Unit of Assessment 17 – Geography, Environmental Studies & Archaeology

Institution	Evidence
Queen Margaret University	As a general point, it has been quite difficult to provide evidence of the various changes described in the questionnaire over a period of 20 years, as to do so would rely on the experience of staff who have been engaged in similar types of research over that 20 year period. This is particularly the case in respect of the first three questions, where the responses are largely qualitative. In relation to the information requested in question 4, this has also proven difficult to access, as typically this detail and type of information is only held for a period of six years. A further general point is that, when looking at subject weightings for research in general, a reasonable sense check for SFC would be to look also at the transparent approach to costing for teaching (TRAC(T)) data that it collects at subject level to inform prices for teaching funding. There will clearly be different costs between research and teaching which means that there would not be a direct comparison, but it might be expected that there would be some correlation, at least in relative terms.
Royal Scottish Geographical Society	**THE CASE FOR CONTINUED WEIGHTING AS A PART-STEM SUBJECT** **1. INTRODUCTION** The Royal Scottish Geographical Society welcomes the opportunity to respond to the SFC on subject weightings. For reasons explained in what follows, this response should be understood as 'pan-Scotland' (that is, it embraces those HEI who submitted Geography FTE staff (in whole or in part) to RAE (1996-2008), and to REF2014 and who are intending to do so to REF2021). It is the Society's understanding that individual HEI will respond separately to SFC. This response covers Geography only.

For the reasons disclosed, this response does not address fully each of the separate questions posed in the request for evidence: changes in research **practice**; changes in **the balance of research activity** between constituent discipline areas; changes in **levels of support**; changes in **the volume** (number and/or size) of research grants won per FTE researcher. We have sought, however, to provide **sources of other evidence** in illustration of changes in the absolute costs of research activity (Geography only) since 1997-98.

The RSGS would draw to SFC's attention the significant shifts in HEI administrative structures and in HEI strategic responses towards RAE/REF in the period since 1997-98, both of which issues make detailed returns difficult. Geography, Environmental Studies and Archaeology (UoA 17) was a sub-panel designation in REF2014. Geography was a sub-panel (H-32) in RAE 1996, 2001, 2008. In consequence of decisions made about sub-panel designation and the funding differentials associated with them, and the strategic responses of HEI to these circumstances, the Geography elements within UoA17 are complex and vary by HEI (see section 4 for fuller explanation).

2. EXECUTIVE SUMMARY

- A significant proportion of geographical research and scholarship in Scotland is scientific work of high quality and international standing;
- Scientific geographical research requires and attracts significant funding to ensure the necessary science-based infrastructure is in place, as evidenced by SRIF investments. This is on a par with SRIF funding to Earth and Environmental Sciences as defined in RAE2008, REF2014;
- Approximately 50% of the research submitted to RAE2008 (UoA H-32) and in REF2014 (UoA C17) can be classed as physical and natural science according to (i) the assessment of the respective RAE and REF sub-panels; (ii) the journals in which the research was published; and (iii) the research councils and charitable funding sources that supported it. This further supports longstanding recognition of Geography as part-STEM in terms of cost weighting;
- There were significant cross-referrals between E-17 (Earth and Environmental Sciences) and H-32 (Geography) panels in RAE2008 and between B7 (Earth and Environmental Sciences) and C17 (Geography, Environmental Studies and Archaeology) in REF2014, implying that these sub-panels should be treated in a similar manner in

any assessment of research cost weighting;

- While the nature of the discipline and its science cost base is widely recognised (part STEM; part non-STEM), Geography did not receive the STEM protection afforded to other scientific disciplines following the 2008 RAE, nor did it after REF2014. This unjust consequence and the continuing implications in respect of the cost of research will have a severe and detrimental impact on the quality of the UK science base and on research in the discipline.
- We do not seek 100% STEM protection, but do believe that it is right and proper that there be 50% STEM protection (part-STEM weighting).

3. THE SCIENTIFIC LABORATORY STATUS AND COSTS OF GEOGRAPHY RESEARCH

Geography combines the insights of physical science with those of social science and the humanities. Geographers work on key environmental questions shaping human society: these include the causes and effects of anthropogenic climate change, biodiversity at local, regional and global scales, Quaternary environmental change, coastal erosion, hydrology and fluvial processes (flooding and drought), ecological variation, desertification, and terrestrial biogeochemistry. This essential physical research informs and directs policy, in the UK and globally. Geography's part-laboratory (part-STEM) status is justified on the grounds that research active Departments/Schools of Geography maintain scientific laboratories with specialist technical support in order to deliver high-quality research.

These essential costs include the demands of field equipment and GIS and Remote Sensing. Intensive computer-based analyses include mapping remotely sensed data and data mining of geospatial information. Human Geography research has, in the review period, developed connections with, *inter alia*, computing science, transport planning, the medical humanities and 'Big Data' around quantitative social science as well as earth observation. In all HEI, Departments/Schools cite science infrastructure support as necessary in order to compete for international grants and research staff.

Since the 1996 RAE, Geography has had a subject cost weighting for research for a 'part-laboratory' subject. At 1.3, this weighting is mid-way between that for humanities' subjects at 1.0, and science subjects at 1.6, and is, therefore, equivalent to the average of these two weights for a unit with equal amounts of science and humanities. It has been established and widely recognised therefore that Geography has a significant element of science in its research (and in its teaching).

The balance of the science and humanities within Geography has been confirmed by the 2008 RAE, as is made clear in the Subject Overview report (http://www.rae.ac.uk/pubs/2009/ov/), and reiterated in REF2014. In RAE 2008, for example, it was stated (#2.5) that 'the number of outputs broadly classified as physical geography and environmental science was approximately 2,240, while those in human geography and social scientific environmental studies numbered about 2,380'. This is a 50:50 balance within the margin of error in assigning outputs to the two categories. This 50:50 split is broadly apparent throughout the review period (but see section 4).

