Institution: University of East Anglia

Unit of Assessment: 7 – Earth Systems and Environmental Sciences

a. Context

The School of Environmental Sciences is in the Faculty of Science at UEA and is located in the Norwich Research Park, which is a partnership between UEA, the Norfolk and Norwich University Hospital and four independent research institutes. The School's mission is to conduct world class research into the functioning of the Earth System, how this System responds to both advertent and inadvertent human influences, and how these changes affect society and human well-being. We bring this knowledge to bear on social and political processes of public understanding, policy deliberation and formation, thereby contributing to more effective environmental management at all scales. In pursuit of this mission, we have built lasting relationships with a wide variety of stakeholders many of whom function as co-producers of knowledge. As a result, our research has had a significant and enduring public impact over the course of four decades.

The School's research is guided by two over-arching principles: the promotion of research that harnesses combinations of natural and social science disciplines to yield insight into environmental challenges (i.e. *inter-disciplinarity*); and the promotion of research that is shaped and guided through interactions with interested non-academic partners (i.e. *co-production*). Our reach and influence is exemplified in the range of actors and institutions with whom we interact, for example:

- International science advisory/assessment panels: e.g. the Intergovernmental Panel on Climate Change (IPCC) and United Nations Environment Programme (*Global Temperature Data, Global Carbon Budget and Halocarbon Case Studies*);
- EU regulatory authorities and policies: e.g. the European Environment Agency (EEA) and the EU Water Framework Directive (*Catchment Management Case Study*);
- UK Parliamentary Committees: e.g. Science and Technology Committee; the Environmental Audit Committee (*Sustainable Adaptations Case Study*);
- National UK Government departments and non-departmental public bodies: e.g. the Environment Agency; Defra; Met Office (*Ecosystem Services Case Study*);
- Large business organisations and SMEs: e.g. South West Water; Gardline;
- Non-governmental authorities and regulatory bodies: e.g. RSPB; the Brazilian Forestry Code (*Biodiversity Conservation Case Study*);
- Civil society organisations at a range of scales: e.g. the 'Transition Towns' movement;
- General public and media institutions: e.g. BBC (*Global Carbon Budget Case Study*).

During 2008-2013, the School's research has had impact on *natural and managed environments* (both directly and indirectly), on *public policy and regulation*, on *economic growth* (with a special emphasis on sustainability), on *quality of life and cultural services* and on *wider society* (through the creation and promotion of platforms and processes for public reflection, learning and deliberation about environmental policy choices). As our Case Studies demonstrate, this impact has been achieved at local (e.g. Norfolk), national (UK), regional (EU) and global (UN) scales.

b. Approach to impact [**Note UEA researchers in bold**]

Our ethos of co-produced research (outlined above) means that the School's research is rarely just 'delivered' to its policy, business and public audiences on completion. Rather, we interact with these audiences at each relevant stage, from research scoping, definition and design, through to completion and application. Through this approach, our scientists frequently engage in face-to-face interactions with businesses, civil society organisations and with senior policy-makers inside and outside government. This engenders the mutual trust and respect that is critical for effective knowledge exchange. The contribution of our work to the UK Government's first National Ecosystem Assessment and the subsequent White Paper is a good example of this commitment in practice (*Ecosystem Services Case Study*), building as it does on decades of environmental economics research and knowledge exchange. Further examples of our approach are described in the following three categories:

i. <u>Policy</u>: The School's long-earned reputation for engagement with the environmental policy community (in London, Brussels and through the United Nations), enables our research to impact

