Integration of CCA and DRR for Flood Resilience: A review of good practices in the United Kingdom

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1. Introduction

Worldwide, flooding is on the rise. Recent studies have identified increases in the frequency of flood events on a global scale (Berghuijs et al., 2017; Najibi and Devineni, 2017) linked to the growing exposure of people and property, rising sea levels and the increased frequency of heavy precipitation events (Hartmann et al., 2013). In the United Kingdom (UK) flooding is the most prevalent natural hazard and recent events have shown the vulnerability of communities and businesses around the country (HM Government, 2016). For example, during the 2015/2016 winter floods 16,000 properties were flooded in England in December alone, communities were evacuated and left without power and there were major disruptions to both road and rail transport routes (Marsh et al., 2016). In total, this widespread flooding event incurred an estimated cost of £1.3 – 1.9 billion (Environment Agency, 2018). In line with global trends, the frequency of heavy rainfall is also on the rise in the UK, with seven of the ten wettest years on record occurring since 1998 (HM Government, 2016) and studies have identified a greater proportion of rainfall falling in intense bursts (Jones et al., 2013; van Oldenborgh et al., 2016). It has been estimated that the number of properties in the UK at significant risk of flooding could double by 2035 unless additional actions are taken (Adaptation Sub-Committee, 2012), with likely implications for property values, business revenues and the viability of communities living in flood prone areas (Committee on Climate Change, 2017b). This combination of factors indicates that climate change is likely to multiply the impacts of flooding the UK already faces, therefore further action must be taken to tackle both flood and climate risks to protect society, the economy and the environment.

Disaster risk reduction (DRR) and climate change adaptation (CCA) are two practices concerned with tackling the increased risk of disasters, such as flooding, with climate change. DRR looks to reduce the risk of both natural and man-made disasters through reducing exposure and vulnerability of people and property and increasing preparedness for such events (UNISDR, 2017), while CCA looks to make adjustments to reduce the potential negative impacts of climate change on society with regard to both climate extremes and gradual changes in mean climate (IPCC, 2012). Both practices aim to reduce the vulnerability and increase the resilience of society to hydro-meteorological hazards (Thomalla et al., 2006) but despite this shared aim, CCA and DRR are frequently handled independently, separated by institutional and administrative boundaries (Schipper and Pelling, 2006; Kelman et al., 2017). This is the case in national level arrangements in the UK, where DRR and CCA are managed by separate government departments (Dias et al., 2018).

Many scholars have suggested that addressing CCA and DRR together could be beneficial. Such benefits include, more efficient use of resources (Venton and La Trobe, 2008; Begum et al., 2014) and improved decision

making through sharing of relevant knowledge (Begum et al., 2014). Fundamentally, the integration of CCA and DRR contributes to achieving sustainable development (Birkmann and von Teichman, 2010; Kelman and Gaillard, 2010), thereby contributing to the goals of international frameworks such as the Sustainable Development Goals (SDGs) (Kelman and Gaillard, 2010; UN DESA, 2014), the Sendai Framework for Disaster Risk Reduction (SFDRR) and the Paris Agreement (Amaratunga et al., 2017a). With the likelihood of more disasters in the future there is obviously a need to reduce risk and adapt and this complex task and is more likely to be achieved by the two practices working together (Schipper, 2009).

2. Rationale

A great deal of research has been conducted on the integration of CCA and DRR, however in practice, integration is limited. As a result, many authors have investigated the challenges and barriers facing integration (Sperling and Szekely, 2005; Schipper and Pelling, 2006; Thomalla et al., 2006; Birkmann and von Teichman, 2010)). Integration has also been explored in different countries and regions around the globe, for example, in Australia (Forino et al., 2018), Ethiopia (Gebreyes et al., 2017) and Indonesia (Djalante and Thomalla, 2012), among many others. Some authors have explored practical integration, for example Hare et al. (2013), who present best practice case studies from around the globe. However, there is still limited guidance on how CCA and DRR can be brought together practically. For the UK, the challenges and barriers to CCA and DRR integration have been explored by Amaratunga et al. (2017a) and Dias et al. (2018), however research focusing on integration in the UK specifically is scarce. This study will contribute to the literature on CCA and DRR integration in the UK and to the body of best practice examples and lessons learned.

