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| **Institution:** University of Chester |
| **Unit of Assessment:** 14 Geography and Environmental Studies |
| **1. Unit context and structure, research and impact strategy** |

### 1.1. Context and Structure

The submission reflects the research activity of 12 Category A submitted staff within the Department of Geography and International Development (GID), comprising 1 Professor, 2 Associate Professors and 9 Senior Lecturers (11.6 FTE). Research and impact activities are concentrated in three GID research groups (Figure 1). The 'Global Environmental Change and Hazard Management' group conducts research into *Hazard Management and Assessment, Earth Surface Processes*, and *Environment and Climate Change;* the 'Communities, Culture and Sustainability' group into *Culture, Identity and Consumption, Sustainable Communities,* and *Transition and Development;* and the 'Technology Enhanced Learning and Student Partnerships' group into *Fieldwork and Technology*, *Student-Staff Partnerships,* and *Teaching and Learning Ethics*.

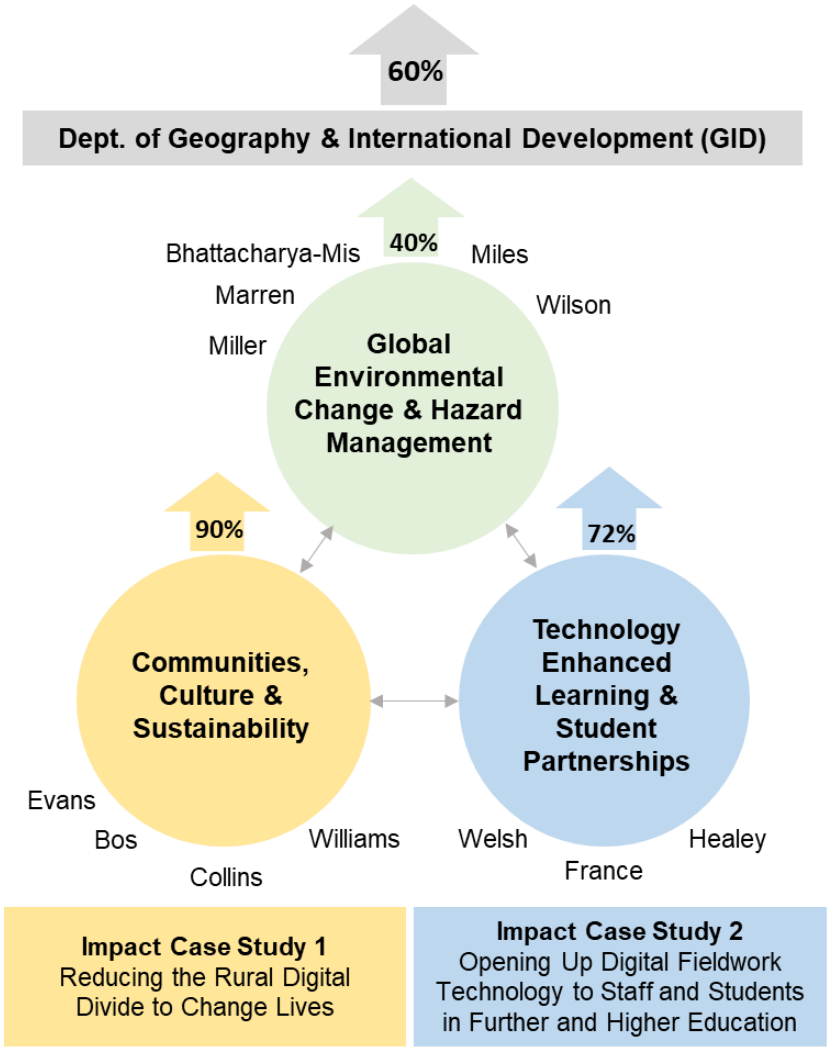


**Figure 1:** The three GID research groups showing Category A submitted staff, with the Impact Case Studies produced by the 'Communities, Culture and Sustainability' and the 'Technology Enhanced Learning and Student Partnerships' research groups. Arrows illustrate the percentage increase (compared with REF 2014) in original research outputs published in peer-reviewed journals collectively (**60% increase**) and by research group (**40–90% increase**). Connecting arrows represent the cross-disciplinary collaboration of academic staff.

The GID research groups emerged in the REF 2014 assessment period and are closely aligned to the four core themes of the University's Research and Impact strategy. An overarching GID strategy in the REF 2021 assessment period was to increase research and impact capacity in the areas represented by the research groups. **As a result of strategic investment and expansion, the REF 2021 UOA 14 return is based on 100% of Category A submitted staff drawn from GID (compared with 60% returned to the UOA in REF 2014).** This is reflective of the institution's broader REF 2014–2021 strategy to host an expanding University research environment. GID research and impact activities are managed and overseen by a research committee comprising the research co-ordinator and research group leaders. A GID ethics committee (of three academics with a rotating 12-month membership) meets five times per year to independently scrutinise all research proposals. The institution operates an open access policy; research outputs are deposited and made available (in accordance with copyright and licensing agreements) in the University of Chester Repository 'ChesterRep'.

GID staff **work across discipline boundaries.** Cross research group collaboration (represented in Figure 1) has been cultivated in the assessment period by an increased staff base, a high level of collegiality, and a strong ethos to innovate. GID-led inter-disciplinary research is held in high regard; our work into the application *of technology in field-based inquiry was described as 'transformative' by* Advance HE. Inter-disciplinary collaboration with external institutions and partners features prominently in our research. GID colleagues collaborate with planners and architects, for example, to assess flood risk and mitigate flooding impact (**Bhattacharya-Mis**, Output 10034/621248) and with communities, industry, and local government to explore rural digital inclusion (**Williams**, Output 10034/620527, 10034/621616). GID also encourages citizen involvement in research projects, in striving to achieve carbon neutrality in the village of Ashton Hayes (Cheshire), for example.

