MOST WANTED
Postgraduate Skills Needs in the Environment Sector
The Environment Research Funders’ Forum has now merged with the Living with Environmental Change (LWEC) Partnership.
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I welcome this report in which we hear about the skills requirements of the UK environment sector which includes business, government and the research base.

The environment sector is a varied, vibrant and vital part of the UK economy and society. It relies on highly skilled people who, through their knowledge and innovation, ensure that the UK:

- provides international leadership and solutions to the long-term challenges we face;
- continues to attract inward investment of high-value business; and
- becomes a world leader in new areas of growth such as low carbon goods and services.

This report summarises the outputs from the first detailed review of postgraduate and professional skills needs of the environment sector. This work will help us to stop vital skills becoming gaps we cannot fill.

NERC has led the review on behalf of the Environment Research Funders’ Forum (ERFF). It gives us a timely opportunity to examine training and skills plans to ensure that we are producing exceptional and enterprising people to address the challenges we face now and into the future.

We are starting from a robust base. NERC will build on these strong foundations by using the detailed outputs that support this summary report to inform our training decisions. I urge people from across the sector to join us in using this information to ensure we have the right people with the right skills to build a productive economy, a healthy society and a sustainable world.

Professor Alan Thorpe,
NERC Chief Executive

"For skills to have economic impact, they must relate to employers’ priorities"1

1 A Strategy for Sustainable Growth: Department for Business, Innovation and Skills. July 2010
This skills needs review provides a clearer picture of current and future training needs in the environment sector than has existed previously. As such, it forms an ideal framework for universities to review their current provision of postgraduate programmes and develop training opportunities that will attract students.

The information from this review will be of tremendous help in mapping skills needs against current activities and generating ideas for new programmes of study. An important aspect of the review outputs is that they have been prepared following wide consultation, in particular with the employers of people with training in the skills needed in the environment sector. This will hopefully drive closer collaboration between employers of skilled people and those who provide the training. Perhaps, most importantly of all, the review provides evidence to prospective students, who increasingly invest significant time and money in their own skills development, of how training opportunities directly increase their employability.

The work reflected in this summary report is welcome and will undoubtedly be an asset both to the environmental sciences and to the wider training community.

Professor Robert Allison,
Deputy Vice-Chancellor, University of Sussex
EXECUTIVE SUMMARY

OVERVIEW OF THE WORK

This review identifies critical skills gaps in the environment sector over the next ten years. It is the first inventory of the postgraduate and professional skills required in the sector, with the need for each skill clearly explained. The review’s outputs, which include this report, the Skills Framework, and supporting evidence, (all available on the NERC website) provide a point of reference for anyone involved in planning training provision, designing new, or revising existing programmes of study and preparing qualification frameworks. Importantly, this extensive resource can help people considering further training to pinpoint skills that will enhance their employment opportunities in the environment sector. In bringing the two communities of trainer and trainee together the review should accelerate the delivery of skilled people of high value to employers and the UK economy.

The review represents a detailed piece of work which has taken two years to complete. This substantial investment of time has been made to ensure information has been properly gathered and analysed from across the environment sector including business, government and the research base. Some 143 responses were received to both open and targeted consultations. 121 responses were from groups or organisations.

34 organisations contributed expertise by participating in a Review Group. The Skills Framework sets out all of the skills identified. The table below sets out the 15 critical skills gaps that were headlined by the consultation process.

THE MOST WANTED SKILLS:

1. Modelling
2. Multi-disciplinarity
3. Data Management
4. Numeracy
5. Translating Research
6. Fieldwork
7. Risk and Uncertainty
8. Taxonomy and Systematics
9. Soil Science
10. Environmental Epidemiology
11. Sustainability Science and Planning
12. Microbiology
13. Food Supply
14. Energy Supply
15. Freshwater Science

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2 The review took a broad definition of skills and considered both knowledge and skills areas.
3 For the purposes of the review the Environment Sector is defined as “those parts of the UK that significantly rely on, or generate, knowledge concerned with the state and condition of the Earth”.
4 http://www.nerc.ac.uk/funding/available/postgrad/skillsreview/
These are the gaps that the review highlighted as most critical but the list should not be taken as absolute. It reflects the inputs received. Some consultees may, in retrospect, think that they could have contributed more, others may have gained new insights in a fast-moving landscape. Inevitably, skills needs will continue to change; other gaps may exist. Nonetheless, this review creates a substantial picture of what the sector needs over the next ten years.