more directly on policy. For example, the School has a long tradition of its scientists serving on expert international environmental assessment panels. This started with the first Scientific Assessment of Stratospheric Ozone Depletion in the late 1980s, and was followed by the IPCC and the Millennium Ecosystem Assessment. This has continued through the period 2008-2013 with the Fifth Assessment Report of the IPCC [four Lead or Convening Lead Authors: **Adger** (until 2012)**, Le Quere; Osborn; Warren**] and The Intergovernmental Platform on Biodiversity and Ecosystem Services (IPBES) [**Watson, R.** Interim Chair, 2010-2013]. The contribution of the School to the IPCC over each of its five assessment cycles covering the period 1990 to 2013/4 is a powerful demonstration of how the overall weight and impact of our work on subsequent climate policy negotiations has been cumulative. Over these five assessment cycles, the School has provided a total of 20 Convening Lead or Lead Authors, plus another 31 Contributing Authors and Review Editors. Seventeen members (12 still active during 2008-2013) of the School were recognised for their *'significant contribution'* to the IPCC's award of the 2007 Nobel Peace Prize. No other university department in the world has made such a sustained and substantial contribution to the IPCC.

With respect to national and European policy, our scientists have served as Special Advisors to Parliamentary Select Committees [**Liss**], to the National Ecosystem Assessment and the Defra/Treasury Natural Capital Committee [**Bateman**] and as members of Departmental Advisory Councils [**Bateman, Liss; Watkinson; Watson, R.**] and Government Foresight Panels [**Adger; Barclay; Liss**]. We also regularly submit written and oral evidence to UK Governmental and non-governmental review bodies such as Defra, DECC, the Marine Climate Change Impacts Partnership and Parliamentary Committees (e.g. Environmental Audit, Science and Technology, International Development, Energy and Climate Change), as well as to the devolved UK Administrations and EU bodies such as the European Parliament [**Bond**], the European Commission [**Jordan**] and the EEA [**Jones**].

ii. <u>Business</u>: The impact of our work on business and commerce is secured through building our environmental consultancy capability and developing new business services and networks. The **Adapt Low Carbon Group**, headquartered on the Norwich Research Park, has grown directly out of the School's enterprise and research activity in the low carbon sector between 2007-2010 [**Powell; Tovey**]. Adapt has worked with Broadland District Council to help secure £10.2m funding from the Government's Eco-towns Programme, with a local company (Green Energy Options) to establish the Visible Energy Trial in Norfolk households [**Hargreaves**] and with a consortium of businesses (including IBM UK Ltd) to win a £1.6m EPSRC grant with Loughborough University to develop and trial new smart home energy technologies. Building on our meteorological expertise [**Dorling**], the School has developed and hosted *WeatherQuest Ltd*., a company that offers state-of-science weather services to the BBC, *Aviva* (the global insurer) and others, with a total revenue of £2.5m between 2008-2013. The impact of the School's research on local authorities, business and commerce has also been developed by Knowledge Exchange grants: for example the NERC-funded Valuing Nature Network [**Bateman**] which includes over 1200 business and policy members; the Defra-funded Wensum Alliance [**Hiscock**]; and petrological analyses for volcanic risk assessment, which was subsequently embedded into a new monitoring strategy for the Montserrat Volcano Observatory [**Barclay**]. Other consultancy work undertaken within the School (valued at £1.7m during the REF period, over and above the grant income detailed in REF4) has cultivated relationships extending the impact of the School's research.

iii. <u>Public and Media</u>: Our approach to impact recognises the value of engagement with members of the public. The School has been a major resource for the *CUE-East Beacon for Public Engagement* run by UEA 2008-2012, one of only four such Community Engagement centres in the UK. CUE-East engagement awards have been made to **Brimblecombe** and **Dorling**. Our scientists have extended the reach of their work through such public ventures, for example in relation to land and water management options in East Anglia (*Catchment Management Case Study*) and to public attitudes to climate engineering [**Vaughan**] and marine climate impacts [**Chilvers**]. Research in the School's Science, Society and Sustainability Group into how the public engage with environmental science and express their policy preferences has been used in the development of Government guidelines on public consultations (for example, relating to Defra's ecosystem services approach) and in informing governmental public dialogue on science and technology (in research projects for BIS and Sciencewise). The School's impact has also been