### 1.2. Strategy for research and impact

An overarching strategy in the assessment period was to increase the capacity for research and impact in the areas represented by each research group, to cultivate a stronger research culture within GID and to stimulate greater opportunities for inter-disciplinary collaboration. This has been achieved through targeted investment in staffing (27% increase in the staff base), infrastructure, and equipment, with strategy successes measured in terms of quality output production, stakeholder engagement, and wider contributions to the discipline research base. *Our strategy for impact is to provide targeted support for applied research of societal and educational relevance.*

*A proportion of internal (QR) income is ring–fenced annually to help the development of underpinning research, to aid outreach activities, to promote wider engagement with stakeholders, and to monitor and evidence the resulting impact. This strategy has been successful, and the resulting reach and significance of our work is exemplified in the impact case studies 'Reducing the Rural Digital Divide to Change Lives'* (Impact Case Study 1) and *'Opening Up Digital Fieldwork Technology to Staff and Students in Further and Higher Education'* (Impact Case Study 2). To increase further our capacity for conducting impactful research, GID played a central role in the formation of the Centre for Research into Environmental Science and Technology (CREST). With a £1.9 million grant from the European Regional Development Fund, CREST provides research support, development, and advice to small and medium business enterprises (SMEs) in the Shropshire, Telford, and Wrekin areas, to foster innovation and growth. CREST forms part of the University Centre Shrewsbury initiative to transform an area of low innovation and low investment in R&D into a vibrant research environment. We detail successes of this collaboration in Section 4.2.

### 1.3. Achievement of REF 2014 strategic aims for research and impact

*(i) Strategic growth.* In a period of strategic investment and expansion, GID has cultivated a vibrant and intellectually rigorous research environment. Investment in staffing, infrastructure, and equipment have led to improvements in research performance in each research group, a greater capacity for research and impact, and a maturing and broadening of existing research foci. GID has collaborated internationally and engaged in research addressing a range of prominent social and environmental issues, including system responses to past climate change, flooding, slope instability, coastal change, sustainable consumption, civil conflict, migrant and asylum seeker experiences, and has produced award-winning pedagogy research. Collectively, we have published 62 research

outputs in peer-reviewed journals, **representing a 60% increase compared with the REF 2014 assessment period**, and have generated over 40 additional outputs (edited book chapters, books, editorials). The overall increase not only demonstrates an improvement in research activity but a greater emphasis on developing and publishing original and rigorously peer-reviewed research. We have delivered over 100 conference papers (20% of which were keynotes) and actively promoted and facilitated research agendas through national and international conference and session organisation (39 conferences and/or conference sessions organised and/or convened), through developing and hosting international workshops (36 in the assessment period), and via activities including journal editorships and chairing of national research groups (Section 4.2). We have also provided knowledge exchange and professional service to regional, national, and international stakeholders, including contributions to Government policy (Section 4.2 and Impact Case Study 1). These activities and achievements demonstrate the vitality of our research groups and overall research environment.

*(ii) Expanding research expertise.* Strategic investment has led to an expansion in the scope and capacity of research activity, particularly in *Environment and Climate Change*. Notable achievements include: the discovery of persistent millennial-scale climate variability in Southern Europe during the penultimate glacial (Marine Isotope Stage 6, 185–130 ka) (**Wilson**, Output 10034/623953); *new insights into the tempo and phase relationships of aquatic and terrestrial ecosystem responses at a major climate transition (Wilson, Output 10034/579231); resolving flooding frequency and severity beyond the instrumental record (Welsh, Output 10034/622493); further development and refinement of novel methods to reconstruct Holocene sea-level change (Wilson, Output 10034/620591); quantifying hydrological and landscape response to recent and ongoing glacier recession (Marren, Output 10034/621348);* and resolving lake and catchment system disturbance and recovery from historical mining pollution (**Welsh**, Output 10034/621228*)*. Research activity in the *'Communities, Culture and Sustainability' group has also expanded into new and innovative areas.* A notable example is **Bos'** work at the intersection of popular geopolitics and critical military studies to investigate how popular culture contributes to framings of military violence and action. His use of video games as both research method and thematic focus has informed innovative exploration of games, gaming, and visual culture as a mechanism for communicating global issues to the public (**Bos**, Output 11111/140002, 11111/140001, 10034/623571). A number of these projects are large, collaborative endeavours (involving colleagues from the Universities of Cambridge, Sussex, St. Andrews, Manchester, Liverpool, Newcastle, and University College London, for example), and several are GID-led.

*(iii) Increased research capacity in key areas*
*Hazard vulnerability and mitigation:* Additional staff appointments, combined with existing research expertise, have consolidated a REF 2014 commitment to increase our capacity to produce innovative and societally relevant research in hazard vulnerability and mitigation. **Miles** has successfully demonstrated the novel application of LiDAR to monitor coastal change (**Miles**, Output 10034/622006), and **Miller** the novel application of high-resolution satellite imagery to map slope instability in the Caribbean (**Miller**, Output 10034/601056). **Bhattacharya-Mis** has engaged in a range of impactful research, including promoting knowledge-sharing in flood risk advice to the commercial property sector in the UK, US, Germany, Australia, and China (**Bhattacharya-Mis**, Output 10034/621248), investigating property level flood risk measures to reduce insurance costs (**Bhattacharya-Mis**, Output 10034/622307), and exploring the concept of social hydrology in a Brazilian context (**Bhattacharya-Mis**, Output 10034/623410). GID has engaged with communities on a range of hazard-related issues and challenges at local, national, and international levels. This includes work with the National Flood Forum and North Wales stakeholders to identify how best to support 'flood disadvantaged' groups, and work with community planners, policy makers and local community groups in the Caribbean to help communities become more hazard resilient.

*Sustainable community-environment interactions:* Strategic investment has led to an expansion in theoretical and applied community-level sustainability research, notably into material cultures and infrastructures and rural sustainability, which complements existing expertise in community carbon reduction. **Williams** has explored in detail digital exclusion in rural areas and the implications of this for sustainable rural futures (**Williams**, Outputs 10034/620527, 10034/621616, 10034/620528), and has demonstrated the transformative impact of broadband access on rural communities and