While previous studies have looked at CCA and DRR integration in general, this study looks specifically at policies and practices relating to flood management. The focus on flood policies and practices was chosen for several reasons. As flooding is the UK's primary natural hazard risk, the issue has received considerable attention in policy and overtime, many strategies have been implemented, providing ample examples which can be drawn upon. In addition, flood management was one of the first fields to consider climate change in its policies (Adaptation Sub-Committee, 2012). The UK has a relatively long standing consideration for climate change, as it was the first country worldwide to place climate change into formal legislation in the Climate Change Act 2008 (HM Government, 2008). Due to this combination of factors, the UK provides a unique case study and a potentially fruitful source of lessons learned in bringing together DRR and CCA for flood risk reduction.

This study presents examples of policies and practices in the UK that support the integration of CCA and DRR for flood resilience. The aim of this is to present existing linkages that could be exploited or expanded to further CCA and DRR integration in the UK and through a review of these practices, present potentially useful lessons learned for others wishing to integrate CCA and DRR.

3. Methodology

This study draws upon 15 semi-structured interviews which were conducted as part of the EU ESPREssO ('Enhancing Synergies for Disaster Prevention in the European Union') project. The interviews were conducted with CCA and DRR stakeholders from public and private organisations operating in the UK, this included academics with expertise in flooding and adaptation, representatives from government agencies such as the Environment Agency and the Committee on Climate Change and independent consultants working in the fields of adaptation and flooding. Further details on interviews can be found in Appendix 1. Interviews were transcribed and thematic analysis was conducted, this allowed key themes to be identified (Robson and McCartan, 2016) and to stakeholder views on UK policy and actions to be elucidated. These data were complemented with an in-depth literature review. The policies and actions presented in this study were chosen as they were frequently given as examples by interview respondents as contributing to CCA and DRR integration in some way.

4. Outline

To provide context, Section 5 (Findings) begins with an overview of current UK arrangements for flood risk management. This is followed by a review of the following policies: Flood and Water Management Act 2010 (Section 5.2); DEFRA's 2009 policy statement 'Appraisal of Flood and Coastal Erosion Risk Management' (Section 5.3); the Climate Change Act 2008 and the related Climate Change Risk Assessment, National Adaptation Programme and Adaptation Reporting Powers (Section 5.5), plus two influential EU directives, the Flood Directive and the Water Framework Directive (5.6), along with related practical examples. Key highlights and recommendations are presented in Section 6.

5. Findings

5.1 UK Governance Arrangements

In the UK, DRR is managed by the Civil Contingencies Secretariat, a department of the Cabinet Office that is responsible for emergency preparedness and response (UNISDR, 2013). The Department for Environment, Food and Rural Affairs (DEFRA), a government department responsible for environmental issues and protection, plays an important role in England as the lead government department for flood and coastal erosion risk management (FCERM) and climate adaptation (Kuklicke and Demeritt, 2016). For both flood risk and climate issues, the Environment Agency, a non-departmental government body sponsored by DEFRA, also plays an important role as the responsible party for managing the risk of flooding from main rivers, reservoirs, estuaries and the sea. It should be noted that although some responsibility is reserved by the UK central Government, flooding and climate change are largely devolved issues and therefore the devolved administrations (Northern Ireland, Scotland and Wales) have their own climate change and flood management plans.