4. RESEARCH DESIGNATIONS AND HEI STRATEGY: GEOGRAPHY, ENVIRONMENTAL STUDIES AND ENVIRONMENTAL SCIENCE IN THE RAE/REF

For the 2008 RAE and again in REF2014, Geography combined with Environmental Studies to form sub-panel H-32 (RAE2008) and C17 respectively (REF2014 also included Archaeology). The 2008 designation was the first use of a panel with this title in an RAE: REF2014 was similarly unique in including Archaeology. Initial [HEFCE] consultation on *Panel Configuration and Recruitment* for the 2008 RAE proposed a Main Panel H with Environment Sciences, Built Environment, Town and Country Planning and Geography. The Geography community responded with support for this since it approved of the subject range, embracing the sciences and social sciences. The conjunction of Geography and Environmental Sciences was especially welcome, these being similar subject areas, both with natural and social science components.

However, the eventual outcome of consultation saw Environmental Sciences moved to Main Panel E in RAE2008, where it combined with Earth System Sciences to form sub-panel E-17. There was no consultation with the Geography community on this move. Whatever lobbying led to this change also led to the arbitrary combination of

	Geography with Environmental Studies, a subject with no clear disciplinary identity. It was never clear what Environmental Studies embraced: appraisal of research submitted in RAE 2001 suggested an admixture of geology, terrestrial ecology, and environmental pollution, with relatively little of the social science environmental research expected. For RAE2008 and again in REF2014, the existence of a sub-panel with this remit created significant difficulties in constructing appropriate panel membership and for institutions in determining where to submit. During the 2008 RAE process and in REF2014, the similarity of remit for H-32 and E-17 (RAE 2008) and C17 and B7 (REF 2014) (especially of the Environmental *Science* component) meant that there was a significant overlap between the two sub-panels. This led to a small number of Geography submissions being split (physical geography FTE staff were returned to E-17/B7, human geography to H-32/C17). In other instances, research submitted to E-17/B7 (for reasons of Department/School/HEI administrative integrity) was cross-referred to H-32/C17 (human geography research, and social science studies in Environmental Science submissions). HEI in Scotland effected different strategies in consequence of institutional structures and the differential weightings/resource attaching to the research recognition exercises. For the University of Aberdeen, for example, in order to more clearly reflect the cost of the research in REF 2014, approximately half of Geography FTE were submitted to UoA B7 (Earth and Environmental Sciences), with five FTE to UoAC16 (Architecture, Built Environment and Planning), and three only to UoA C17. In the University of Edinburgh, all FTE in Geosciences were submitted to B7, with the human geography FTE staff cross-referred for assessment of outputs to UoAC17. In the University of Glasgow, the UoAC17 return of 13 FTE (REF2014) was human geography only; the return of 34.80 FTE to UoA B7 included physical geographers. Given these circumstances, it is difficult to provide exact figures for the volume of research won per researchers active in UoA C17 over the review period, or to state the balance of research activity with certainty. The outcomes of RAE 2008 and REF2014 in general - which suggest a more or less steady state in terms of balance between human and physical geographers - do not readily disclose the increased profile of science-based geographers represented within B7.

It is absolutely the case that there is more environmental *science* research being done in Geography Departments/Schools administrative units than is indicated by submissions to the Geography, Environmental Studies and Archaeology UoAC17 sub-panel. Equally, submissions to E-17 (RAE 2008) or to B7 (REF2014) contain physical geography research whose costs are at least equivalent to STEM-rated subjects (there is no evidence of any difference in research quality).

5. FUNDING CONSEQUENCES

The funding consequences in submission strategy across the two sub-panels (UoA C17, B7 in REF 2014) are radically different, largely because B7 is afforded full STEM weighting [as initially outlined in the March 2009/08 HEFCE paper *Recurrent Grants for 2009-10*]. Given the degree of similarity of the two fields, and the level of joint assessment through cross-referral, this unjust outcome is at risk of undermining the place and strength of physical geography research, the 'environmental' science research base, and the status of Geography as a whole.

This has resulted in a series of specific anomalous outcomes. Elements of social science research submitted to E-17/B7 and assessed by H-32/C17 have been funded at abnormally high levels. Elements of geography submitted to E-17/B7 and assessed as a lower-than-average research output quality profile by H-32/C17 standards, are funded as equivalent to a high-ranking submission to H-32/C17. Some earth sciences research submitted to H-32/B7 is funded less well than equivalent submissions to E-17/B7. In sum, there is more, and more diverse, geography research being undertaken and at high quality levels than is suggested by returns to RAE 2008 and to REF 2014 Geography UoA, and more science-based geography within E-17 and B7 than is suggested by returns to that UoA.

6. THE CASE FOR CONTINUED WEIGHTING AS A PART-STEM SUBJECT

This evidence supports the view that Geography (and Environmental Studies) should be afforded STEM weighting equivalent to Environmental Sciences. This would be consistent with the evidence that the physical geography/environmental science conducted in Departments/Schools of Geography has the same basis in laboratory and field investigation, and their associated infrastructure costs, as that conducted in Environmental

	Science departments (Section 3). Inequities in allocation, together with structural changes in institutions, have had serious and unintended consequences (Section 4). Given the evidence of a 50:50 balance between research in physical geography and in human geography (including social science environmental science), it would be appropriate that the current weighting of 50% STEM protection to Geography and Environmental Studies should continue. There is evidence, nonetheless, that even this weighting does not adequately recognise the significant research costs of research in physical geography or the importance of science-based research in geography to the strength of the discipline, to the economic well-being of Scotland and the UK, and to geography's place in the UK's global research profile.
University of Stirling	**1. Changes in research practice in areas covered by Unit of Assessment 17.** Since 1997/8 there have been monumental changes in the way the Environmental Science research has been conducted. Changes in the expectations of funders, the needs of society and changes in technology availability and use have led to an increase laboratory based research and the use of satellite earth observational data. The move to an increase in laboratory based research brings with it the need for expensive equipment, training and maintenance. Over and above the initial capital required to purchase equipment and the ongoing spend on consumables, appropriately skilled personnel are required to provide the training, perform the maintenance and keep up to date with change and improvements in techniques and use of equipment. The use of longitudinal satellite earth observation data sets which are difficult to process also brings the requirement for new skills, computing infrastructure and training to handle and interpret these massive petabyte sized data sets. This may require specialist consultation, technical staff or researchers with cross discipline expertise, for example in image processing, in order to process and interpret available data.