In total the review identified 224 skills areas. All of these are presented in detail in the Skills Framework. This is a far-ranging statement of skills needs and it is freely available and accessible online. This unique resource will be built upon through time, with regular updating of information and by generating debate (see Annex A for details of the full outputs of the review and how they can be accessed).

This summary report, however, provides a quick entry point for ease of use, with references to more information for those who need to delve deeper. This report can be used in a variety of ways for a number of reasons:

**IF YOU ARE…. thinking about undertaking training** and you want to improve your employability, then this report shows you the skills that employers want. You might also use it to compare different training options to see which will give you the widest number of skills that are valued by employers.

**IF YOU ARE…. responsible for funding different training options** and want to ensure your money has the greatest impact, then this report shows you which skills areas employers value but find it difficult to recruit into and which skills are particularly useful because they are sought after across the whole environment sector.

**IF YOU ARE…. a supervisor or course designer** and want to make sure what you offer is relevant, then this work will help you to tailor your training so it gives students the skills that the sector wants and will use.

**IF YOU ARE…. an employer** and want to engage with training providers to ensure that they are meeting your needs, this report identifies areas where you could consider collaborating, e.g. being involved in training as a partner on a studentship.

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http://www.nerc.ac.uk/funding/available/postgrad/skillsreview/
THE CRITICAL SKILLS GAPS

15 critical skills\(^6\) gaps for the environment sector were headlined by the consultation process.

More details about each (and other skills areas and gaps) can be found in the Skills Framework (see http://www.nerc.ac.uk/funding/available/postgrad/skillsreview/). The reference number given with each critical skills gap tabled below shows the link to the Skills Framework. This allows you to search easily for areas of interest and shows how information in the Skills Framework has been summarised for this report. All quotes used in the tables are taken directly from consultation responses.

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**Modelling**

A014

**Summary:**
There is a specific need for modellers who have a breadth of experience and broad understanding of the different disciplines within which they are embedded. This is particularly needed to help drive innovation through the exchange of knowledge and experience.

**Why these skills are crucial:**
- Developing appropriate climate adaptation strategies.
- Preventing coastal erosion and flooding.

**Specific needs:**
- Physical systems modelling:
  - carbon and nitrogen systems
  - soil systems
  - coastal systems
  - climate systems
- Model interrogation and interpretation.

“Carbon modellers are rare, and the lack of them often creates bottlenecks for other work.”

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\(^6\) The review took a broad definition of skills and considered both knowledge and skills areas.
Multi-disciplinarity
A010 A003 A015

Summary:
The greatest innovation is often seen when ideas developed in one arena are transferred to another. There is a clear lack of individuals with the ability to drive and develop cutting edge work across academic boundaries.

Specific needs:
- Working across the natural-societal science boundary.
- Communicating across disciplines.
- Experience and understanding of working with multi-disciplinary teams and outputs.

“The lack of interdisciplinary communication remains a fundamental impediment to significant progress.”

Why these skills are crucial:
- Understanding and responding to the impacts of:
  - extreme weather and climate events; and
  - changing populations.

Data Management
A004

Summary:
It is a data rich world but we don’t have the people needed to fully manage and exploit this resource. The skills shortage is both at the specialist level and at a cultural level with a need to ingrain understanding of data management across the environment sector.

Specific needs:
- Interrogating large datasets and data mining.
- Large scale data manipulation.
- Understanding data integrity protocols, assurance and archiving.

“We need to avoid unnecessary data collection or overly high collection costs.”

Why these skills are crucial:
- Impacts of waste management activities.
- Environmental surveillance and monitoring.
**Numeracy**

**A020 A011**

**Summary:**
Individuals with strong quantitative skills are highly employable in the environment sector as there is a serious shortage of numerate individuals. Strong basic skills that can be applied to a range of situations are most desired.