5.2 The Flood and Water Management Act

The Flood and Water Management Act 2010 (FWMA) underpins approaches to flood management in England and Wales. The aims of the Act can be grouped under three overarching themes which are to 1) Achieve greater security for people and property; 2) Provide better service and 3) Achieve greater sustainability through helping communities adapt to the likelihood of increased severe weather events in the future (Environment Food and Rural Affairs Committee, 2017). Interview respondents highlighted the FWMA as being useful in bringing CCA and DRR together. Clear roles and responsibilities are often cited as important aspects of successful CCA and DRR (Lauta et al., 2018) and the FWMA has been commended on defining who should be involved in flood management and in what way. Under the Act, Lead Local Flood Authorities (LLFA) were established and given responsibility for managing flood risk in the local area. Alongside the LLFAs, district councils, drainage boards and the highway authorities, among others, are listed as actors. The LLFAs are obliged to assess flood risk in their area and produce and implement a local Flood Risk Management Strategy (Environment Food and Rural Affairs Committee, 2017). As discussed by respondents, this encourages consideration for flooding at the local level and puts decision making in the hands of local authorities who are best placed to make decisions that are appropriate for the local context.

Another way the FWMA integrates CCA and DRR is through the promotion of Sustainable Drainage Systems (SUDS). SUDS are a nature-based alternative to traditional piped drainage and act to reduce surface water runoff

through providing above ground water storage, limiting flows into sewers and filtering runoff further downstream, thus reducing the likelihood of surface flooding (Adaptation Sub-Committee, 2012). Examples of SUDS may include permeable pavements, green roofs, retention ponds and soakaways (Davis and Naumann, 2017). The FWMA looks to increase the uptake of SUDS by introducing standards for their design, construction, maintenance and operation and requires planned drainage systems to receive approval before construction can commence (Environment Food and Rural Affairs Committee, 2017). SUDS also contribute to CCA as they are better at handling extreme rainfall events, in particular they can be designed for exceedance and working with nature means they are flexible and sustainable in order to cope with future changes in precipitation (Woods Ballard et al., 2015). To provide an example, SUDS were employed in Alma Gardens in the London Borough of Enfield. The area suffered from surface water flooding and pollution due to wide spread impermeable surfaces and runoff from roads directing into water courses. The project aimed to reduce surface water flooding through the use of rain gardens, permeable paving and the planting of trees. The rain gardens were implemented along the highways which maximised infiltration of rainwater into the ground. Gullies were retained in case of an exceedance event. Through monitoring, the rain gardens were found to be functioning well during storm events (Susdrain, 2017). The project also cited additional co-benefits such as reduced water pollution, community cohesion and improved biodiversity. However, there are issues with successful implementation. The use of SUDS is only required if they are deemed 'appropriate' which has led to developers often opting out of their use on cost and practicality grounds (Environment Food and Rural Affairs Committee, 2017). It was also noted that the resources needed for implementing The Act are not always provided, leaving actors such as the LLFAs with the responsibility, but not the required resources to take action. Lack of resources and poor resource distribution are commonly cited barriers to CCA-DRR integration in Europe (Albris et al., 2017). One interviewee identified the FWMA as one of the most complex frameworks of its type in the world and although stakeholders are listed, it is still difficult to navigate even for professionals. One interview respondent also noted the benefits for adaptation are not made explicit in the Act, therefore may not be obvious to readers. Despite the FWMA being a significant legislative step for flood management, issues exist in successful translation of the policy into practical implementation.

5.3 The DEFRA Policy Statement

The DEFRA policy statement 'Appraisal of Flood and Coastal Erosion Risk Management' published in 2009 also provides positive policy implications for CCA and DRR. The Policy Statement promotes a long-term, holistic approach to FCERM and puts emphasis on flexibility for the future, for example by encouraging solutions that can

be adapted over time with climate change (DEFRA, 2009). It also intends to place more focus on community engagement and social factors in the FCERM process which can contribute to effective CCA and DRR (Gero et al., 2011). In addition, the statement supports the assessment of a variety of approaches, including 'risk management' and 'adaptation' as alternatives to the traditionally employed 'protection' and 'defence' approach to flood management. In line with this, the Statement highlights the use of managed adaptive approaches (Wingfield et al., 2017). Managed adaptive approaches enable flood management schemes to maintain their standard of protection, even with rising flood risk from climate change, through incorporating flexibility and adaptability into the design. For example, engineered defences as part of flood management schemes in Morpeth, north-east England and the Thames estuary have been constructed so that they may be modified and made taller in the future if required (Parkes (2016); Wingfield et al. (2017)). One interview respondent advocated the importance of 'flexibility in existing systems' to deal with events that might be outside of what is expected and that managed adaptive approaches are one way the government are showing commitment to this. Such approaches allow traditional flood management methods to be employed and revised in the future if necessary; flood risk is reduced now, with allowances for uncertainties in rates and degree of change (van Buuren et al., 2018). The DEFRA policy statement can be seen to support CCA and DRR in two ways; firstly, through putting emphasis on community engagement. Community knowledge can be important for understanding risks and needs at the local level, therefore is often seen as an important factor for the success of CCA and DRR (Amaratunga et al., 2017b). Secondly, through supporting the implementation of managed adaptive approaches, the statement also contributes to the implementation of DRR measures that have the flexibility to be adapted in the future.