	Satellite observation datasets come in open licence and proprietary formats. Those datasets that are proprietary have to be licenced for use and some open datasets are limited and require payment for access to the detailed level data required for research. The technological equipment, training and licencing requirements for using satellite data requires a considerable on-going financial commitment to access and use these resources for research purposes. Field work plays a role in Environmental research both on its own and in tandem with the satellite observation data. Samples from the field have to be taken and analysed in the lab in order to verify hypotheses around the satellite data. Increasingly research in environmental science is international and collaborative which necessitates the need for travel and often cross discipline research which is more expensive to undertake than the traditional single disciple research that was performed in the past. **2. Changes in the balance of research activity between constituent discipline areas covered by Unit of Assessment 17.** **3. Changes in levels of support required by academics active in research in the disciplines covered by Unit of Assessment 17, specifically in terms of** • **Research Assistants or equivalents;** • **Specialist support staff such as technicians;** • **Access to specialist research equipment, infrastructure and facilities.** An increase in the use of massive earth observation datasets has driven the need for specialists with the computational skills required for big data retrieval and manipulation.

As satellite data can also be image based there is a need for researchers to be skilled or have adequate support to enable the interpretation of these datasets.

Using massive datasets requires suitable computing infrastructures to support the collation and aggregation of data – this infrastructure requires ongoing financing for maintenance and support from suitable trained technicians to optimise, upgrade and manage.

The move to an increase in laboratory based research also brings with it the need for technicians for maintenance and training and an ongoing financial overhead for consumables and laboratory space.

4. **Changes in the volume (ie number and/or size) of research grants won per researcher active in the disciplines covered by Unit of Assessment 17.**

Year	Researcher count	No. Awards	Sum of Awards (£000's)
2017-18	**8**	**12**	**660**

5. **Any other sources of evidence that might illustrate any changes in the absolute costs of research activity in the disciplines covered by Unit of Assessment 17 since 1997-98.**

Institutional TRAC returns show that the recovery of full economic costs at the institution is in steady decline.

In the year 2011/2 TRAC recovery of full economic cost on research was 71.9% in the latest TRAC return of 2017/8 this is sitting at 60.7%.

University of Aberdeen

Research income	2001 UoA	FTE submitted	1997/98*	2008 UoA	FTE submitted	2006/07**	2014 UoA	FTE submitted	2017/18***
Geography	(35)	19.24	152,753	(32)	25.7	401,483	(7)	10.2	769,151
Town and Country Planning	(34)	16	234,723	(31)	7.9		(13), (14)	9	373,843
				(32) incl Archaeology			(15)	9.4	396,360

*RAE2001 income metrics

**Minor Volume Indicator submission to SFC 2009

***REF2014 income metrics

PDRA/PGR metrics from Minor Volume Indicator Returns 2001 and 2009; Integrated Research Reporting (IRR)									
	PDRAs	PDRAs	PDRAs	PGRs		PGRs		PGRs	

Research income	2001 UoA	FTE submitted	1997/98*	2008 UoA	FTE submitted	2006/07**	2014 UoA	FTE submitted	2017/18***
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				(32) incl Archaeology			(15)	9.4	396,360

*RAE2001 income metrics

**Minor Volume Indicator submission to SFC 2009

***REF2014 income metrics

Snapshot	31 Mar	31 Mar	31 Mar 200	31 Mar 200	31 July 201	31 July 201	1 Dec 96	1 Dec	1 Dec 200	1 Dec 200	31 July 201	31 July 2018

	96	99	5	7	7	8		99	4	6	7	
Town & Country Planning	7.5	10.8	0	-			12	6	9	5.5		
Geography	7.4	2.3	6.7	6	12.35	4	19	13.5	16.5	18.5	14.05	19.68
Archaeology					2	5.8					8.93	8.25
Total	14.9	13.1	6.7	5.5	14.35	9.9	31	19.5	25.5	24	22.98	27.93

Please note that the department has undergone a substantial shift in focus and size over the period.

1. **Changes in research practice in areas covered by Unit of Assessment 17.**

Geography at Aberdeen has changed significantly since 1997-98. It is currently best described as data-driven in its research profile. It is heavily reliant upon field-based data collection, laboratory-based sample analyses and computer laboratory data analyses (geospatial data in particular). The field-based data collection spans both the human and physical sides of the discipline and involves for example mapping and monitoring (including airborne drone surveys), physical sample collection, interviewing and questionnaire-based data collection. Intensive computer-based data collection and analyses include mapping from remotely sensed data and data-mining of large volumes of geospatial and social media content, for example, twitter feed (related in particular to transport planning research) and some of these activities come under the “big-data” banner.

All aspects of geographical research at Aberdeen require significant effort on data analyses. Human Geography

research activity aligns more traditionally with disciplines such as Psychology but over the past decade also with Computing Science, Transport Planning and Engineering, and Biology (within Environmental Science and Management). Physical Geography research aligns directly with Geology, Computing Science, Chemistry, Biology and Soil Sciences. Staff in Geography at Aberdeen collaborate with staff in all these disciplines within the Institution. This provides a clear pointer towards an increased subject weighting for Geography at Aberdeen.

2. **Changes in the balance of research activity between constituent discipline areas covered by Unit of Assessment 17.**

In RAEs 2001 and 2008 Geography was submitted to the Geography Panel, Unit of Assessment (UoA) 35 and 32 respectively. However, in order to more clearly reflect the cost of the research in REF 2014 approximately half of the Geography staff were submitted to UoA 7 (Earth and Environmental Sciences), with three going to UoA 17 and 5 to UoA 16. For REF2021, we are considering submitting the majority of Geography research to UoA 7, and transport research to UoA 12 (which also attracts a higher subject weighting). The choice of UoA to which Geography staff will be submitted most clearly demonstrates the fieldwork oriented, lab intensive (both ITC and analytical), data-driven research that is now the focus of the discipline at Aberdeen.

The choice of UoA to which we will be submitted is a clear pointer towards the true cost of the research activity which is undertaken within Geography at Aberdeen. This requires expensive field equipment, high quality analytical and computing laboratories and intensive effort by PhD students, Postdoctoral Research Fellows and staff related to data processing, analyses and interpretation. This demonstrates the need for an increased subject weighting for Geography in order to align with subjects such as Geology, Computing Science, Transport Planning and Engineering, Chemistry, Biology, Soil Science and Environmental Science and Management.