businesses (Impact Case Study 1). This impactful research involved community-level engagement and business partnership. GID has a history of nurturing community-level engagement to tackle issues such as flood vulnerability, carbon reduction, and sustainability, and continues to be successful in forging industrial and stakeholder partnerships. The initiative to achieve carbon neutrality in the village of Ashton Hayes (Cheshire) is now in its 15th year and is supported by a range of government-related (e.g., DEFRA, Energy Saving Trust) and non-government organisations (e.g., Oxfam, the Energy Institute), as well as various businesses (e.g., Scottish Power Energy Networks, Energy Saving Trust, United Utilities, Green Fuels). The success of this project (co-led by **Alexander**) is evident from the approximately 200 towns, cities and countries that have sought advice on implementation, and by prominent media coverage (e.g., New York Times front cover 22/08/2016; BBC TV interview with **Alexander** 02/05/2019). **Collins'** research focuses on the intersections of youth, consumer and material cultures, and cultures of creativity and craft (**Collins**, Outputs 10034/347316, 10034/622514). Her work on how craft and other practices of making can inform environmental awareness and care has drawn on ethnographic work with amateur makers and members of maker-spaces, and has fed into the AHRC Stitching Together research network. Furthermore, her (auto-)ethnographic work has informed growing methodological experimentation with art and craft practices as tools for cultural understanding of socio-spatial issues. **Collins** has also received RGS-IGB funding to examine how teen and young adult material consumption is shaped by complex social dynamics, information sources and external infrastructures challenging contradictory stereotyping of youth *vis-à-vis* sustainability.

*Inequality and vulnerability in the Global South:* GID is committed to producing important and wide-ranging research in this area. **Evans'** work focuses on the schism and reconstitution of communities at different scales amid West Africa's longest-running civil conflict (rooted in the separatist rebellion in Casamance, southern Senegal), with a focus on human displacement driven by the conflict and the complex dynamics of return and reconstruction (**Evans**, Output 10034/600713). **Evans** has also explored a range of issues related to paddy rice cultivation in Casamance, specifically the relationship between agro-ecological dynamics, social change, and development interventions, allowing insights into the sustainability of rainfed cultivation in the lowland tropics, food security amid climate change and the usefulness of international aid in supporting agriculture. **Healey** has explored refugee exclusion and integration in their host country, analysing the importance of the relationship between employment, integration, and feelings of gratitude from refugees towards the host community (**Healey**, Output 10034/344318). The appointment of **Bhattacharya-Mis** has further increased capacity for impactful research in development, inequality, and vulnerability. Her research interests extend to flood risk vulnerability in the Global South, specifically the evaluation of real-time big data to inform emergency flood risk management in informal settlements.

*(iv) Leadership in pedagogic research.* GID has a growing international reputation as a leader in geography pedagogic research. Several GID staff are recognised leaders in this field (evidenced by journal editorships, chairing learned society working groups, and fellowship recognition (Section 4)). A REF 2014 strategic aim was to further explore the use of novel technologies in fieldwork teaching and learning. Insightful research into the benefits, barriers and challenges for higher education practitioners and students of 'Bring Your Own Device' in fieldwork teaching has been a key achievement. GID has produced a considerable body of work in this area (12 outputs, including a 2015 SpringerBriefs in Ecology series title '*Enhancing Fieldwork Learning Using Mobile Technologies*' (**France** lead author, with **Welsh**)). **France** and **Welsh** won the prestigious 2018 Advance HE Collaborative Award for their '*Enhancing Fieldwork Learning*' research, a GID-led project collaboration with the Universities of Reading and Sheffield. Advance HE commended the "*multi-institutional and multi-disciplinary collaboration which demonstrated a transformational impact on attitudes towards the use of technology to enhance fieldwork learning*". The interdisciplinary and impactful nature of this research is illustrated in Impact Case Study 2.

Strategic investment and greater GID research group collaboration has led to an expansion in pedagogic research, most notably in *'Student-Staff Partnerships'* (e.g., **Healey**, Output 10034/344298). The relevance and appeal of GID's research in this area is illustrated by the 18 invited keynotes delivered by **Healey**, organisation and delivery of numerous national and international seminars and workshops on the subject, and an invitation for **Healey** to co-write an

updated guide on '*Students as Partners*' as part of the Advance HE Framework. **Healey** is leading research investigating the experiences of student and staff partnerships in the realm of publishing. Affording students an opportunity to both write and peer-review selected manuscripts for publication is one important initiative. **Healey** has achieved this for the *Journal of Geography in Higher Education* by soliciting both student and peer review of manuscripts submitted for publication in the journal's 'Directions' section – a section publishing articles written for a student audience to support their key academic geographical skills – and actively encouraging students to write or co-write 'Directions' articles. GID is further expanding its pedagogic research focus to include *'Teaching and Learning Ethics',* and **Healey's** work in this area has led to an invited contribution on the subject in the 2019 *Handbook of Teaching and Learning in Geography* (Edward Elgar Publishing).

*1.4. Five-year strategic aims*

We have achieved our REF 2014 strategic aims. Measures of success include a significantly increased capacity for research and impact, the quality of the research conducted (evidenced by awards, funding support (including UK Research Council), and disseminated in journals with a significant international reach), and a considerable and varied contribution to the discipline research base (Section 4). We have exceeded our REF 2014 strategic aims by expanding into new research areas (notably in Environment and Climate Change, Rural Geographies, and Critical Military Studies), producing work of international importance in each. Building upon this momentum, our strategic aims for the next 5 years are:

**Aim 1: to exploit our increased capacity to engage in, and produce, fundamental and applied research of international importance.**

We have established a solid research base during the assessment period, principally driven by strategic staff appointments, targeted funding and support of excellent and impactful research, an improved research infrastructure, more productive and interdisciplinary internal and external collaborations, better targeted dissemination of outputs (via peer-reviewed journals), and a greater national and international presence. Our aim is to capitalise on this growth by further increasing the proportion of internationally excellent and outstanding research, and the continued execution of applied research with considerable reach and impact. We plan to achieve this through: careful management and targeting of resources to support and encourage excellent research; furthering our long-standing commitment to work with industrial partners and community groups in maximizing opportunities to understand and develop solutions for issues of societal importance; and seeking opportunities to collaborate across traditional disciplinary boundaries when tackling issues that benefit from an interdisciplinary approach. We have recognised growth challenges over the assessment period and have identified PhD intake and grant capture as two important areas for development (Section 3.1).

**Aim 2: to further develop impactful research of fundamental importance to society.**

Continuing our successful approach of developing and supporting impactful research, efforts will focus on community vulnerability, and resilience to flooding. With our growing expertise and research capacity in this area, coupled with our experience in developing positive community links, we are increasingly able to make a sustained and substantial contribution to flood hazard impact research, particularly in identifying community vulnerability and advising on mitigation and adaption measures.