**Why these skills are crucial:**
- Using and understanding predictions and forecasts of the rates, magnitude and types of environmental change.
- Development and application of technologies.

**Specific needs:**
- Applying advanced statistical skills to meteorology.
- Developing predictive mathematical models.
- Statistical methods for handling large datasets.

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**Translating Research**

**for policy makers, businesses and society.**  
**A003 A018 A002 A012**

**Summary:**
There is a lack of available people with the skills to work with policy makers and regulators, industry and business, non-governmental organisations and charities, and the media to develop appropriate ways to address environmental issues, increase public understanding and translate research outcomes directly into products and services.

**Why these skills are crucial:**
- Coordinating unified responses to climate change through legislation and policy.
- Promoting sustainable behaviour.
- Understanding the environmental impacts of products and services.

**Specific needs:**
- Understanding the requirements of policy makers (science to policy).
- Business and management skills.
- Media training.

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“We generally find it most difficult to recruit those with numerical skills.”

“What we need are top scientists who are excellent communicators.”
**Fieldwork**
A008

**Summary:**
The number of people available to conduct skilled field research has decreased and employers are finding it difficult to recruit individuals with fieldwork skills. Such skills underpin environmental observation and monitoring, leading to a greater understanding of environmental issues.

**Specific needs:**
- Survey skills including species identification.
- Sampling techniques.
- Collection and recording protocols and methodologies.
- Technology use e.g. Unmanned Aerial Vehicles (UAVs).

**Why these skills are crucial:**
- Environmental data collection.
- Improving and developing new monitoring techniques.
- Improving development and deployment of sensors and instruments.
- Understanding the vulnerabilities of ecosystem structures and functions.

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**Risk and Uncertainty**
A017 A005

**Summary:**
Employers find it hard to recruit people with the skills to understand and quantify both uncertainty and complexity, and the scientific principles of risk. It is vital that the skills are available so that research outputs can be effectively interpreted, especially when being used as evidence for decision making.

**Specific needs:**
- Uncertainty modelling.
- Quantitative risk assessment.
- Risk evaluation.
- Managing and communicating uncertainty.

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“Field identification skills are essential to complement academic learning.”

“There aren’t enough skills relating to managing uncertainty in the development of policy solutions to climate change.”

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**Why these skills are crucial:**
- Effective communication to engage with policy makers, the media and the general public.
- Risk assessment of chemical substances including nanomaterials.
Taxonomy and Systematics
A022

Summary:
There have long been concerns about skills in both Taxonomy (describing, delimiting and naming organisms) and Systematics (organising taxonomic information). Respondents highlighted a major gap in all taxonomy and systematic skills: from core practical field skills to basic theoretical understanding.

Why these skills are crucial:
- Monitoring and understanding the functionality of the marine environments.
- Recognising the role of biodiversity and ecosystem resilience in a changing climate.

Specific needs:
- Applying understanding of taxonomy and systematics to:
  - Oceanography (the biological pump);
  - Physiology;
  - Ecological function;
  - Biomathematics; and
  - Data management.
- Identification skills – across all organisms.
- Biological monitoring.

Soil Science
A019

Summary:
There is a lack of skilled individuals with soil science skills, linked to a decline in soil science training provision in the UK. Soil science skills are relevant across the environment sector including in the critical areas of food and energy security.

Why these skills are crucial:
- Security of agricultural land and food supply under demographic and environmental change.

Specific needs:
- Soil carbon monitoring and modelling.
- Understanding of soil system functions.
- Impact of land use on soils.
**Environmental Epidemiology**

**A007**

**Summary:**
There are not enough available people with the skills that are associated with the branch of public health that deals with environmental conditions and hazards that may pose a risk to human health. These skills are expected to become increasingly important over the next decade.

**Why these skills are crucial:**
- Understanding the impact of disease vectors on human and non-human health.
- Assessing the health effects of exposure to environmental pollutants.
- Identifying the development and policy implications of human migration.