3. **Changes in levels of support required by academics active in research in the disciplines covered by Unit of Assessment 17.**

Across the review period the levels of support provided internally and secured via external grant funding have

	changed significantly. The nature of the funding environment is that the numbers of grants have decreased while the value of grants awarded have increased. This has fuelled a shift across Geography whereby grants have increased in value and essentially all awards in excess of around £80,000 will employ Postdoctoral Research Fellows who are essential to support the major efforts required for data collection and analyses. Indeed Geography took the lead on a very large grant of ~£12 million awarded by the EPSRC in 2009 to the University of Aberdeen, dot.rural, the RCUK Digital Economy Hub focusing on the rural digital economy. Since then, a highly competitive funding environment and internal re-structuring and re-focusing has led to a reduction of specialist support staff numbers. Where funders allow, specialist support staff time is now charged directly to grants which may require employment on fixed term contracts. The need for specialist research equipment has also changed. Equipment is now shared across Schools so what is held by any individual discipline does not reflect the breadth of equipment required. Geographical research utilises high-specification analytical equipment, for example, electron microscopy, mass spectrometers, isotope analysers and also has an ever-increasing requirement for high performance computing. This reflects the nature of the modern Geography research environment and the increasing support costs in terms of both staffing (especially Postdoctoral Research Fellows) and equipment. **4. Changes in the volume (ie number and/or size) of research grants won per researcher active in the disciplines covered by Unit of Assessment 17.** As noted above the nature of the funding environment has changed over the review period. The number of grant applications submitted per year per active FTE staff has unquestionably increased as has the value of grants applied for and those awarded. **5. Any other sources of evidence that might illustrate any changes in the absolute costs of research activity in the disciplines covered by Unit of Assessment 17 since 1997-98.**

	The most obvious illustration of the cost of research in Geography at the University of Aberdeen is shown by the change in UoA to which Geography staff have been submitted. In REF 2014 and for the upcoming exercise the choice of Unit of Assessment is dictated by the cost of that research to the Institution. The vast majority of research in Geography has the same costs to that undertaken in, for example, Geology, Biology, Computing Science, Transport Planning and Engineering, Soil Science and Environmental Science and Management. In recognition of this SFC may wish to consider raising the weighting for Geography to equivalent to the subject areas noted above. Failure to do so will, following the law of unintended consequences, lead to the abandonment of submissions to the Geography REF Panel, as institutions across Scotland will follow the path taken by Edinburgh, Aberdeen and Glasgow in the recent past.
University of Dundee	Geography at Dundee has a significant research portfolio in the application of both social sciences and the physical sciences. We undertake generating new understandings through policy-relevant research in both the physical and human environments. In the area of Physical Geography in particular, we are increasing our use of large datasets that require high performance computing for data analysis, visualisation and dissemination of products. For example, the current increase in the availability of satellite-based Earth Observation data (from both ESA and NASA) means that researchers have access to significantly larger and more comprehensive datasets regarding many critical Earth and ecosystem properties that enable new types of research relating to environmental and climatic change, but only if appropriate computing power is available. At more local scales, the development of new technologies, such as terrestrial laser scanning, UAV-based observations and the increasing use of *in situ* sensors for hydrological, chemical and sedimentological analysis, mean that new research into physical processes that occur with high temporal and spatial frequencies can now be studied in ways that were not possible a mere decade ago. This, though, requires both the purchasing and maintenance of this new equipment, along with training and support in order to maximise the opportunities in any investment. This has significantly increased (by more than 50%) the financial costs of running viable laboratories for these kinds of research.

UKRI	We completed a comparison exercise of grant information for the two financial years 2007/08 and 2017/18. We compared the total value of awards classified against the above UoAs and the cost headings within these awards to identify any changes in costs attributable to defined areas of spend, such as staff costs. These data provided no compelling evidence of significant shifts in costs for any of the above UoAs. Data access restricted our analysis to grants data from 2007 onwards. In addition, the sample size of grants was small for each UoA (e.g. 35 awards for UoA17 in 2007/08) limiting the power of any analysis. Further analysis might identify subtle changes in funding patterns within these UoAs but we do not currently believe there to have been any significant shifts between these periods.
University pf St. Andrews	1. Changes in research practice in areas covered by Unit of Assessment 17. In broad terms: • Staff numbers have grown (doubled) and technical support to research has declined • Significant growth in research in sustainable development (and in 2017 with the School renamed the School of Geography and Sustainable Development) • Changes to costing of research grants (FEC, modernisation of research staff pay). Growth of FEC-costed research activity, with research conducted by growing numbers of postdoctoral and independent researchers • Closer accounting of staff research and teaching time (both institutionally, with workload models, and through FEC and similar accounting and audit procedures) • General shift away from large (£1m+) grant income generation in particular areas (housing and health inequalities – 1997-2014) to a broader range of medium-to-large grant income generation (£0.1m-£1m – 2014-present) across the spectrum of geography, and with a mixture of FEC-costed and non-FEC-costed research

- Growth in 'intersecting' (sometimes called 'interdisciplinary') research projects that cross physical and social science domains in the School, and with a growth in funding sources and calls that promote more hybrid social science-natural science projects

- Less 'blue-sky' research and research into fundamental questions now than in 2007-08 or 1997-98, and unfunded research is less valued now than it was then

- Increased involvement in large public engagement and impact activities, particularly since 2008

2. Changes in the balance of research activity between constituent discipline areas covered by Unit of Assessment 17.

The main change with the Unit of Assessment 17 within the School of Geography and Sustainable Development has been the creation of the School itself, in 2017. In 1997 Geography comprised a Department in a School of Geography and Geology, and then Geography and Geosciences, and with complementary and intersecting research expertise in earth surface and deep earth processes.

