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| Institution: University of Hull | | |
| Unit of Assessment: 14 Geography & Environmental Studies | | |
| Title of case study: Informing flood risk management & resilience strategies nationally & globally | | |
| Period when the underpinning research was undertaken: 2007 to 2018 | | |
| Details of staff conducting the underpinning research from the submitting unit: | | |
| Name(s): | Role(s) (e.g. job title): | Period(s) employed by submitting HEI: |
| Thomas Coulthard | Professor | 2005 to present date |
| Lynne Frostick | Emeritus Professor | 1991 to 2015 |
| Graham Haughton | Professor | 1998 to 2010 |
| Period when the claimed impact occurred: 2014 to 2020 | | |
| Is this case study continued from a case study submitted in 2014? No | | |
| <p>1. Summary of the impact (indicative maximum 100 words)</p> <p>The University of Hull's flood hazard and risk research has informed UK national flood policy and has guided an investment of £2.6 billion of government funding between 2015 and 2020, resulting in improved flood protection for more than 300,000 homes nationwide.</p> <p>The underpinning research has delivered an ongoing and deepening impact on UK flood policy through legislation in terms of the Water Act (2014), the Surface Water Management Action Plan (2018), the 25-year Environment Plan (2018) and the development of the Environment Agency's new Flood and Coastal Erosion Risk Management Strategy (2020).</p> <p>An international dimension has broadened the reach of the impact, with Kingston-upon-Hull being one of five cities selected as global exemplars of multi-agency adaptive approaches to living with water as part of the Rockefeller Foundation's Resilient Cities programme. The underpinning research directly led to Hull being selected and has in turn shaped the development of the City Water Resilience Approach (CWRA), which is now being adopted and deployed by city administrations globally as the new international standard for city-level water resilience.</p> | | |
| <p>2. Underpinning research (indicative maximum 500 words)</p> <p>This case study builds ongoing impact from a case study presented in REF2014 <i>and</i> describes extensive further, and new, impact on flood legislation and policy within the REF2021 period. The impact from the research has seen a combination of: our policy influence - which underpinned our REF2014 submission - being fully realised and implemented within the REF2021 period; a deepening of reach and significance through further impact on new policy and new legislative influence over the last six years within the UK; and, an extension of the reach and significance of the impact into the global context through the development of the City Water Resilience Approach (CWRA).</p> <p>The underpinning research presented multi-factorial analysis of how the devastating 2007 summer floods across the UK developed so quickly and why the physical, institutional and regulatory structures designed to prevent flooding failed comprehensively. The research combined the insights of physical and human geographers (Thomas Coulthard, Lynne Frostick, Graham Haughton) to establish what went wrong in Hull in 2007, and how water management strategies and governance structures could be strengthened for future flooding events.</p> <p>The research was designed to be policy-relevant and impact-driven, with key partnership working at its core. Following an approach by Hull City Council in July 2007, an Independent Review Body (IRB) was established by the Council to investigate the cause and effects of the June 2007 floods in Hull and the Humber. The IRB was led by University of Hull staff and chaired by Coulthard. It also included representatives from local authorities, water companies, community organisations and industrial and commercial organisations. The collaborative research involved 30+ interviews, panel meetings, reviews of literature and reports, and field and site visits. The interim findings (August 2007) and the final report (November 2007) were edited and led by Coulthard [3a, 3b, 3c]. Three key findings from these reports are directly cited within the Pitt Review [5b (NB: Section 5 below provides detailed page and paragraph references for the content that evidences the route to impact)]. In turn, the Pitt Review has guided and directly informed UK flood policy for the past decade through the Flood and Water Management Act 2010, the Water Act 2014, and the 25-year Environment Plan 2018.</p> <p>The summer 2007 floods had significant environmental and societal impacts across the UK. In addition to reviewing the physical impacts of the flooding and the response of flood</p> | | |

infrastructure, the IRB reports also addressed the social and psychological impacts of flooding too. In Hull alone over 8600 houses and 1300 businesses flooded, with 90% of the city's schools closed and many events cancelled. The reports concluded that, at the regional scale, the flooding was mainly caused by problems conveying rapid surface water through the drainage networks, along with the poor performance of three key pumping stations. The research detailed how the city drainage system functioned sub-optimally, causing much of the flood damage [3a, 3c]. The research was highly influential in terms of the technical outcomes it described. It was also impactful because it revealed a series of weaknesses in the governance and policy systems for managing drainage and flood response regionally but also, and crucially, at the national scale.