**Aim 3: to pursue cross-disciplinary collaboration to address multi-faceted complex problems.**

Our partnerships with industry and the policy-making community (as part of our rural digital exclusion work, for example), and collaboration with researchers from a range of academic disciplines (as part of our flood vulnerability work, for example) have led to significant progress in highlighting, and helping to solve, difficult issues. Our aim is to build on this experience by promoting inter-disciplinary approaches in addressing specific issues, particularly in aspects of rural development, community hazard awareness and preparedness.

## 2. People

### 2.1. Staffing strategy

Of the 12 Category A submitted staff, seven were appointed in the assessment period (**Bhattacharya-Mis, Bos, Collins, Marren, Miles, Williams, Wilson***).* Of these, three appointments replaced outgoing staff, whilst four were new appointments, reflecting an overall investment increase in GID staffing. The appointments reflect the institution's wider strategy to recruit staff with strong research credentials and a keen desire for innovation and knowledge exchange. In GID, there has also been a strategic emphasis on recruiting early-career colleagues (**Bhattacharya-Mis, Bos, Collins, Miles**), who have become independent researchers during the assessment period. This has allowed GID to achieve a well-balanced staffing profile, with an equal proportion of early and mid-career staff, as well as some established and experienced colleagues. Such a profile allows for effective management of research and for succession planning.

#### 2.1.1. Increasing capacity for research

Through strategic staffing investment, we have grown all three of the GID research groups to achieve an increase in research capacity and productivity:

- *Global Environmental Change and Hazard Management. The appointments of* **Bhattacharya-Mis**, **Marren, Miles** and **Wilson** bring to the group additional expertise in: fluvial processes; flooding vulnerability and resilience; coastal processes, erosion and management; Quaternary environmental change. The group achieved a 40% increase in peer-reviewed research outputs in the REF 2021 assessment period compared with REF 2014.

- *Communities, Culture and Sustainability.* Expertise in Sustainability and Development geographies has been further developed by the appointments of **Bhattacharya-Mis, Bos***,* **Collins,** and **Williams**, resulting in greater research capacity, expansion into new complementary research areas (rural, digital, military, political and cultural geographies), and new cross-disciplinary research collaborations (e.g., GPS technologies in rural landscapes). The group achieved a 90% increase in peer-reviewed research outputs in the REF 2021 assessment period compared with REF 2014.

- *Technology Enhanced Learning and Student Partnerships.* Research group membership has increased following new appointments and emerging synergies in staff research interests. The group achieved a 72% increase in peer-reviewed research outputs in the REF 2021 assessment period compared with REF 2014.

#### 2.1.2. Increasing capacity for impact

Strategic staffing investment has also improved our ability and potential to produce **impactful** research. The appointment of **Williams** to the *Communities, Culture and Sustainability* research group has brought additional expertise in digital and rural geographies, along with a wealth of experience in knowledge transfer and community and local business engagement. GID has supported **Williams'** transformative research into rural community and rural business broadband provision, specifically via priority allocation of QR income. The significance and reach of this research are detailed in Impact Case Study 1.

Additional strategic appointments (**Bhattacharya-Mis, Marren, Miles, Welsh** (fractional appointment)) increase further our capacity to produce impactful research, particularly in hazard management. **Bhattacharya-Mis** brings to GID research expertise in flood hazard vulnerability, **Welsh** expertise in flood and catchment sediment flux modelling, and **Marren** and **Miles** process-based expertise in flood hazards and coastal change, respectively. As a result of these new appointments, **we are building critical mass in hazard vulnerability and management**. This has allowed GID to develop a continuing professional development course series in Flood Modelling and Resilience, and to attract £112,682 of HEFCE catalyst funding to develop in 2019 a MSc in *Flood Risk Assessment, Modelling and Engineering* (Section 4.2)*.*

Through new collaborative partnerships, coupled with strategic allocation of staff time, GID has optimised its potential to deliver impact. A notable example is our involvement with the CREST

initiative (Section 1.2), where several members of GID staff were seconded on a fractional basis (**Miles**, 0.4 FTE; **Marren**, 0.3 FTE; **Williams**, 0.3 FTE (February 2018 to March 2020), with **Alexander** an advisory group member (until 2019)) to work with SMEs in the Shropshire, Telford, and Wrekin areas to foster innovation and growth as part of Phase 1 of the project '*Promoting research and innovation*'. We detail successes of this collaboration in Section 4.2.

### 2.2. Staff development

Research activity and staff development are monitored annually by line managers via staff Personal Development Plans. Research activity is one of four areas in which staff can be promoted to Associate Professor, and subsequently to Professor where research performance expectations are met. Two Category A submitted staff have been promoted to Associate Professor in the assessment period. All newly recruited academic staff are allocated a mentor and undergo a 12–month probation, successful completion of which is based on satisfactory performance against criteria including research achievements. New colleagues are supported in their requirement to obtain a PGCert in HE within two years of appointment, and in securing Higher Education Academy/Advance HE fellowships. Academic GID staff are invited to apply for competitive internal (QR) funding to support new or existing research projects, or to generate pilot data in support of external grant applications (typically several awards are made annually), whilst new colleagues have access to £2,000 of 'seed-bed' internal research funding. A proportion of QR income is ring-fenced to support conference attendance; additionally, staff can apply for institutional support (up to the value of £500 per annum) for conference attendance.

### 2.3. Postgraduate research students

The doctoral degrees awarded, as reported in REF4a, are all PhDs and not research-based professional doctorates.

The institution ranks 9$^{th}$ out of 103 institutions for overall satisfaction, and for satisfaction with supervision (2019 Research Experience Survey). GID postgraduate research (PGR) students are either self-funded or acquire institutional funding as part of a Graduate Teaching Assistant role. GID PGR students undergo rigorous selection, including interview and scrutiny of research proposals. Successful applicants are enrolled and become part of the institution's PGR community. PGR students are supervised by three members of staff, at least one of whom must have experience of successful PhD completions. Supervisors are required to complete Supervisor Development Training at three-year intervals. Each PGR student is required to undergo annual progress monitoring and to submit an Annual Progress Report. PGR students are permitted to upgrade from MPhil to PhD at 18 months following assessment by an Independent Panel. The panel comprises two independent assessors who evaluate progress via an interview with the student, a review of work, and a consideration of progress as reported by the supervisory team. Reviews at 30 and 42 months consist of a review of an Annual Progress Report and an assessment meeting with an independent assessor. Completion, upgrade, and progress statistics are collected and monitored annually at Faculty level.