A Sustainable Development programme was established in 2004 as a cross-School research and teaching programme that formed part of the University's drive towards sustainability, and a growing cohort of Sustainable Development-facing staff – specialising in research in biodiversity, communities, energy, technology, well-being - have been based in the School since 2010 (and with staffing in this area varying between 4 and 8 FTE staff since then). Staffing in the School has grown (doubled) since 1997, from 16 (a number of whom were in Geology) to 32 FTE staff at a peak, and currently at 27.

Since 1997-98 there has been a fluctuation in research staffing and activity in the physical science (physical and environmental geography) end of Geography's disciplinary spectrum, chiefly due to organisational changes in the

	Department/School. But at the time intervals stipulated - 1997-98, 2007-08 and 2017-18 – there were roughly equal numbers of researchers in physical and human geography (albeit a larger number now than in 1997-98). The establishment of the current School in 2017 provided an impetus to expand and consolidate research in the environmental studies area of UoA 17, with significant investment (growth in research income and outputs, and staff and postgraduate recruitment) in environmental geography (nature-society interactions, and palaeoecology), and Geographical Information Science research (including remote sensing). Since 1997 research in environmental change (especially glaciology, and currently also palaeoecology), and in population and health research (demography, housing and health inequalities, mixed – quantitative and qualitative – social science research), which comprise two of the School's three groups, have been key to the School's research profile and reputation, and to core funding from research councils, charitable bodies and other organisations. The School's third research group, GOSSIP (Geographies of Society, Sustainability, Inequalities and Possibilities) was established in 2018 and with its staff and postgraduate research complement drawn from human geography, environmental geography and sustainable development. The 'intersecting' research noted in 2 (above) involves collaborations across the three research groups, as well as an array of collaborations with external/international partners, and has also been nurtured in recent years by a growing number of FEC-costed and non FEC-costed funding sources and calls that promote social science-natural science collaborations. This, along with the growth in the environmental studies (environmental geography and sustainable development) area of the UoA in the School's overall research profile, reflects broader disciplinary trends and funding initiatives (including, most recently, the Global Challenges Research Fund). **3. Changes in levels of support required by academics active in research in the disciplines covered by Unit of Assessment 17, specifically in terms of** The School has operated in an increasingly mixed and sub-divided system, and currently with most FTE staff on research-and-teaching contracts and a small number on teaching-facing contracts. There has been a general rise in research assistants funded via research grants (especially FEC-costed researchers) and a gradual decline (from 5 in 1997 to 2 on 2017-18) in technicians funded institutionally (by the University, or through the School), and changing

	access to University-funded research equipment, infrastructure and facilities, with a greater reliance in recent years on site-licenced computer software and hardware (particularly in connection with GIS and remote sensing research). A growing proportion (particularly since 2005) of staff and equipment support has been costed and provided through research grant applications. **4. Changes in the volume (ie number and/or size) of research grants won per researcher active in the disciplines covered by Unit of Assessment 17.** There have been fluctuations of between £0.8m and £2.5M in research income – between £1.2M and £2M most years, and £2.7M in 2008-09 and £1.72M in 2017-18 (figures for 1997-98 could not be ascertained) - rather than a significant trend (either of growth or decline) in the number and type of research applications, income and PIs. Increases per se in the volume of research grants has been affected by the introduction of FEC rules in 2005, and the modernisation of research staff salary scales in 2006. Many post-2005 FEC-costed research grants have been costed at up to three times the amount they would have been pre-FEC, albeit with a good portion of this extra resource going to research support (post-doctoral researchers, research assistants, and access to specialist equipment, for example) rather to fund more expansive/lengthier field work. Calculations regarding the volume of research grants are also impacted by local institutional (university and school) rules and guidelines about the percentage of overhead return. Fluctuations in grant income between 1997-98 and the present have come against the backdrop of a steady rise in the number of FTE staff in the School and a general increase in the number of FTE staff securing research grants. Overall, there is a lower mean per researcher today than there was in 2008-09, and certainly between 2008-09 (when a small number of individuals held very large grants) and 2017-18 (with fewer staff holding very large grants, although very large grants are still being attained – most recently a 5-year ERC grant in Population/Demography for £2.5M). On the one hand, externally funded research has remained transient: i.e. temporary, as the funds exist and are

	spent. On the other hand, consistent and continuing pools of research income (from diverse sources) have been generated by bespoke research centres and clusters in the School and through wider networks (for example, the School's Centre for Housing Research, and St Andrews Geography's stake in the UK-wide Centre for Population Change, and the NERC DOMINOS project). **5. Any other sources of evidence that might illustrate any changes in the absolute costs of research activity in the disciplines covered by Unit of Assessment 17 since 1997-98.** A greater priority is now placed on Impact (and what constitutes impactful research) than it was in 2008-09, and with the School performing very well in the Impact category in REF 2014. There has been an increase in research costed and funded through impact pathways, and with new School and University funds to facilitate this activity.

University of Aberdeen

Archaeology	Research spend	REF eligible staff	Post-doctoral staff	Other T/R academic staff
2007-08	0	2.2 FTE	0	0
2017-18	£396,360	6 FTE	3.8	0

Table 1: Changes in research spend (£/pa) and research staff (FTE) over the past decade in the

1. Changes in research practice in areas covered by Unit of Assessment 17.

As shown in Table 1, Archaeology at Aberdeen has changed significantly since 2007-8, a situation mirrored by many Departments across Scotland and the UK. At Aberdeen, 2007-8 was the year in which a rich-history of research in the past was consolidated with the establishment of a dedicated Department of Archaeology. Housed in the School of Geoscience (as opposed to with the humanities), the intellectual and physical situating of the Department was deliberate and reflects the well-established natural science focus of contemporary archaeological