5.4 Ecosystem-based Approaches

In combination with traditional engineered defences, the UK policy rhetoric is increasingly moving towards the use of natural flood management (van Buuren et al., 2018), thus there has been an increasing focus on Ecosystem Based Approaches (EBA). EBA provide a natural means of flood management and can be used to adapt to climate change and promote sustainable development by making use of ecosystem services (Temmerman et al., 2013; International Institute for Environment and Development, 2017). EBA were highlighted by interview respondents as one clear way CCA and DRR are being integrated practically in the UK. As a requirement of the FWMA the Environment Agency produced 'The National Flood and Coastal Erosion Risk Management Strategy for England' and although the strategy does not explicitly endorse EBA, they are compatible and there are several Environment Agency documents investigating the use of EBA for FCERM (Rouquette, 2013) showing this as a clear area of interest.

The most common EBA approach for the management of coastal flooding in the UK is managed realignment (Doswald and Osti, 2011). Along the coastline, managed realignment removes or purposefully breaches existing engineered defences and creates instead a 'buffer' area of marsh land that can be inundated during a flood (MacDonald et al., 2017). For example, in the Hesketh Outmarsh region of the Ribble Estuary, north-west England, the existing hard-engineered sea defences were breached as part of a managed realignment programme, allowing 150 hectares of salt marsh to be restored in the intertidal zone (European Environment Agency, 2016; RSPB, 2017). New flood embankments were also installed on the land-ward side. Due to the buffer zone provided by the salt marsh, the new defences did not have to be constructed so heavily, therefore had positive financial implications when compared with structural defences alone (European Environment Agency, 2016). The multi-partner project involved the UK Environment Agency (EA), Natural England, the Royal Society for the Protection of Birds (RSPB) and stakeholders such as Lancaster City Council. Overall, the salt marsh and flood embankments have reduced the flood risk for over 140 properties and 300 hectares of agricultural land (RSPB, 2017). The project at Hesketh Out Marsh provides a clear example of a joint CCA and DRR approach. The combined salt marsh restoration and flood embankments provide flood protection for infrastructure and buildings in the local area while also adapting to sea level rise and possible increases in coastal flooding. Stakeholder engagement is highly important for the success of managed realignment projects (Doswald and Osti, 2011) and the Hesketh Outmarsh example shows how different actors were brought together on a joint project. Multi-stakeholder collaboration on projects such as this can help to support CCA and DRR by bringing different actors together. Managed realignment has also been implemented at other sites across the UK including West Sussex (Environment Agency, 2012) and the Humber Estuary (Doswald and Osti, 2011). Managed realignment projects were generally viewed positively by respondents. They noted that in many cases action is taken post-disaster which can hinder consideration for both CCA and DRR being taken, while managed realignment projects demonstrate successful pre-emptive action. However, they also noted that implemented CCA and DRR actions are often driven through economic motives rather than environmental ones. This has also been noted to be the case for managed realignment programmes, where they may be primarily economically driven, with economic appraisals not fully taking into account sustainability objectives, e.g. Ledoux et al. (2005); therefore the use of such approaches are not directly related to initiatives to actively bring CCA and DRR together.