**Specific needs:**
- Predicting emergent diseases.
- Understanding population fluxes.
- Understanding the effects of climate change on disease.

**“There is a very substantial skill shortage in environmental epidemiology in the UK.”**

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**Sustainability Science and Planning**

**A013**

**Summary:**
Sustainability Science is a new and needed discipline. There is a widespread lack of the technical skills necessary to ensure sustainability and the promotion of sustainable behaviour is at the heart of policy and economic activity. In parallel with this there is a lack of skills to enable sustainable planning in response to increasing urbanisation.

**Why these skills are crucial:**
- Protection of natural landscapes.
- Using legislation and policy to deliver sustainable use of natural resources.

**Specific needs:**
- Environmental impact assessment.
- Strategic environmental assessment.
- Economic analysis.
- Developing indicators for sustainable consumption.
- Sustainability appraisal.

**“Sustainability should be at the heart of policy.”**
**Microbiology**

**A013**

**Summary:**
Microbial physiology and basic microbiology are areas of UK weakness. Skills in microbiology are required to understand issues such as ecosystem change and to improve anaerobic digestion which is used in renewable energy and waste management technologies.

**Why these skills are crucial:**
- Understanding the role of biodiversity in maintaining healthy ecosystems.
- Applying technology to the fields of energy provision.

**Specific needs:**
- Quantitative microbial community analysis.
- Measurement and monitoring of microbial catalysts of geochemical processes.

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**Food Supply**

**A001**

**Summary:**
There was a particular emphasis on skills at the boundaries of disciplines, and fostering and applying learning between subjects. A report from the Food Research Partnership Skills Sub-Group\(^7\) has alleviated some of the concerns raised by the consultation. Future skills needs work must continue to monitor this area.

**Why these skills are crucial:**
- Security of agricultural land and food supply under demographic and environmental change.
- Protection and management of existing soil resources.

**Specific needs:**
- Combining agricultural knowledge with biological modelling.
- Understanding and managing diffuse pollution from food production.
- Understanding the effects of agriculture on soil systems.

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\(^7\) High-level Skills for Food Report from the Food Research Partnership Skills Sub-Group (GO! Science) http://www.dius.gov.uk/assets/biscore/goscience/docs/h/10-929-high-level-skills-for-food.pdf
Energy Supply

“A006 A016

Summary:
The need for energy specialists with an understanding of environmental sciences and issues, and technical expertise to be allied with environmental understanding. Different energy sources present their own challenges so skills associated with developing energy sources and emerging technologies are particularly valued.

Specific needs:
- Marine energies.
- Energy technologies.
- Economics of energy supply and demand.

Energy provision is one of the key challenges to man and the planet.”

Why these skills are crucial:
- Energy security.
- Means and impacts of increasing renewable energy provision.

Freshwater Science

“A009

Summary:
The shortage of freshwater science skills is particularly acute in the integrated freshwater sciences which bring together the physical, chemical and biological aspects of the subject. The skills are linked to the efficient and sustainable use of water resources.

Specific needs:
- The evaluation of freshwater goods and services.
- Understanding longitudinal links in running waters.
- Ecological community dynamics.
- Understanding environmental legislation.

“Recognising the importance of evaluating and interpreting the indicators of the state of freshwater ecosystems is key.”

Why these skills are crucial:
- Ensuring water quality under changing demand.
- Understanding the importance of water resources to ecosystems.
WHAT NEXT?

CONTINUING THE PROCESS

To help develop this resource and prevent future skills gaps the Skills Framework has to be a living document. It cannot sit on the shelf gathering dust; it must be used to help to identify developing shortages. The Skills Framework needs to be challenged, reviewed, and updated. For these reasons, this report makes two clear recommendations:

ONE – People across the environment sector should: (i) use it (ii) learn from it (iii) replicate the process and (iv) help develop the work further.

