UNIVERSITY **OF HULL**

By the rising tide of Humber Using immersive storytelling to recreate past floods and build resilience to present-day flooding in secondary schools in the Hull and Humber region

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1. The Problem: Bridging Hull's 'resilience gap'

- The City of Hull is recognized internationally for its vulnerability to flooding from rising sea levels, one of five global cities selected in 2018 for the City Water Resilience Framework (ARUP 2018).
- Hull suffered serious surface water flooding in June 2007 affecting 8,600 households (Coulthard et al. 2007) and tidal surge flooding in December 2013.
- 55% of respondents to the Hull Household Survey felt flooding could happen again within the next 30 years (Ramsden et al. 2020).
- Yet the same survey also highlighted a 'resilience gap' (Ramsden et al. 2020), with limited local engagement in 'at risk' wards with resilience measures like registering for free flood warnings (21%), purchasing an emergency flood kit (9%), and making a flood plan (6%).
- How can we address this 'resilience gap' not only raising awareness about flooding but bringing about behavioural change?

2. The Concept: Using past flood events in Hull to promote resilience building today

- Research has highlighted the use of 'sustainable flood memories' drawn from living communities to foster resilience within those communities (McEwen and Jones 2012).
- We applied this model to the more distant past, drawing on Hull's 800-year history of living with water, and the records of water management preserved in the city and university archives, to create place-based learning histories that would draw attention to Hull's flood heritage.
- Working with secondary schools in the Hull and Humber region, we also wanted to encourage 'learning-by-doing' (Ferdani 2020) approaches to flood resilience, using VR technology to create interactive virtual environments that immerse school groups in the experience of flooding.
- The project focused on one well-documented flood in 1646, which saw a Humber storm surge breach already-damaged flood defences and cause extensive flooding.
- 1646 is also the approximate date of Hull poet Andrew Marvell's, 'To his Coy Mistress', a poem which discusses flooding 'by the tide of Humber'. Our aim was therefore to read the 1646 flood through Marvell's well-known poem.

ARUP (2018). 'Five cities selected to develop global water risk resilience framework'. https://www.arup.com/news-and-events/fivecities-selected-to-develop-global-water-resilience-framework - Coulthard, T.J., et al. (2007). The June 2007 floods in Hull. Final Report by the Independent Review Body, 21 November.

http://www.coulthard.org.uk/downloads/floodsinhull3.pdf

- Ramsden, S. et al. (2020). Hull Household Flooding Survey 2018. https://www.hull.ac.uk/editor-assets/docs/hull-household-flooding-<u>survey.pdf</u>











Scan for 3-minute Rising tide of Humber 360 film



Picture Captions

A. Wenceslaus Hollar, Map of Hull (c. 1640). Hull History Centre, U DDMM/33/8. B. Georeferenced map of Hollar's Hull, overlaid onto OS map of Hull of 1888-1913. C. 3D visualisation of Hollar's Hull, with OS/ LIDAR terrain data added. D. Still from Rising tide of Humber 360 film (<u>https://www.youtube.com/watch?v=eyLkIpEPIEA</u>): Beverley Gate, looking east, with flooding in foreground, and Humber Estuary visible on RH side. E. Still from the CAESAR-LisFlood animation showing different scenarios for the 1646 Hull flood.

F. Rising tide of Humber storyworld: Andrew Marvell on Hull High Street, with docks and garrison visible on RH side. G. Rising tide of Humber storyworld: North Gate Sluice, looking south-west.

Rising tide of Humber is a digital resource designed for use with VR headsets in secondary schools. We consulted with secondary school teachers at CPD events, and in July 2019 the project ran interdisciplinary pilot workshops on Hull's history of flooding, with A-level students from four schools across the Humber region.

Feedback from A-level workshops highlight VR's potential to build 'sustainable flood memories' (McEwen and Jones 2012) in at-risk cities like Hull by bringing past flooding to life:

- Hull

Further fieldwork (delayed by Covid-19 school closures) is planned for 2021-22 and the team has also produced an online 360 film of Rising tide of Humber (scan QR code to view), which was showcased in September 2020 at Hull's Freedom Festival (www.freedomfestival.co.uk/by-the-rising-tide-of-the-Humber) and in October 2020 at the Waterline Summit (<u>www.waterlinesummit2020.vfairs.com</u>).

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3. The Process: Recreating the 1646 flood of Hull

• In order to recreate the 1646 flood of Hull we first had to build a digital model of the 17th-century town and surrounding terrain.

Basing our model on Hollar's c.1640 scaled map of Hull (A), we used Arc-GIS to georectify (B) and digitize (C) Hollar's map, adding terrain data (from the Ordnance Survey and LIDAR), and gauge data from recent storm surges in Hull, both adjusted for 17th-century sea levels.

We sourced building, wall, & revetment dimensions from standing buildings, archaeological reports, & archival accounts of Hull's early modern flood defences.

We then applied the open-source CAESAR-LisFlood landscape evolution model to our digitized Hollar map, creating time-lapsed simulations of the 1646 storm surge and flood path (E).

The simulations were validated against historical accounts and animated in Unity VR (D) by industry partners, BetaJester Ltd.

Visitors to the VR storyworld are immersed in the experience of the flood, guided by Andrew Marvell (F), who prompts users to make decisions about flood mitigation measures like raising or lowering sluice gates

4. Research Findings: Qualitative feedback from secondary school students

• A-level participants saw value in 'virtually recreating Hull in the 17th century'. • They reported interest in 'the visuals of the flood'.

• They enjoyed 'learning about the geography and heritage of Hull'

• They said the workshops had made them think differently 'about floods in



[·] Ferdani, D. (2020). '3D Reconstruction and validation of historical background for immersive VR applications and games'. Journal of *Cultural Heritage* 43: 129-43. <u>https://www.sciencedirect.com/science/article/abs/pii/S1296207419307964</u> - McEwen, L. & O. Jones (2012). 'Building local/lay flood knowledges into community flood resilience planning after the July 2007 floods, Gloucestershire, UK'. Hydrology Research 43(5): 675-688. https://iwaponline.com/hr/article/43/5/675/855/Building-local-lay-floodknowledges-into-community