GID PGR students are fully integrated into the institution's PGR community; one of our students is the incumbent Postgraduate Representative for University of Chester Students' Union, for example. PGR students can enrol in institutional professional development courses (e.g., academic writing, critical analysis, data analysis), schedule one-to-one study skills training sessions, and participate in writing workshops and retreats. Annual PGR conferences are organised at Faculty and institutional level and all PGR students are required to present their work at each. GID PGR students are encouraged to integrate into the national and international communities of their respective disciplines. For example, one of our PGR students organised and hosted the first virtual Quaternary Research Association's Postgraduate Symposium (August 2020). GID provides funding for PGR students to attend relevant external workshops and to present their work at international conferences (e.g., European Geosciences Union congress).

### 2.4. Equality and diversity

Category A submitted staff have been identified following implementation of the University of Chester REF 2021 Code of Practice. This process is inclusive, and within GID captures a diverse age range,

ethnicity (17% BAME), career stage (newly independent researchers to Professor), and a gender balance of 5 females and 7 males. Output selection is via author and, internal and external expert peer review, thereby achieving an inclusive, yet rigorous, selection approach. Additional fairness measures include completion by the UOA co-ordinator of 'Unconscious Bias' training.

GID staff complete a range of mandatory short courses, including in Equality and Diversity, and benefit from engagement with a range of institutional networks (e.g., Disabled Staff Support Group, Women's Networking Forum, LGBT+ Staff Group, Parent's Network, Carers Network). The institution hosts an annual Diversity Festival, providing an opportunity for staff to learn about, and experience, different cultures and perspectives. GID staff have actively contributed to the Diversity Festival. As part of the 2019 event, **Collins** gave a talk entitled '*Pink, purple, or teal?',* which provided a colourful critique of neoliberal consumer womanhood in the workplace and was one of several talks related to the politics of the female body. This coincided with, and was a contribution to, International Women's Day. In May 2020, the institution implemented a Race Equality Challenge Group (**Miller** is a core member (academic representative)) which seeks to promote, facilitate, and enact positive change in relation to race equality and diversity across the institution. Mechanisms to achieve this include ensuring that equality, diversity, and inclusivity are incorporated within corporate core values and reflected in policies, procedures, and everyday practice.

GID colleagues reflect on, and promote, equality and diversity in the wider research community. **Healey's** work into gender and research activity **has informed elements of the University of Chester REF 2021 Code of Practice** (*Davies, C., **Healey**, R.L., Cliffe, A., 2016. Gendered experiences of academic staff in relation to research activity and the REF 2014. Forum for research into Equality and Diversity, University of Chester*). **Healey** and **Collins** wrote an invited review paper on gender inequality for Geography Review, connecting GID research to A-level students' learning on the impact of gender inequalities and how these might be addressed. **Wilson** and **Welsh** ensured a gender and age balance at the 2019 Quaternary Research Association's Annual Discussion Meeting programme (hosted by GID at the University of Chester). In a context where women are under-represented in the natural sciences, they sought established and early-career female researchers to provide opening keynote and closing solicited talks, respectively. Professor Roe, attending the meeting in her capacity as Quaternary Research Association Secretary, said we had "*looked carefully at the gender balance issue in terms of the M:F breakdown of speakers and keynotes…, and had also made great efforts to include ECR[s] in the programme*' (Roe, personal communication, 11/12/20).

## 3. Income, infrastructure and facilities

### 3.1. Income

The institution's Research and Knowledge Transfer Office publishes opportunities for research collaboration, funding, and specific calls for funding proposals, and offers grant development, project costing and project management support. Each GID research group has been successful in securing external funding, with individual applicants afforded the opportunity of internal (GID) peer-review to ensure quality thresholds are reached and maintained. GID has attracted over £90,000 of external income from a range of sources to support its research (including from the UK Arts and Humanities Research Council, Higher Education Academy, local authorities and learned societies (e.g., British Ecological Society, Royal Geographical Society)). GID has also been successful in securing competitive income from the institution's Learning and Teaching Institute, for example to explore the use of Virtual Reality (VR) to investigate public knowledge of socio-environmental issues, including the climate crisis.

A proportion of the institution's QR income is distributed to academic departments. GID's strategy was to utilise 75% of its QR allocation to stimulate research activity, principally to support new and innovative research, to further develop existing areas of expertise, and to broaden the intellectual research base; the remaining 25% was used to generate impact *(development of underpinning research, supporting outreach activities, promoting wider stakeholder engagement, monitoring and evidence impact), to provide 'seed-bed' research money for new colleagues, and to help sustain GID's research culture (e.g. seminar series support, conference attendance, research equipment purchases).*

GID staff may apply annually for QR research support to develop projects. The competitive application process, with multi-tiered rigorous peer-review and approval (involving the GID research committee, Faculty Dean, and the Research and Knowledge Transfer Office) ensures research with the highest quality potential is identified and supported. Through efficient use of resources and strategic collaboration, GID has achieved high-quality research (evidenced with outputs appearing in peer-reviewed journals with an international reach, for example) and impact with its QR allocation.

In Section 1.4 we recognised external grant capture as a growth challenge and identified this as an important area for future development. As part of a strategy to generate greater external income, GID is placing more emphasis on utilising a proportion of QR income to strengthen grant applications by funding pilot data collection. As an early example of the success of this approach, **Wilson** and **Welsh** collaborated with the University of Sussex to secure £29,400 of NERC grant-in-kind funding (National Environmental Isotope Facility grant number 2242.0320). The grant supports a larger GID-led project investigating the character and special expression of Holocene millennial-scale climate variability in the Balkans, a project which began with QR-funded pilot data generation.

An additional strategy to generate external income is to be more proactive in developing collaborative networks, and for colleagues to increasingly adopt a principal investigator role in collaborative research ventures. GID has a growing track record of collaborating with colleagues in national and international institutions. For example, **France** was a senior researcher and mentor on a £45,000 Newton Fund application (led by University of Hull). This work package included a learning without borders workshop (in Tha Ton, Thailand), bringing together 40 UK and Thailand academics to share practice, particularly on the use of affordable mobile technologies for learning in marginalised, remote non-formal settings. **Bhattacharya-Mis** was co-investigator on several externally funded flood risk projects, with funding sources including the Royal Institution of Chartered Surveyors, and the National Centre for Monitoring and Alerts for Natural Disaster (Brazil). At an institutional level, the Chester Grant Support Initiative will further support grant capture.