5.5 The Climate Change Act 2008

The Climate Change Act 2008 is one of the key pieces of UK legislation governing action on climate change. The Act covers both mitigation and adaptation, providing a legally binding framework to cut greenhouse gas emissions and to build capacity for adaptation. For adaptation, the Act promotes a 'continuous approach', wherein every five years the Climate Change Risk Assessment (CCRA) is produced which assesses key climate risks, along with the National Adaptation Programme (NAP) which outlines Government plans for the next five years (Frankhauser et al., 2018). Flooding is a key risk identified in the CCRA therefore is highlighted throughout the first NAP published in 2013. For example, under Focus Area One related to flood and coastal risk management for the built environment, Objective One was 'to work with individuals, communities and organisations to reduce the threat of flooding and coastal erosion, including that resulting from climate change, by understanding the risks of flooding and coastal erosion, working together to put in place long-term plans to manage these risks and making sure that other plans take account of them' (HM Government, 2013). Several factors mentioned in this statement contribute to effective CCA and DRR, for example working with communities, understanding risks and working together (Birkmann and von Teichman, 2010). Chapter 4 of the NAP 'Healthy and Resilient Communities' also creates further linkages between CCA and DRR through aiming to prepare communities for extreme weather events. In July 2018, the second NAP was released and flooding remains a key issue throughout. The first NAP was criticised for not addressing surface water flooding in enough detail (Committee on Climate Change, 2017a), however in addition to the second NAP, the Government have also recently released a separate Surface Water Management Action Plan (Department for Environment Food and Rural Affairs, 2018), which was an important step for addressing surface water flood risk.

Another important aspect of the Climate Change Act is the Adaptation Reporting Powers (ARP). The Climate Change Act requires key infrastructure organisations to report the effects of climate change on their organisation and their proposed actions to adapt through the ARP (Department for Environment Food and Rural Affairs, 2015). It has been found that the ARP has provided a stimulus for adaptation in the majority of the industries. A review of adaptation reports by Jude et al. (2017) found that 78% showed evidence of change in the management of climate risks in these organisations. The ARP has also led to improved risk assessments. For example, the energy sector and the Met Office have developed a common approach for assessing the risk of flooding on electricity sub-stations. The ARP thus supports CCA and DRR through assessing risk and also through raising awareness of climate risks amongst industries and promoting adaptation in key infrastructure organisations (Jude et al., 2017). Interview

respondents noted that often companies may be unaware of the impacts of climate change on their business and that the ARP has gone some way towards improving this by providing a clear framework for major industries to understand risks facing them and to plan to minimise them.

The CCRA, NAP and ARP required under the Climate Change Act have clearly played an important role in fostering climate action and for flood resilience. The CCRA produced every five years allows knowledge and adaptation plans to be updated (van Buuren et al., 2018) which helps to manage uncertainties. CCA and DRR are both heavily reliant on clear assessments of risk to identify suitable actions, therefore the CCRA contributes to integration through providing a coherent risk assessment for both. Another positive aspect is that the NAP is coherent with several other policies, such as the Environment Agency's National Flood and Coastal Erosion Risk Management Strategy for England and the Flood and Water Management Act 2010 through further promoting the use of SUDS as property level adaptations (Committee on Climate Change, 2017a).

However, the Climate Change Act has been critiqued for the fact that for mitigation there is a requirement for emissions to be reduced, but for adaptation there is no requirement for risk to actually be reduced (Frankhauser et al., 2018). This has meant that adaptation *planning* for increased flooding through the NAP has been relatively strong, but actual implementation of practical action has not occurred to a great extent. Several respondents noted that there is a great deal of planning for climate change but it was suggested that there is "more words than action" taking place.

5.6 European Legislation

As a current member of the European Union, European policy such as the EU Floods Directive (2007/60/EC) (FD) and the Water Framework Directive (2000/60/EC) (WFD) also influence CCA and DRR action in the UK. Respondents indicated aspects of these frameworks bring together adaptation with flood risk reduction. The FD aims to have member states assess whether their water courses and coastlines are at risk from flooding, to map the extent of flooding and assets at risk and to take efforts to reduce flood risk (Amaratunga et al., 2017a). The Directive requires EU member states to produce Flood Risk Management Plans that cover the key areas of prevention, protection and preparedness (European Commission, 2017) therefore creating the requirement for states to consider flood risk. The Directive also called for member states to take climate change into account in their plans. In the UK, the preliminary risk assessments were implemented by the Flood Risk Regulations 2009, led by the Environment Agency and conducted by LLFAs. The Floods Directive is regarded highly relevant to CCA through introducing new instruments to manage risk (European Environment Agency, 2009; Santato et al., 2013).