In summary, the research demonstrated that:

- 1) the UK had no robust warning system for localised pluvial flooding following heavy rain. The Environment Agency (EA) had established a warning system for *fluvial* flooding (due to increasing river flow) in 2000, but *pluvial* flooding was not addressed before 2007. The research exposed this oversight and proposed a suitable warning system for pluvial flooding, based on modelling rainfall patterns.
- 2) the '1 in 30-year event' average usually used in UK urban flood planning is not appropriate in all regions, and especially not in low-lying regions with little natural drainage. In such regions, like Hull and the Humber, additional measures are required.
- 3) the structure of UK water governance (with local authorities, the EA and privatised water utility companies controlling separate parts of the system) left no single agency with overall responsibility for managing flooding. This dispersed management was also found to hinder the development of better flood-event responses [3c, 3d].

3. References to the research (indicative maximum of six references)

- a) Coulthard, T. and Frostick L. (2010) The Hull floods of 2007: implications for the governance and management of urban drainage systems, *Journal of Flood Risk Management*, 3, 223-231: <https://doi.org/10.1111/j.1753-318X.2010.01072.x>.
- b) Coulthard, T., Frostick, L., Hardcastle, H., Jones, K., Rogers, D., Scott, M. and Bankoff, G. (2007) *The 2007 floods in Hull. Final report by the Independent Review Body*, 21 November 2007. Hull City Council, 68pp. <https://zenodo.org/record/4454437#.YEqnwLYYBnJ>
- c) Coulthard, T., Frostick, L., Hardcastle, H., Jones, K., Rogers, D. and Scott, M. (2007) *The 2007 floods in Hull. Interim report by the Independent Review Body*, 24th August 2007. Hull City Council, 36pp. <https://zenodo.org/record/4454422#.YEqno7YYBnJ>.
- d) Haughton, G., Bankoff, G., and Coulthard, T. (2015). In search of 'lost' knowledge and outsourced expertise in flood risk management. *Transactions Institute of British Geographers*, 40(3), 375-386: <https://doi.org/10.1111/tran.12082>

Underpinning research - grants awarded:

- Coulthard, T. Haughton, G., and Bankoff, G. *Rethinking the spaces and institutions for the governance of flood management*. Funder: ESRC, Partner: Hull City Council (2008-11).
- Haughton, G., Coulthard, T. and Bankoff, G. *Flood Risk and Economic Development*. Funder: ESRC, Partner: Environment Agency (2008-11).
- Haughton, G., Coulthard, T. and Bankoff, G. *Sub-Contracting Risk: Neoliberal Policy Agendas and the Changing Nature of Flood Risk Management*. Funder: ESRC, Partner: Hull City Council (2008-11).

4. Details of the impact (indicative maximum 750 words)

Note: Section 5 (below) provides detailed and specific citation and page and paragraph locations for the relevant content and context within the supporting evidence.

The route to impact:

Research [3b] and [3c] and the three insights (highlighted at the end of Section 2) directly informed the findings of:

- the House of Commons Select Committee on Environment, Food and Rural Affairs on the Summer 2007 floods (published 7 May 2008) [5a];
- the highly influential 2008 Pitt Review (a Government Independent Review into the 2007 floods led by Sir Michael Pitt) and its Final Report [5b].

These reviews, and their recommendations, provided the route to impact from our 2007 research

into the Hull floods. The policy impact was realised when our research findings were implemented in the Flood and Water Management Act 2010 and this policy impact underpinned our REF2014 case study. However, impact is only realised when policy shapes legislation and is implemented and the REF2021 period has seen this legislation embedded into the national approaches to flood management, in turn guiding ~£2.6bn in UK flood management funding between 2015 and 2020 [5c]. The REF2021 period has additionally seen impact delivered through new policy frameworks and the shaping of new national legislation including the Water Act 2014, the related Surface Water Management Action Plan 2018 [5d], and the 25-year Environment Plan 2018 [5c]. These documents contain significant policy drivers founded on our underpinning research and they have significantly improved flood prevention and mitigation measures across the country (~300,000 homes better protected [5c]). Further, beyond their impact on legislation, these documents also highlight the importance of physical *and* social resilience. The underpinning research changed the tone of UK debates about flood planning: it embedded cooperation and communication between communities, industry, civic agencies and government throughout the legislation cited. It helped flood planning to progress beyond technical analysis to also encompass wider aspects of the societies at risk [5c, 5d, 5e].

Impact in the REF2021 period:

During the REF2021 period, the research impact has enjoyed increasing reach and significance both nationally and internationally. The underpinning research has shaped policies and strategies for flood prevention and response, evidencing the full impact translation pathway of research into policy and subsequent implementation.