furthered through the appointment (since 2003) of a Communication and Engagement Manager in the Tyndall Centre for Climate Change Research (headquartered in the School). Through this, the reach of the Centre's research has extended worldwide in relation to mitigation and adaptation. The Centre receives over 6,000 unique web visits monthly and has 6,300 Twitter followers. The School's scientists appear regularly on national and international television and radio networks to convey their research to mass audiences. Two recent examples – both broadcast in August 2012 – being on volcanic processes and risks [**Barclay**] on BBC1's *Volcano Live* and on severe weather forecasting research [**Renfrew**] on BBC1's *The One Show*.

Flexibility, Facilities, Capabilities: The School's size and interdisciplinary outlook brings opportunities for exploiting new impacts of our research. For example, our long-standing work on global carbon budgets enabled us to take the lead (from 2007 onwards) in publishing the annual Global Carbon Project budget, now recognised worldwide as the primary authoritative source for global carbon budget information *(Global Carbon Budget Case Study)*. Our cross-disciplinary research in the area of volcanic hazards and societal risk, built-up over nearly a decade, enabled us to respond rapidly after the May 2006 eruption on Montserrat to secure a NERC Urgency Grant to complete a rapid response survey of the affected areas. The long-term investment in our atmospheric chemistry facilities, and the development and retention of associated world-class expertise, have enabled the School to make unique contributions to the detection, and subsequent monitoring of policy implementation, of new trace gas substances such as powerful perfluorinated and hydrofluorocarbon greenhouse gases (*Halocarbons Case Study*). Similarly, the School's Stable Isotope Laboratory has enabled the development of a novel methodology for atmospheric nitrate detection in air, soil and water samples, and has led to significant amounts of contract work to guide the development of new Defra policy on nitrate concentrations. The co-development of a variety of decision-support tools has meant that our research is being used directly in a variety of decision-contexts – e.g. the UKCIP09 weather generator used in the UK's National Climate Change Risk Assessment [**Jones; Goodess**]; ISO guidelines (ISO/DIS 17402) have standardised the use of cyclodextrin 'smart molecules' [**Reid**] to support the assessment of soil quality under the EU Soil Thematic Strategy (COM(2006) 231); a web-based aerosol model developed [2007-2011; **Clegg**] for Met Office applications; the Community Integrated Assessment System used by UK DECC for climate policy advice [**Warren**].

Research Staff and Graduate Students: The School's ethos of co-produced research inspires some of our early or mid-career research staff to secure temporary secondments inside Government Departments or other non-academic institutions. This fosters research-policy relationships and widens our impact culture; for example, a policy internship to the *National Assembly for Wales* in 2012 [**McDougall**] and an industrial secondment to *EDF Energy* in 2012 [**Rau**]**.** The School runs an annual PhD showcase event at 'The Forum' in central Norwich which allows PhD researchers to share their research directly with members of the public. Our PhD students won a Silver Medal for their *'Climate Change Garden'* at the **2008 Chelsea Flower Show** and won *NERC's Environmental Young Entrepreneurs Scheme* in 2011/12. The School has been successful in securing funding for CASE and other externally-funded PhD studentships enabling graduate-level research to be co-developed with non-academic beneficiaries, such as the Met Office, Centre for Ecology and Hydrology, Centre for Environment, Fisheries & Aquaculture Science, WeatherQuest, and the Worshipful Company of Insurers.

c. Strategy and plans

The School is in a strong position to build on its successes in converting world-class environmental science and social science research into usable knowledge. At the heart of our strategy for impact is a continuing commitment to the principles of co-production and inter-disciplinarity.

In the years ahead this strategy will benefit from a number of institutional developments at UEA. These include the recognition of *"Impact, Enterprise and Engagement"* as specific promotion criteria, and the roll-out of new in-house training for research staff in line with the national Researcher Development Framework domain D3 'Engagement and Impact'. Examples include modules on 'Pathways to Impact', 'Blogging for Researchers', 'Generating Impact from Intellectual Property'. UEA is also investing in a new £15M *Enterprise Centre* on the Norwich Research Park site, as well as embedding Business Development Managers and annual pump-priming funds for enterprise activities. A number of impact funding streams are now available from the University.