	practice – with the sciences best equipped to host a future-forward faculty. The Department now has six members of staff, and is still growing – by 2019 we will have 10FTE and 4.8 post-doctoral staff. The changes seen at Aberdeen over the last ten years are not just a reflection of its inception and growth, but also reflect broader changes in UK Archaeology in recent decades. Archaeology as a discipline has expanded and shifted its foci, incorporating STEM themes and approaches, leading to the flourishing of computational archaeology, materials science, bioarchaeology, geo-archaeology and environmental archaeology. In particular, the expansion of the scientific study of human and animal remains – bioarchaeology – has blossomed, and now includes overlaps with biochemistry, genomics, proteomics and other advanced approaches. This has certainly been the case at Aberdeen, as reflected in the on-going expansions in staffing covering these areas, specifically the appointment of an specialists in isotope analysis, osteoarchaeology and ancient genetics. In turn, the cost of research has increased, largely due to the need for dedicated laboratories and other facilities, and analytical expertise and services. These not only require the initial costs of set up and equipping, but also on-going running expenses to undertake laboratory-based sample analyses. With the impending appointment of a Lecturer in Ancient Biomoleules (from September 2019), we will require access to DNA extraction laboratories and sequencing facilities based in the Medical School, but dedicated facilities will increasingly be imperative. Since 2007-8 we have also set up a stable isotope/archaeological chemistry laboratory, a conservation space, faunal analysis and soil processing laboratories and regularly utilise two general laboratories, all of which reflects a shift towards archaeological science as a main focus of our research. At the same time Archaeology remains a fieldwork and practice-based discipline with field schools and fieldwork a primary means of data collection. These are also costly activities with the mapping equipment and software increasing the costs of fieldwork research. At Aberdeen field-based approaches are key to research with large-scale projects in Alaska, Scotland and Mongolia/China. The field-based research increasingly requires expensive geospatial field equipment such as drones and GPS technology, as well as high power computing facilities and dedicated software to process, analyse and access these data. Techniques such as photogrammetry, laser-scanning and Lidar are data and computer processing intensive, and a number of ‘big data’ and inter-university projects are

	now being undertaken at Aberdeen. **2. Changes in the balance of research activity between constituent discipline areas covered by Unit of Assessment 17.** As noted above, across the UK and Aberdeen there has been a notable shift towards science-based archaeological projects – in 2007-8 there were no archaeological science-based academics at Aberdeen, in contrast as of 2019 archaeological science will be one of the Department's main research areas. As well as incorporating science-based specialisms, Archaeology has also grown in size and influence as a distinct field and now has its own REF panel to reflect these big changes in the discipline. Nationally, Archaeology was formerly part of the Geography Panel, Unit of Assessment XX?, but has moved on to incorporate closer collaborations and alignments with biology, medical sciences, as well as physical geography, and the geospatial and environmental sciences. Hence this diverse, multi-faceted field requires its own unit of assessment. As noted above most of our research now requires some form of laboratory component with seven laboratories at the university now solely or partly dedicated to the teaching and research components of our discipline. **3. Changes in levels of support required by academics active in research in the disciplines covered by Unit of Assessment 17.** The huge increase in number and award level of grants (see Table 1, and point 4 below) has meant a very significant increase in the level of support required by research projects in archaeology. The average size of a grant has grown from tens of thousands of pounds to hundreds and the department has been awarded two c.£1 million pound grants. The numbers of postdoctoral and PhD researchers within the department has subsequently increased year-on-year with real issues in terms of accommodating the number of researchers that archaeology

research projects require – not least since significant proportions of Aberdeen's grant income originates from non-FEC sources (e.g. Leverhulme, British Academy, charitable donations, etc).

The shift towards archaeological science has resulted in much greater demands for analytical equipment and services which in a number of cases can only be obtained through strategic collaborations with other institutions, or as commercial analyses. The possibilities of purchasing new equipment is limited given that cost recovery and overhead contributions are generally low for core equipment and analytical services as archaeology is only rarely able to apply for 'pure' science funding and facilities grants despite the overall shift towards scientific analysis being a core component of archaeological research projects.

4. Changes in the volume (ie number and/or size) of research grants won per researcher active in the disciplines covered by Unit of Assessment 17.

The archaeology department at Aberdeen has seen huge growth in research grant capture since 2007-8. This has included the institutions' largest ever AHRC grant for a project looking at climate change in pre-contact Alaskan indigenous communities (£1.1m); the institutions' only Leverhulme Leadership award that was funded (£979,149) for the Comparative Kingship project. Most recently, Archaeology at Aberdeenhas been awarded over £250K for a major archaeological science project on Pleistocene faunal biogeography and the implications for Neanderthal subsistence strategies, PleistoHERD. Overall, the Department has gone from very small research grants (2-20K) to large, multi-institution (and cross-disciplinary) grants with multiple postdoctoral researchers and research that leans heavily toward archaeological science and inter-disciplinary approaches, with research income growing year-on-year.

5. Any other sources of evidence that might illustrate any changes in the absolute costs of research activity in the disciplines covered by Unit of Assessment 17 since 1997-98.

The lab component is the most obvious indicator of the shift towards the STEM subjects in our research. Five dedicated labs and access to two others requires significant investment in space, equipment and support. While

	research grants enable the hiring of project personnel, and meet the costs of project-based consumables and small equipment, the long term equipping and provisioning of these laboratories for non-funded projects (including pilot work ahead of grant applications) requires long-term, sustainable resourcing. These needs will only increase with time, both on an institutional level (with the appointment of Aberdeen's latest Archaeology hires), and in the field as a whole, as archaeology ever-increases its hard-science focus.
University of the Highlands and Island	**1. Changes in research practice in areas covered by Unit of Assessment 17 at the University of the Highlands from 1997/8-current.** In the 2014 REF, Archaeology was included with Geography and Environmental Studies. In 2021, as in earlier research exercise cycles, however, it will be considered as an individual discipline. As such, this review will only consider the situation for Archaeology at the University of the Highlands and Islands. Archaeology is concerned with the study of human societies in the past through the recovery and analysis of material remains. Although traditionally aligned with the historical disciplines, since 1997/8 there has been a major shift within the subject area towards the application and development of scientific approaches in archaeology to the extent that archaeological science is now firmly embedded within the teaching and research culture of most Archaeology Departments within the UK, including the University of the Highlands and Islands. Archaeology was established within the UHI as an academic area in 1999. Research capacity has developed subsequently, rising from a FTE of 3.3 on the subject area's first subject entry into the RAE in 2008 to a projected 11.4 FTE in 2021. Concomitant with wider development across the discipline, this expansion in capacity has included development of research expertise and facilities in scientific archaeology, here in the areas of Geophysics and Environmental Archaeology. This includes the appointment of lecturing staff with specialisms in Survey and Geophysics (1FTE, 2007), zooarchaeology (1FTE, 2009), palynology and geoarchaeology (1FTE, 2012) and non-vertebrate zooarchaeology (0.5FTE, 2014). This has required development of new laboratory facilities and of technical support staff (1.5FTE) in these areas, supported by infrastructural investment (eg the Environmental Geophysics Project c. £400k and the Marine