At the *national* scale, the Flood and Water Management Act 2010 gave the Environment Agency (EA) overall responsibility for all flooding, including surface water flooding. Part of this core recommendation from the underpinning research went into policy in the REF2014 period, but has been implemented fully in the REF2021 period. Local authorities now retain responsibility for the control of regional surface water drainage, but do so under the auspices of the EA [5c, 5d, 5f]. This change responded to the third recommendation of the underpinning research: that one lead agency should oversee flood events with multi-agency partnerships working together and collaborating on broader flood governance.

Second, the regional Surface Water Management Plans (SWMPs), which are now fully codified in the REF2021 period through the Water Act 2014, the related Surface Water Management Action Plan (2018) [5d], along with the 25-year Environment Plan (2018) [5c], have also been shaped by the call for connected governance and planning advocated by the University's 2007 research and the subsequent Pitt Review. Hull was one of five areas to trial SWMPs, and Coulthard sat on the Steering Committee from 2014 to 2017. The SWMPs mandate planners, investors and developers to incorporate flood risk into their planning. This tranche of legislation prepares society for future flood events to a degree that was never required previously. The University's research also recommended creating 'Aqua Green' sites in open public spaces, that would retain surplus surface water temporarily during flood events. Hull City Council has adopted these recommendations within the work of the Living with Water Partnership (see below). The use of natural flood management strategies like these are now also firmly embedded in the new EA *National Flood and Coastal Erosion Risk Management Strategy* (2020) [5f, 5g] and the 25-year Environment Plan (2018) [5c]:

"...Lead Local Flood Authorities (LLFAs) are now required to maintain a register of flood defence structures, including details of ownership and condition. The 2018 Surface Water Management Action Plan, which also has foundation in the University's research, requires the Environment Agency to work with LLFAs and other expert bodies to develop best practice for local flood defence management." **Director of Flood and Coastal Risk Management (FCRM), EA [5g].**

The University's research recommendations have additionally shaped new UK flood policies and strategies in the REF2021 period through their incorporation into the development of the Environment Agency's new *National Flood and Coastal Erosion Risk Management Strategy for England* (2020) [5f, 5g]. The EA Director of FCRM further states:

"...the University of Hull research has significantly impacted governance and inter-agency partnership working, as well leading to the adoption of a more integrated approach to flood risk management." [5g].

In this review period, the research has also impacted **international** flood and resilience strategies through the development, and subsequent global deployment, of the **City Water Resilience Approach (CWRA)**. This is part of the Resilient Cities Programme pioneered by the Rockefeller Foundation, with support from Arup, Resilience Shift, and the OECD [5e]. Launched in 2018, the CWRA [5e, 5h] is now the global standard for city-level water resilience. It promotes a methodology and framework that enables cities to diagnose their challenges related to water and deploy that knowledge to inform planning and investment decisions to better-prepare for, and respond to, shocks and stresses to their water systems. The University's underpinning research was vital to Hull being chosen as one of only five founding cities for the programme (along with Amman, Cape Town, Mexico City and Greater Miami) [5h]:

"The University of Hull's research into the 2007 Hull floods and the partnership working enabled by the research, created the governance and inter-agency working that lay the foundations that helped to support the case for why the city was selected as one of the Wave 1 cities for the development of the CWRA in 2015."...

"Kingston-Upon-Hull's specific water challenges... have been adopted into the establishment of qualitative and quantitative indicators to measure city water resilience embedded within the CWRA, for use in any city, anywhere." **Global Water Director, Arup [5h].**

Hull's participation in the CWRA project was facilitated by the creation of the **Living with Water Partnership (LWW) [5i]** between the Environment Agency, Yorkshire Water, Hull City Council and the East Riding of Yorkshire Council, with Professor Dan Parsons (Director of the Energy and Environment Institute) representing Hull University on the Partnership's Executive Board. As part of this partnership, the University's Energy and Environment Institute undertook a baseline city-wide investigation of flood risk, surveying >450 households to understand the impacts – physical, economic, or linked to health and wellbeing– of Hull's 2007 and 2013 floods. It also explored concerns about future flood risk and how people hoped to protect themselves and their homes [5j]. This survey contributed to the development of the CWRA approach and has informed its global adoption [5i]. Without the multi-agency approach advocated by the University's underpinning research, the CWRA would lack a robust, evidence-based framework for approaching water resilience on a multi-factorial, catchment-focussed basis:

"Hull was specifically selected as a Wave 1 City for the CWRA due the way in which research undertaken by the University into the 2007 floods had resulted in strong partnership working across the city."