This has been a considerable undertaking and during the review process a number of lessons have been learnt. Annex B explains why this has been so complicated. One of the biggest lessons is that if you talk to employers about skills needs you need to frame the questions carefully and provide a guiding structure for their answers to avoid getting limited and disparate information. It is difficult starting with a blank piece of paper which is why the Skills Framework was developed. It is a complex framework that can be adapted to need and will be helpful both for the information it contains and as a methodology for generating further information.

A number of organisations have already started thinking about how they can use the information collected with suggestions such as:

• for extracting specialist discipline-based information;

• developing action plans that can be used to bid for funding;

• encouraging different disciplines to collaborate on tailoring course provision to improve student employability.

Feedback on how the Skills Framework can be improved, the gaps which have been missed or misinterpreted, and changing skills needs is welcome (see below).

TWO – NERC should nurture this resource – refreshing the work regularly.

NERC have already welcomed this recommendation and agreed both to manage the review outputs on behalf of the environment sector and to refresh the work regularly. This is important as skills needs change, and gaps will have been missed, overstated and understated. The first refresh of the work, which NERC intend to carry out in 2012, will involve a Review Panel who will challenge and tension the views raised and take on board additional evidence received. If you wish to contribute to this refresh please contact: skills@nerc.ac.uk.
This annex sets out all the outputs from the review. They are all available on the NERC website at http://www.nerc.ac.uk/funding/available/postgrad/skillsreview/.

REVIEW OUTPUTS:

1) **The Summary Report - ‘Most Wanted’**
   ERFF Report Number 7
   (electronic and hard copies of this report are available).

2) **The Skills Framework**: the summary of all the postgraduate and professional skills needs for the environment sector.

3) **Overview and Outputs Paper**:
   1. Overview
   2. Guide to the Skills Framework for the Environment Sector
   3. The Skills Framework for the Environment Sector
   4. The Postgraduate and Professional Skills Needs Inventory
   5. Report on additional feedback from the consultation
   6. Report on the Methodology
   7. The Way Forward

4) **Annexes Paper**:
   1. Membership of the Project Board
   2. Membership of the Review Group
   3. Glossary
   4. Documentation for the Public Consultation
   5. Respondents to the Public Consultation
   6. Hierarchy of Drivers, Topics and Challenges
   7. Bibliography
   8. Record of Methodology used to analyse Responses
   9. Documentation for Review Group input

The first refresh of the work will take place in 2012 and involve a Review Panel who will challenge and tension the views raised and take on board additional evidence received.

If you wish to contribute to this refresh, including giving details of your own skills needs, or if you want any further information please contact: skills@nerc.ac.uk.
ANNEX B

THE REVIEW METHODOLOGY

The review has helped bring clarity to a complex and dynamic sector by gathering evidence about what skills are needed and why they are needed. The review used a different approach to standard skills and employment research because:

i. the environment sector is characterised by its multi-disciplinary nature: there is high connectivity both within the sector and through links to other communities; and it is reliant on capabilities and expertise from a broad range of subject areas;

ii. from the perspective of either an academic discipline or an economic activity, the sector is not well captured in standard classifications;

iii. it is a relatively new and rapidly evolving area of activity and expertise;

iv. there is a significant lack of consistency within the available data, with many gaps and little ability to compare data from different sources;

iv. there are no comprehensive sources of information about, or definitions of, the current stock of skills; and

v. it was important to ask why as well as what skills are needed.

By creating a framework for asking questions about skills needs a useful body of evidence has been collected. The full methodology is accessible online (see Annex A). The diagram below sets out the main review process.
ERFF identified the need for Skills Review.

Phase 1 (pre-2009) consultants engaged to undertake feasibility study. Results highlighted need to run review in-house.

NERC led Review set-up (2009)

Open and targeted consultation to develop and input into the Skills Framework.

Sector Challenges identified using ERFF horizon-scanning study.

Skills Framework Designed: Structure for thinking about skills needs in terms of why they are needed.

Skills Framework revised: 124 broad challenges identified with associated skills needs.

Challenges prioritised by Review Group.

Critical postgraduate and professional skills gaps identified.
THE PROJECT BOARD AND TEAM

THE PROJECT BOARD

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Additional copies of this report can be ordered from skills@nerc.ac.uk