	Historic Environment Project c. £500K, funded by ERDF, HIE, & OIC) and investment in commercial archaeology activities through the development of an in-house commercial archaeology unit, ORCA. A further major change to Archaeology at the UHI was the area's achievement of UHI Institute status in 2015. This was associated with expansion in staffing and additional infrastructural support (c.£600k, supported by HIE, UHI, OIC, Robertson Trust), further enhancing existing laboratory facilities and providing for new fieldwork and survey equipment. **2. Changes in the balance of research activity between constituent discipline areas covered by Unit of Assessment 15 (Archaeology).** 1997/8: 0 researchers in UoA15 (Archaeology) in this year 2007/8: 3.3 researchers in UoA15 (Archaeology) in this year 2017/18: 11.4 researchers in UoA15 (Archaeology) in this year **3. Changes in levels of support required by academics active in research in the disciplines covered by Unit of Assessment 15 (Archaeology), specifically in terms of** Research Assistants or equivalents; • 1997/8: 0 researchers in UoA15 (Archaeology) in this year • 2007/8: 2 researchers in UoA15 (Archaeology) in this year • 2017/18: 4 researchers in UoA15 (Archaeology) in this year

	Specialist support staff such as technicians • 1997/8: 0 support staff in UoA15 (Archaeology) in this year • 2007/8: 2.5 support staff in UoA15 (Archaeology) in this year • 2017/18: 5 support staff in UoA15 (Archaeology) in this year • Access to specialist research equipment, infrastructure and facilities. 2003: Geophysics – c. £250K (ERDF, OIC) 2011: Environmental Geophysics Project – c. £400K (ERDF, HIE, & OIC) 2013: Marine Historic Environment Project - c. £500K (ERDF, HIE, & OIC) 2015: UHI Archaeology Institute funding package, c. £600K (HIE, UHI, OIC, Robertson Trust) **4. Changes in the volume (ie number and/or size) of research grants won per researcher active in the disciplines covered by Unit of Assessment 3.** 1997/8: 0 researchers in UoA15 (Archaeology) 2007/8: Research spend associated with grant income for this year was £134,000 (out of a total spend from 2000-2008 of £472,392) 2017/18: Research spend associated with grant income for this year was £412,000 (out of a total spend from 2014-2018 of £1.46m).

University of Glasgow	**Response from Archaeology (College of Arts) and Geography (College of Science and Engineering) at the University of Glasgow** **_____** Preamble: The University of Glasgow (UofG) requested that two separate submissions be made to REF2014 UoA17: one for Archaeology and one for Geography.

At UofG these two research units are located in separate Colleges with no shared management, strategy or infrastructure, and so it was appropriate for them to be returned separately. In addition, a strategic decision initially taken for REF2008 and then confirmed for REF2014 split Geography into a cohort of Human Geographers who comprised the UofG submission to UoA17 and a cohort of Physical Geographers who were entered, along with the University's Earth Scientists and staff from the Scottish Universities Environmental Research Centre (SUERC) at East Kilbride, into the UofG submission to UoA7.

Physical Geography nonetheless still clearly comprises one of the "constituent discipline areas" covered in the UoA17 descriptor for REF2014, and the same will be true with respect to the UoA14 descriptor for REF2021. As such, our responses to the SFC questions will report in terms of Archaeology and Geography, with the latter being taken to include Human Geography and Physical Geography. We provide two tables below, under *Questions 3* and *4*, furnishing data where possible that aligns to the suggested time points: 1997-1998; 2007-2008; 2017-2018.

1. **Changes in research practice in areas covered by Unit of Assessment 17.**

    - *Archaeolog*y: The trajectory of this discipline is placing increasing weight on digital approaches to the study and representation of the past, on ways in which archaeological research can engage with wider society, and on landscape archaeology. These are all aspects which archaeology at Glasgow is heavily engaged through its research clusters in digital archaeology, engaged archaeology, and landscape and material culture. Research within Digital and Computational Archaeology Research Cluster has been a focus of the unit since the late 1990's and continues to adapt and develop to meet the changing technological landscape (e.g. the opportunities afforded by VR/AR). Engagement archaeology draws on a long Glasgow-tradition of public archaeology and leadership in the heritage sector. Landscape Archaeology at the University of Glasgow focuses on the development of new approaches to data collection, analysis and interpretation. This area is enriched through collaborations with colleagues at the Scottish Universities Environmental Research Centre, bringing an emphasis on environmental archaeological approaches to understanding the landscape, through active engagement with colleagues at Historic Environment Scotland.

	• *Geography*: The discipline entails the rigorous deployment of field, laboratory and interpretative methods alongside diverse theoretical framings of how space, time and scale shape processes and landscapes across the Earth's physical and human surfaces. Research practices have combined continuity since the late-1990s with significant shifts in technical and conceptual emphasis, the latter of which have been associated with greater demands on resourcing of fieldwork (increasingly and necessarily global in reach), equipment (for field and laboratory), computational capacity and the human support (from research assistants and technicians) required for all these activities. The discipline is inherently and growingly *inter*disciplinary, forging new alliances in many different directions with the life sciences, data sciences, engineering, the humanities and more, also with resourcing implications (in building teams, collaborations, networks and shared capacity in terms of staff expertise, training, mobilities, etc.). The discipline has also been a leader in extending its influence beyond the academy, seeking to be accessible, relevant and impactful to wider society in tackling 'big questions', again with resourcing implications (in fostering partnerships, creating products and services, curating and communicating knowledge, etc.). These developments characterise both the discipline in general (nationally and internationally) and the marked upward curve in endeavour and achievement displayed by UofG Geography. • *Human Geography* at UofG has deepened its use of social-scientific methods (especially forms of interviewing, ethnography and discourse analysis), enhanced with new digital-analytic and humanities-facing methods, to address enduring questions about environment-society or people-place interactions within new frames (such as the Anthropocene, urbanisation, austerity, health inequalities and associated global challenges and stressors). • Physical Geography at UofG has seen the application of hitherto unavailable and highly sophisticated analytical technology and computational capacity – for observation, instrumentation and recording; for dating, mapping, modelling and prediction – to address enduring questions about the ages of landscapes, rates of erosion and deposition shaping landscapes, and the articulation of short-term

processes and longer-term structural changes in/of landscapes (with growing attention to past, present and future trajectories and effects of climate/environmental change).