"The global rollout of the CWRA now underway through the Rockefeller Foundation, Arup and the OECD, and is seeing the learning from Hull's experience of flooding, the implementation of aspects of Living with Water concerning flood resiliency now being adopted around the world." **Head of Resilience, Yorkshire Water, and Living with Water Programme Director [5i].**

The impact generated by the University's flood research is considerable. Policy influence in REF2014 has translated into full implementation in the REF2021 period. New UK policy impacts have also resulted from the research and they have been adopted into legislation and have been implemented on the ground. The reach and significance of the impact has expanded and is now world-wide through its influence on the development of the Rockefeller CWRA and its ongoing deployment in cities across the globe such as Thessaloniki (Greece), Addis Ababa (Ethiopia), and Kigali (Rwanda).

5. Sources to corroborate the impact

(All available as pdfs on request.)

- a) House of Commons EFRA Select Committee report (2008) *Flooding* : <http://www.publications.parliament.uk/pa/cm200708/cmselect/cmenvfru/49/49.pdf>
 - p11, p14-15: Lack of single agency with overall responsibility for managing flooding
 - p36: Underpinning research was taken into account in proceedings
 - p50: Coulthard cited as a witness.
- b) Pitt, M. (2008) *The Pitt Review: Lessons learned from the 2007 floods: Final Report*
 - p33: p47-51, Recom. 5 p51, p168, p328: Lack of a robust pluvial flood warning system
 - p33: Recom. 2 p34: Lack of single agency with overall responsibility for flooding
 - p94: Lack of integrated flood plans, management systems and data sharing
 - p97, p101: Inappropriateness of '1 in 30-year' standard of urban flood protection and need for risk-based approach

- p97: Lack of adequate planning and the IRB's role in exposing Yorkshire Water's role
 - p111, p168, p129: Conceptual frames adopted by the Pitt Review from the IRB about 'hard' and 'soft' infrastructure, and 'essential services'
 - p407-408: Importance of local scrutiny committees and the utility of the Hull IRB report by the Pitt Review
 - p408: IRB's role in exposing the inadequate design, maintenance and operation of Hull's flood-water pumping system
 - p408: Acknowledgements: the role of the underpinning research in shaping Pitt's understanding of the 2007 floods.
- c) *A Green Future: Our 25 Year Plan to Improve the Environment, DEFRA (2018)*
https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/693158/25-year-environment-plan.pdf
- p51: Statutory planning consultations
 - p52: Storage of water on open lands
 - p54: Lead Local Flood Authorities, water and sewerage companies, highways authorities and other risk management authorities work together.
- d) *Surface water management action plan, Defra (2018)*, with linkage to Water Act 2014
<https://www.gov.uk/government/publications/surface-water-management-action-plan>
- p7, pp21-22 Box 6: Importance of multi-agency approach with clarity about responsibilities
 - p7, p.5; 1.17 p7: Coordinated action by all those with responsibilities for managing flooding
 - p8, pp26-30: Coordinated planning and action specifically in relation to surface water, to include water industry
 - p14: Improvements to surface water mapping and forecasting
 - p18: Need for resilience in infrastructures
 - p19 Box 4: Inappropriateness of '1 in 30-year' standard of urban flood protection and need for risk-based approach
 - p19: Need for regulatory control to establish performance standards for water industry in relation to surface water and drainage
- e) The City Water Resilience Approach (Arup) https://www.arup.com/-/media/arup/files/publications/c/cwra_city_water_resilience_approach.pdf
- p57, p102, p110: Importance of multi-agency approach with clarity about responsibilities
 - p59: Need to incorporate resilience into water sources, networks and assets
 - p61: Promotion of diverse infrastructure for flood protection (i.e. hard and soft defences (e.g. aqua greens)).
- f) Environment Agency (2020) *National Flood and Coastal Erosion Risk Management Strategy for England*
https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/920944/023_15482_Environment_agency_digitalAW_Strategy.pdf
- p74, Measure 2.1.5: Extending risk management planning to encompass more adaptive responses to increasingly extreme climate-change driven events
 - p87, Measures 2.7.1 and 2.7.2: Cooperation between flood agencies and water industry for long-term adaptive planning and surface water flood management
 - p105, Measures 3.3.1 and 3.3.3: Multi-agency approach to surface water flood resilience.
- g) Impact evidence letter from Director, Flood and Coastal Risk Management, Environment Agency, highlighting how Hull University's underpinning research has continued to shape flood risk policy in the UK, including natural flood management.
- h) Impact evidence letter from Global Water Lead, Arup, highlighting how the underpinning research led to Hull being selected as one of five global cities in the CWRA programme.
- i) Impact evidence letter from Director of Resilience, Yorkshire Water, highlighting how the underpinning research led to Hull being selected as one of five global cities in the CWRA and the role of the Living with Water Partnership.
- j) Hull Household Flooding Survey (2018) Results, showing the data that informed elements of the CWRA: <https://www.hull.ac.uk/editor-assets/docs/hull-household-flooding-survey.pdf>