE

1. Our science must be supported with a fit for purpose infrastructure. A crucial driver in agreeing the new CEH shape was the need to make best use of infrastructure resources. This means that less should be spent on buildings and facilities and more on providing direct support to scientists (~330 full time equivalents). The new CEH infrastructure reflects this ethos.

2. CEH will have:-

   - A corporate infrastructure operating common policies and procedures across the organisation

   - professional support to the Executive Board and our science staff to facilitate the best possible science through effective financial, people, facilities and IT management

   - an infrastructure to support a 20-year science plan and beyond

   - effective interaction between science groups and infrastructure staff with the latter having in depth knowledge of their specialist area with the authority and commitment to take issues forward.

3. Infrastructure will be centrally managed with most of the ~120 staff located at our HQ site in Wallingford. It will comprise of Director's Office, Resource & Operations (finance, people & skills, facilities management, computer support, health & safety and quality assurance) and Knowledge Transfer. Professional expertise will be available at Edinburgh, Bangor and Lancaster ensuring closer engagement of functional areas with the scientists and greater understanding of issues across the organisation.

4. The establishment of a dedicated Knowledge Transfer section will strengthen our marketing, business development and information services activities. The proposal will help NERC meet UK Government's expectations for science delivery by Government-funded bodies.

5. The plan for infrastructure takes account of the drive for 'harmonisation of back office activities' across the Research Councils. The Research Councils have agreed to establish, by 2009, a single Shared Service Centre (SSC) focussing primarily on the high transactional areas. By March 2009, it is the intention that the SSC will include the transactions relating to HR, finance, procurement, IT and administrative information systems.

6. It is envisaged that we move to this structure as soon as possible consistent with the operational needs of CEH during the four-year transitional period.

SECTION 4 - MANAGEMENT STRUCTURE

Governance of CEH is via the following groups.

- **Executive Board**
  The Executive Board comprises Director CEH, Science Directors of Biodiversity, Water, Biogeochemistry, and Environmental Informatics, and Director Resource and Operations.

- **Science Board**
  The Science Board comprises Director CEH, and Science Directors of Biodiversity, Water, Biogeochemistry, and Environmental Informatics. Members of the Senior Management Team will be invited to join the Science Board on an *ad hoc* basis.

- **Programme Colleges (PCs), cross-cutting Working Groups (WGs) and Infrastructure Management Team (IMT)**
  There are four Programme Colleges, one each representing Biodiversity, Biogeochemistry, Environmental Informatics and Water. In addition a Climate Change Working Group (CCWG) and a Sustainable Economies Working Group (SEWG) are being established. The Infrastructure Management Team, consisting of the Heads of the Infrastructure Sections and working with the Director Resources and Operations, will be responsible for the overall delivery of corporate infrastructure.

- **Theme Champions and Science Programme Coordinators**
  Themes will be managed and co-ordinated by the Science Directors with the assistance of Science Programme Coordinators and Theme Champions.

- **Sections and Section Heads**

Section Heads are responsible for the leadership and management of around 30±5 staff. Together they will form the Senior Management Team (SMT) and play a significant role in wider CEH management.

Science Sections	**Location**
Environmental Informatics	Lancaster*
Biological Patterns & Predictions	Wallingford
Population and Community Ecology	Wallingford
Land-Atmosphere Interactions	Wallingford
Environmental Hydrology and River Ecology	Wallingford
Hydrological Risks and Resources	Wallingford
Chemicals in the Environment	Lancaster
Integrated Ecosystem Assessment	Lancaster
Atmospheric Sciences	Edinburgh
Ecological Processes	Edinburgh
Ecosystem Science from Catchment to Coast	Bangor

Infrastructure Sections	
Computer Support	Wallingford*
Facilities Management	Wallingford*
Finance	Wallingford*
People & Skills	Wallingford
Knowledge Transfer and Business Development	Wallingford

*These sections have staff based at other sites.

SECTION 5 – BUDGETS

1. In ratifying the CEH business plan on 8 March 2006, Council approved a transition budget of £43.7M to implement the changes to reshape CEH into the four-site model of Wallingford (HQ), Edinburgh, Bangor and Lancaster. The changes will take place over the four-year period ending 31 March 2010.

2. Council also approved an annual Science Budget of approx £20M pa. Against this background, a budget plan has been developed for the period 2006/07-2009/10 and this is shown in table 1.

Table1

CEH Q1 Budget Plan

	Actual	Q1 Budget				Q2
Year	2005/06	2006/07	2007/08	2008/09	2009/10	2010/11
Costs						
Science pay	18.1	18.4	16.6	15.9	14.5	14.5
Science non pay	5.6	5.7	5.9	6.2	7.2	7.3
Science income	(15.4)	(12.5)	(12.0)	(12.0)	(12.5)	(13.6)
sub total	8.3	11.5	10.5	10.1	9.2	8.1
Infra pay	5.3	5.3	5.4	5.7	4.8	4.5
Infra non pay	7.7	7.7	7.7	6.8	6.3	5.8
Infra Income	(0.6)	(0.5)	(0.5)	(0.5)	(0.5)	(0.5)
sub total	12.5	12.5	12.6	12.0	10.6	9.8
Capital	1.5	2.9	2.0	1.5	1.5	1.6
Total	22.2	26.9	25.1	23.7	21.3	19.5
Funding						
Science Budget - Resource	18.8	18.9	18.4	18.1	18.1	18.1
Science Budget - Capital	1.5	2.9	2.0	1.5	1.5	1.4
Transition (part)	2.0	5.1	4.7	4.1	1.7	
Total	22.2	26.9	25.1	23.7	21.3	19.5