The Associate Deans for Enterprise and Engagement in each Faculty have an annual budget of £30k to pump prime small scale enterprise activities. Further internal funding has been made available for a proof of concept fund (£120k pa) and a strategic fund (£450k pa) distributed at the discretion of the Universities Enterprise Executive. In addition the Norwich Research Park will be investing £1.8M on impact over the next few years. The CUE-East Beacon for public engagement will continue through a new Community University-Engagement Office at UEA which the School will continue to reach out with its research to regional audiences.

At School level, several new plans to support this strategy are in train. These include adjustments to criteria for staff sabbaticals to specifically include activities that will further promote and exploit previously undertaken research and the appointment of experienced impact specialists to the internal research grant sift panel. The School is sufficiently large and flexible in its staffing arrangements to absorb short or long-term secondments of staff to work with stakeholders or to serve on international assessment panels. Several of our existing Case Studies show great promise for on-going impact and will be carefully nurtured. We have also identified five 'incubator impact case studies', areas of current research that have the potential for much greater impact in the future and which we will nurture. UEA has recently allocated a £70k *Impact Accelerator Award from NERC* to help nurture such activities, with the offer of a phase II award of £200k now also received.

Ultimately, however, research impact can neither be managed nor guaranteed through performance criteria or institutional structures alone. It emerges from the combination of high quality research and motivated, perceptive and innovative staff, together with a dose of serendipity. Inducting new staff into the School's culture of high quality inter-disciplinary research, of working closely alongside engaged stakeholders and of being articulate and passionate about communicating research, is the best strategy for success. Our research environment is conducive to nurturing this culture and our existing high profile research impacts will inspire the next generation of researchers and students in the School to achieve new successes.

d. Relationship to case studies

Each of the seven Case Studies exemplifies different aspects of the School's approach to, and delivery of, research impact. The *Ecosystem Services Case Study* demonstrates how our development and application of innovative methods and tools has guided UK Government thinking, subsequently set out in new priorities and policies contained in a White Paper. The *Biodiversity Conservation Case Study* shows a similar pathway to impact in the case of the Brazilian Government and its Amazon Forestry Code. The *Global Carbon Budget, Global Temperature Data, and Halocarbons Case Studies* demonstrate how the world-class scientific and social scientific expertise in the School has enabled us to exert a sustained and seminal influence on a number of international scientific assessment panels operating inside and outside the UN system. The *Global Temperature Data Case Study* demonstrates how original forensic research over several decades, leading to the co-production of high quality global-scale climate data underpinning IPCC assessments, has had an enormous impact on global climate policy negotiations and development. The subsequent *'Climategate'* controversy in November 2009 was very much a confirmation of the worldwide impact of the School's work over many decades. Each of the subsequent independent *Climategate* reviews and investigations re-affirmed the quality and robustness of the School's work, reconfirming its seminal impact on public and policy engagement with climate change.

Other Case Studies illustrate different facets of our approach to impact. The *Halocarbons Case Study* shows how the School, through specialised laboratory science for atmospheric trace gas chemistry, has influenced the implementation and monitoring of global emissions policy; while the *Global Carbon Budget Case Study* shows a similar pathway from basic science to worldwide policy and public impact through the establishment and worldwide recognition of the Global Carbon Project. The *Catchment Management, Sustainable Adaptations* and *Halocarbons Case Studies* demonstrate how the School's delivery of cross-disciplinary research has underpinned regulatory decisions in the UK and beyond in areas such as water quality standards (through integrated watershed management), climate adaptation and the built environment (through climate scenario development) and emissions standards (through detection, attribution and monitoring capabilities).