2. Changes in the balance of research activity between constituent discipline areas covered by Unit of Assessment 17.

Archaeology:

The significant change to Archaeology has been a restructure in the 2000s which removed the contract archaeology division (GUARD) from the subject area. The result has been an increased focus on research within the subject area and strategic development and growth in areas such as Spatial Archaometry. In RAE2001, submission to UoA58 had a return of 23.95 FTE, RAE 2008 return to UoA33 submission had 20.86 headcount and REF2014 UoA17B had a return of 9.55 FTE: we envisage a significant rise in FTEs for REF2021.

Geography:

Notwithstanding the strategic decision to return UofG Physical Geographers to UoA7, there have been no significant changes in the balance between Human Geography and Physical Geography since the late-1990s. Staffing levels have increased for the overall Geography staff cohort, but with little change in the relative proportions of staff whose primary research interests lie within respectively Human and Physical Geography.
For RAE2001, UofG made a single Geography return in which 10 FTE staff members were returned under our Human Geography cluster and 10 FTE staff members under our Physical Geography cluster. The equivalent figures for 2017-2018 are, respectively for Human Geography and Physical Geography, 12.60 and 12.81 FTE staff members, showing that the 50:50 balance from 2001 has been essentially retained.

3. Changes in levels of support required by academics active in research in the disciplines covered by Unit of Assessment 17, specifically in terms of

	• **Research Assistants or equivalents;** • **Specialist support staff such as technicians;** • **Access to specialist research equipment, infrastructure and facilities.** *Archaeology***:** • *Research Assistants or equivalents and specialist support staff such as technicians:* Archaeology has seen a small increase in RA staff which is in line with the increase in research income for the subject area. • *Access to specialist research equipment, infrastructure and facilities:* The research environment hosts a microscope laboratory, furnace and kiln, flint knapping pit, cold room and freezers, DSLR cameras with a range of lenses, thin section facilities, fume cupboard and laboratory spaces. We collaborate with cognate disciplines across the university to access laboratory equipment for computed tomography, scanning electron microscopy and organic residue analysis. For us, as other in the subject area, access to SUERC – and hence the continued proper level of resourcing for SUERC – is vital. *Geography* • *Research Assistants or equivalents and specialist support staff such as technicians*: Notwithstanding either stasis or minor decreases in the absolute numbers and per academic FTE loadings of research assistants (and equivalents) and technicians across GES – it not being possible or meaningful to disaggregate these figures between Geography (Human and Physical) and Earth Sciences – it remains the case that the availability of such human expertise in supporting the new fieldwork and analytical-technological demands of Geography research is indispensable: the quality of the resulting science will be seriously compromised without such 'resource'. In no way should this small drop be taken to indicate any *lessening* of the support required here. • *Access to specialist research equipment, infrastructure and facilities:* This access has been fundamental to endeavour and achievements in Physical Geography, with acute relevance to UofG Physical Geography. For us, indeed, access to SUERC – and hence the continued proper level of resourcing for SUERC – is vital. SUERC is a world-leading facility for geochronological analyses and environmental isotopic tracers, notably through it being home to more than 30 mass spectrometers, at the heart of

	our vision and practice for UofG Physical Geography (and Earth Sciences). Complementary analytical capacity, involving machines and computational power, has also been developed on site at UofG and requires ongoing resourcing to ensure the continual upgrading essential for continuation of cutting-edge research inquiry (and with applications for postgraduate work and undergraduate teaching). **4. Changes in the volume (ie number and/or size) of research grants won per researcher active in the disciplines covered by Unit of Assessment 17.** *Archaeology* Archaeology has seen a marked increase in research funding since the late-1990s. The creation of distinct research clusters has allowed the subject to better target funding income. Strategic appointments have also contributed to the increase and value of research income. *Geography* There has been a marked upwards trajectory in the winning of research grants (numbers and total income) by UofG Geography overall since the late-1990s. It is hard to disentangle differences between Geography (Human and Physical) and Earth Sciences before the 2000s, but what can be clearly seen by comparing the suggested time points for 2007-2008 and 2017-2018 is that both UofG Human Geography and Physical Geography have substantially – and in the former case, quite dramatically – improved their standing with respect to grant capture. The key point to be made is that this improvement reflects both well on the efforts of the staff involved *and* the genuine increase in resourcing requirements for the production of the highest-quality Geography research. **5. Any other sources of evidence that might illustrate any changes in the absolute costs of research activity in the disciplines covered by Unit of Assessment 17 since 1997-98.** *Archaeology*

	Restructure and subsequent growth signal a move toward an investment in fields that will require greater resource and technical/RA support which should be supported. *Geography* Our strategic decision from RAE2008 onwards to submit our Physical Geographers together with our Earth Scientists, and with staff from SUERC, has principally been driven by the reality of close intellectual and practical working relations emerging between these three cohorts. In other words, it really has made good academic and organisational sense to proceed along these lines 'on the ground' and in how we present ourselves to research assessment exercises. That said, close working relations continue to exist between the Physical Geographers and their Human Geography colleagues, with some shared research and postgraduate supervision, and also with close integration in the delivery of our undergraduate Geography programme. Additionally, though, the above-mentioned strategic decision has also reflected the recognition that the subject weighting ('unit of resource' return) for disciplines submitted to the Earth Sciences/Environmental Sciences RAE/REF SubPanels has historically been greater than that for disciplines submitted to the Geography RAE/REF SubPanels (in their various incarnations, with or without Archaeology). Such a weighting realistically mirrors the resourcing requirements of modern Physical Geography. In this regard, we would wish our remarks here to be cross-referenced with the Response to the SFC Consultation that is being forwarded separately from the Royal Scottish Geographical Society.