## 3.2. Infrastructure and facilities

### 3.2.1. Research infrastructure and facilities

All GID academic staff and PGR student offices are located within the Best Building at Exton Park, together with analytical and computer laboratory spaces, seminar and lecture rooms and field equipment storage. Research and impact activities are supported by wider institutional facilities and infrastructure. The Research and Knowledge Transfer Office has responsibility for the promotion and development of research, scholarship, and knowledge transfer across the institution, and plays a central role in facilitating funding applications and grant management (Section 3.1). Staff have full-text access to 65,000 journal titles and over 750,000 e-book titles, and to research development opportunities via Faculty-wide training courses.

GID research is facilitated by modern and well-equipped laboratory spaces, access to a range of field equipment and excellent computing facilities and infrastructure. GID's physical science laboratory underwent a £20,000 refurbishment and 30% extension in 2016, including provision of a new research analytical clean space. The laboratory is run by a dedicated manager educated to PhD level, and facilitates the research of the 'Global Environmental Change and Hazard Management' group. The laboratory is well equipped. Sample processing equipment includes a fume cupboard, a large-capacity centrifuge, filtration equipment, drying cabinets, ovens, a chamber furnace, sieve stacks and shakers, hotplates, water baths and refrigerators (including for core storage). Laboratory analytical kit includes Leica and Nikon research binocular microscopes (up to x1200 magnification with phase contrast and dark-field, and with high resolution image capture), stereomicroscopes, visible and infrared spectrophotometers, a MS2 mineral magnetic susceptibility system with core-scanning sensors, research-grade balances and pH, salinity, TDS, and dissolved oxygen laboratory sensors.

GID has a range of field equipment for surveying, monitoring, and sample retrieval, which supports our research in hazard processes, fluvial and coastal monitoring, and environmental change. Surveying and monitoring equipment includes a Leica GS08 Plus GPS and Leica CS10 field

controller (sub-centimetre accuracy), UAVs (DJI SJ100 with Gimbal for Panasonic camera, DJI Mavic, DJI Phantom 3 and Phantom 4 drones) operational by four trained members of staff, one of whom has a CAA commercial drone licence, MS2 mineral magnetic susceptibility system with field loop sensor, field photometers for measuring water and soil quality parameters, and environmental loggers (Thermosense HDT-GFX-2 Logs air temperature, relative humidity and dew point, and x2 Tempcon Hobo Weather station H21-001). Sample retrieval equipment includes a vertical water sampler, Russian and gouge corer sets (>12m depth of penetration for peat and wetland sediments), a gravity corer with core extrusion apparatus for lake sediments and two inflatable rafts.

GID is equally well-equipped with computing infrastructure. A £30,000 refurbishment in 2019 has increased our computing capacity, with staff benefiting from a dedicated computing laboratory equipped with data and spatial analysis and mapping software (e.g., ArcGIS, Canvas 11 GIS, Nvivo, Geopacks, Flood modeller, SPSS). GID also has access to additional specialist software (including Origin, Tilia, C2, CANOCO, Microdrainage), as well as 18 rugged iPads for field data collection, 7 VR headsets, four 360$^{O}$ and one 4k camera for image capture and simulation. In addition to analytical and computer laboratory refurbishments, a further £25,000 refurbishment of GID's photogrammetry laboratory was completed in summer 2020, **demonstrating continuing institutional investment in GID and its infrastructure**.

### 3.2.2. Infrastructure and facilities for impact

Research detailed in Impact Case Studies 1 and 2 has been facilitated by strategic investment in facilities and by collaborative use of equipment and infrastructure. GID has invested over £10,000 in equipment (mainly iPads and Android tablets) to facilitate research into the use of digital technology to enhance fieldwork teaching and learning. GID also provided **Williams** with additional support (priority allocation of QR funding) to progress research into the rural digital divide and facilitate take-up of broadband infrastructure in rural communities.

GID continues to invest in facilities and to form strategic partnerships to ensure the continuation of impactful research. For example, GID has utilised a proportion of its QR allocation to: explore the feasibility of wearable devices, specifically in the context of 'nudge' theory to improve student motivation in meeting learning goals; evaluate the role of VR and Augmented Reality in teaching and learning, specifically with regards to student motivation, engagement, and ethics; explore the impact of sheep on the landscape, in partnership with Wolf Logic (geotechnical support for sheep tracking). Momentum is building in the production of impactful research in the field of hazard monitoring and vulnerability (e.g., **Miller**, Output 10034/601056; **Bhattacharya-Mis**, Outputs 10034/621248, 10034/623410, 10034/622307). This is a REF 2021 strategic aim (Section 1.4), which we intend to meet through ongoing investment and strategic collaborations. For example, investment in UAV technology (and in staff training to pilot them), and in computer infrastructure and software (Section 3.2.1), has increased our hazard monitoring and surveying capability; the strategic partnership with CREST (Section 1.2), and the access to additional equipment this brings (Section 3.2.3), further increases this capability.

### 3.2.3. Collaborative use of research infrastructure and facilities

**Wilson** has collaborative use of the National Environmental Isotope Facility though a £29,400 NERC grant-in-kind (grant number 2242.0320). Through the CREST partnership, GID has access to additional laboratory, surveying, and monitoring equipment. This includes a Malvern Mastersizer 300 laser particle sizer, a Malvern Epsilon 1 X-Ray Fluorescence analyser, a range of professional UAVs (DJI M600 Pro (large weight drone), Inspire 2 (medium weight drone) and Mavic Pro Fly (lightweight drone)) with 4k resolution RGB camera (DJI X7), near infrared (Parrot) and thermal infrared (DJI Zenmuse XT) capability), a Spectra Precision Focus 35 Total Station with SP60 GNSS receiver (2mm accuracy), YSI research-grade multi-parameter (salinity, TDS, temperature, dissolved oxygen) water quality field probes, and Valeport flow meters for water velocity monitoring. Additionally, GID has access to x-ray diffraction and scanning electron microscope facilities via the Institute's Faculty of Science and Engineering, and an institutional high-performance computer facility for flood and sediment flux modelling.

## 4. Collaboration and contribution to the research base, economy and society

### 4.1. Collaboration, networks, and partnerships

GID staff lead and contribute to a range of national and international research groups. **Healey** became Chair of the RGS-IBG 'Higher Education Research Group' in 2018. Under her leadership the group formally expanded its remit to become the 'Geography and Education Research Group' in 2019. **Collins** co-founded the MEND*RS research group, has been Secretary and Workshop Officer of the RGS-IBG Geographies of Children, Youth and Families research group, and is a member of the AHRC Stitching Together research network. **Williams** is a committee member of the RGS-IBG Rural Geography research group. Examples of international research collaboration include: the UK–Japan connections (Rural) project (**Williams**, partner); the Trans–Atlantic Rural Research Network (**Williams**, member); collaboration with Bahia State University, Brazil (**Miles**) to create a coastal classification of Bahia state based on satellite data; flood risk in the commercial property sector (UK, German, Australian, Chinese and US partnerships) (**Bhattacharya-Mis**, Output 10034/621248); social hydrology, Brazil (**Bhattacharya-Mis** Output 10034/622307); staff-student partnerships (**Healey**, with Bryn Mawr University (USA) and Universiti Utara Malaysia); collaborative research workshops in the Philippines, China, Brazil (**Bhattacharya-Mis**).

### 4.2. Contribution to the research base, economy, and society

GID makes a significant contribution to the **research base** via widespread research dissemination in academic journals and at national and international conferences, promoting and facilitating research agendas through journal editorships, organising national and international conferences, convening sessions at major international conferences, organising and hosting international workshops, and chairing working groups. Disciplinary contributions and achievements include:

**Award winning Research** 'Advance HE' award and 'Collaborative Award for Teaching Excellence' for transformative pedagogic research into the use of mobile technologies in fieldwork teaching (**France** and **Welsh**).

**Journal editorship:** *International Journal for Students as Partners (***Healey**, founding co-editor); *Journal of Geography in Higher Education* (**France** as co-editor, **Healey** as sub-editor); *Higher Education Pedagogies* (**France**, associate editor); *Review of Geographical Education Online (***France**, editorial board)*; Geoscience Communication (***Welsh**, associated editor); *Canadian Journal of African Studies* (**Evans**, Geography sub-editor and the first British resident to serve as an editor of this journal)*; Cuadernos de Geografía* (**Alexander**, advisory board member).

**Fellowships:** William Evans Visiting Fellowship to University of Otago, New Zealand (**France**), National Teaching Fellowships (**France** and **Healey**), Fellowship of the International Society for the Scholarship of Teaching and Learning (ISSOTL, **Healey**), one of only nine inaugural fellowships awarded worldwide in 2019. In awarding the ISSOTL Fellowship, the society noted **Healey's** internationally recognised research in pedagogy, and highlighted the *International Journal for Students as Partners* (of which **Healey** is founding co-editor) as one of the most exciting developments within ISSOTL since its inception.

**Invited contributions:** 17 invited journal articles, editorials, and edited volumes.

**Conference organisation (Full):** 14 national and international conferences, including the 2019 Quaternary Research Association's Annual Discussion Meeting (**Wilson** and **Welsh**, host Institution), the 2018 Place Planning and Raising Flood Awareness public engagement event (**Welsh** and **Miller**, host Institution), and the 2018 and 2019 Disaster Risk Reduction in the Caribbean conferences (**Miller**). France and Welsh, in collaboration with colleagues at the Universities of Sheffield and Reading and at the British Ecological Society, have developed and maintained the annual Enhancing Fieldwork Learning Showcase event, now in its 10th year (host institution in 2017). In 2019 **Healey** led a *Geography and the student experience* two-day event to launch the newly named RGS-IBG 'Geography and Education Research Group'. Outputs generated in the writing workshop led to an *Area* special issue.

**Conference organisation (Session):** organised, convened or chaired 25 sessions at major national and international conferences, including: the European Geosciences Union General Assembly, Vienna (**Wilson**, *Session CL1.28 'Quaternary glacial-interglacial transitions: causes and effects, 2017*); the 4th largest session at the International Union for Quaternary Research congress, Dublin (**Wilson**, *Abrupt climate changes: the view from lakes, 2019 (28 talks over 4 sessions)*; the American Association of Geographers (**Bos**, 2016, 2017, 2018, 2019; **France**, 2017; 2019); the Canadian Association of African Studies conference, Canada (**Evans,** 2016; 2017); the EcoDesert: Geoecology and Desertification conference, Spain (**Alexander**, 2019) and the XXVIII European Society for Rural Sociology Congress, Norway (**Williams**, *Animalia: partnerships, policies and understanding of more than human rural futures*, 2019). We have convened and chaired numerous sessions at the RGS-IBG annual conference, including sessions on: '*Cultural and Creative Industries*' (**Collins**, 2016); '*Crafting Alterity: Creativity, Making, and Hope-Full Geographies*' (**Collins**, 2019); '*Pedagogic Partnerships in Higher Education*' (**Healey**, 2019); '*What is Rural? Ensuring a Fair Deal for Rural Communities*' (**Williams**, 2017); '*Beyond Mere Signifiers: Centering Animals in the (Re)production of Rural Landscape*' (**Williams**, 2018).

**Workshop organisation:** 36 workshops hosted either by GID, or delivered as part of conference programmes (e.g. RGS-IBG annual international conference (5 workshops, 2015-2019), the Association of American Geographers annual conference (6 workshops, 2014-2019), the British Ecological Society Annual Meeting (2 workshops, 2015, 2019), the International Society for the Scholarship of Teaching and Learning conference (Norway, 2018), the Centre for Education and Learning Cross University Meeting (Netherlands, 2017), or by invitation at UK (e.g. University of Birmingham) and international institutions (e.g. University of Canterbury, New Zealand). Workshops have been delivered on a range of topics (e.g., Implementing the Sustainable Development Framework in Nigeria; Cultures of Mending; Rural Places, Rural Challenges; Experimental Geographies; Digital Mobile Technologies in Fieldwork Teaching; Ethical Development of University Students; Writing Successfully for Journal Publication; Students as Partners). We have also disseminated applied research strategies on engaging students as partners in developing academic curricula, teaching and learning, the scholarship of teaching and learning and in research at several UK Universities (e.g., York, Surrey, Central Lancashire, Cardiff), and international institutions (e.g., Universities of Groningen and Amsterdam (Netherlands), Göttingen (Germany), Limerick (Ireland) and Indiana (USA). The workshops were typically delivered as part of annual teaching conferences, or to inform institutional strategic development planning. **Taken together, the above research-informed workshops have potentially influenced the practice of over 1000 academics.**

During the assessment period, we have also delivered 19 keynotes and over 75 oral presentations at national and international conferences (UK, USA, Canada, Brazil, Japan, Poland, Netherlands, Germany, Switzerland, Spain, Austria, Republic of Ireland, Greece, Norway, Thailand, Caribbean). Additionally, GID runs a research seminar series featuring the work of academics from national and international institutions (e.g., Universities of Birmingham, Hull, Manchester, Liverpool John Moores, Manchester Metropolitan, and the University of the South (Tennessee). All colleagues provide the wider academic service of journal peer review (numerous titles) and grant peer review (national and international, e.g., US National Science Foundation, Dutch Research Council).

Beyond academia, examples of our wider contributions to **economy** and **society**, include:
**Provision of research expertise and expert advice:** Through their work with CREST, **Miles**, **Marren** and **Williams** have provided research support, development, and advice to SMEs to foster innovation and growth. Notable achievements include the collaboration between **Miles** and Wolf Logic, a web application and software development company based in Telford. **Miles'** research expertise in environmental geospatial analysis enabled Wolf Logic to launch '*Geopoints*', a product enabling users to search any location (using a postcode or map co-ordinates) to find land and property details including boundaries, title information, solar suitability, terrain, and other environmental information. This successful academic-industrial partnership featured as a case study in the National Centre for Universities and Business 'State of the Relationship' report. Glyn Davies (Wolf Logic) remarked, '*CREST support has enabled us to accelerate product development and the advice given by Dr Andrew **Miles** has been invaluable*' (State of the Relationship 2019 report, p.43).

More recently, **Miles** collaborated with Groundwater Science Ltd (hydrogeologists and code developers specialising in surface and groundwater modelling) in a novel research project investigating the potential of deriving evapotranspiration estimates from remotely sensed imagery to improve the predictive capabilities of groundwater models. **Miles** also worked with Severn Gorge Countryside trust in a research project investigating the potential of high-resolution thermal drone imagery and indicators of vegetation stress derived from near-infrared imagery, for identifying patterns of groundwater flow to inform flood modelling predictions.

Other examples of research expertise provision and expert advice include: working with community planners, policy makers, experts, and local community groups in the Caribbean to help communities become more hazard-resilient via better planning and disaster risk reduction training. As part of this work, **Miller** developed the Annual International Disaster Risk Reduction conference, held in Jamaica and now in its 3rd year. This initiative, and the associated sharing of research, contributes to capacity building of local agencies in the region (such as the Mines and Geology Division, Kingston and St Andrew Metropolitan council, Government of Jamaica), by providing training and resources in innovative risk mapping and community engagement; utilising Government Strategic Priority funding to work with the National Flood Forum and a range of North Wales stakeholders, including community groups and council leaders, to identify how best to support groups classed as 'flood disadvantaged' (e.g. a Place, Planning and Raising Flood Awareness 2018 public engagement event, co-organised with Kinmel Bay Council (North Wales); development of the Rural Services Network and associated events (e.g. 2018 Rural Places, Rural Challenges event attended by participants representing policy, local authority, commercial and charitable organisations).

**Continuing professional development provision:** GID staff engage in knowledge exchange and use their research expertise to upskill practitioners. GID has developed and delivered continuing professional development courses in Flood Modelling and Resilience, collectively upskilling over 100 national and international participants, drawn from over 13 councils (county, city and district), government agencies, trusts and interest groups (e.g. Environment Agency, Natural Resources Wales, Severn Trent Water, National Flood Forum, Shropshire Wildlife Trust), consultancies (e.g. Atkins Global, Mott McDonald, WML Consulting, GWP Consultants, RAB consultants, Jacobs) and universities (e.g. Ghent University (Netherlands), Ilorin University (Nigeria), and the Universities of Ulster, Southampton, Cambridge, Nottingham, and Exeter). Building on this success, GID secured £112,682 of HEFCE Catalyst funding to develop in 2019 a MSc in *Flood Risk Assessment, Modelling and Engineering* (certified by the Chartered Institution of Water and Environmental Management). Co-designed with flood risk practitioners, the MSc enables practitioners working in industries related to flood management to study while remaining in the workplace, thereby facilitating knowledge transfer to industry.

**Professional service:** GID staff have provided a range of professional services. These include: annual (April-September) airborne pollen monitoring in Chester for the UK Met Office (2012–present); provision of evidence and advice to the Rural Communities Policy Unit (Department for Environment, Food and Rural Affairs) and to the Scottish Government's Digital Directorate Broadband Policy Team; sharing research on carbon neutral villages with the Indian Climate Parliament (members of upper and lower house) (London, October 2016); provision of research-informed advice and expert testimony in relation to asylum claims by Casamançais (UK and US); analysis and advice to NGOs on the Casamance conflict; invitation and participation in Foreign and Commonwealth Office briefing events for British diplomats recently appointed to missions in Senegal and The Gambia, specifically HM Ambassador designate to Dakar (June 2015) and HM Ambassador designate to Banjul (March 2014); OECD policy briefing contributions (Home-Based Businesses).

**Public engagement and outreach:** GID have an excellent track record of engagement with communities on a range of issues and challenges at local, national, and international levels. Examples include: working with CREST to form the Shropshire Food Poverty Alliance, a consortium of public, voluntary and faith organisations committed to tackling food poverty; co-leadership of the Chester Wetland Centre initiative, a collaborative endeavour (with the University of Bangor) involving public consultation to develop a diverse wetland meadow habitat within the Countess of Chester Country Park, both for wildlife conservation and educational purposes; contribution of research-led

expert advice and opinion to online forums (e.g. invited blog for TechUK's Insights campaign #ConnectivityForAll ('Connecting remote rural communities? Time to be smarter', March 2020).