The Floods Directive is carried out in coordination with the WFD. The WFD has several objectives relating to protecting aquatic ecosystems and the environment, sustainable use of water resources and in mitigating the effects of floods and droughts (Wilby et al., 2006). The WFD integrates climate adaptation through encouraging adaptation measures to be considered in river basin district plans. It was found that all UK river basin district plans included adaptation, however the focus is on water quality issues rather than on flooding (Benson and Lorenzoni, 2017). This shows that the WFD has gone some way in encouraging consideration for adaptation in water management plans but not in terms of flood resilience. For the upcoming second preliminary flood risk assessment for the Floods Directive, there is a specific requirement on climate change which may reveal greater explicit ties between flooding and adaptation (European Commission, 2017).

6. Key highlights and areas for further improvements

This study aimed to present and review key examples of UK policy and legislation which support the integration of CCA and DRR for increased future flood resilience and provide good practice examples of practical action in order to highlight lessons learned and provide potential ways forward.

Several positives for CCA and DRR integration can be drawn from UK flood policies and practices. The UK approach to CCA and DRR for flooding has shown good practice in the joint assessment of climate and flood risk. There is strong support for the assessment of flood and climate risk, which in several cases is a statutory requirement of UK and European policies. For example, the ARP has encouraged key infrastructure institutions to consider the impacts hazards on their business and has played an important role in raising awareness and pushing forward action. There is growing consideration for climate change in flood risk assessments which is a positive integrative step and provides a basis on which joint CCA and DRR action can be developed. In addition, such risk assessments are often required to be updated regularly. This is advantageous for CCA and DRR as it allows plans to be updated as new knowledge is gained and is a good way to maintain awareness of risk over time while dealing with uncertainties in future climate change. It can be seen that requiring risk assessment and adaptation planning through legislation has worked relatively well at ensuring these actions are taken, demonstrating the effectiveness of creating legal requirements for driving positive action.

The practical actions reviewed in this study (e.g. SUDS, managed realignment and EBA) also generally incorporate some element of flexibility which helps to ensure practical implementation now, even in the face of future uncertainty. The practical examples have shown that working with natural processes is a particularly good

way to integrate CCA and DRR, as these methods offer more flexibility and sustainability. It is acknowledged that natural approaches to flood management may not be sufficient in isolation to tackle the rising risk of flooding, but that they may be useful in combination with other methods. Managed adaptive approaches, for example, are useful in settings such as the UK where traditional structural approaches are embedded in society, therefore allow some adaptive action to be taken in a way that actors are more comfortable with. Furthermore, in several cases reviewed, policy has clarified roles of actors and created an environment for communication and collaboration, factors which are important for fostering CCA and DRR integration.

Despite strengths in planning for CCA and DRR, there appears to be difficulties in translating plans into practical action. Several examples have highlighted the gap between policy and implementation. Often, the issue appears to be a lack of requirement or enforcement of the practical action compared to planning and assessment. In order to further CCA and DRR integration in the UK legal requirements should be placed on taking action as well as planning. The actual reduction of risk is not always a statutory requirement, therefore lags behind. Existing governance structures and stakeholder engagement methods that have been developed for flooding could be exploited to bring CCA and DRR closer. It is hoped that by taking flood management examples from the UK that important lessons can be learned for others looking to integration the two practices, it is however noted that it is unclear whether the same issues are present in the wider policy arena relevant to CCA and DRR, that do not focus on floods specifically.

In many ways UK policy and legislation has created the supporting foundations for CCA and DRR integration. In several instances, these policy foundations can be linked to the implementation of practical actions, such as the use of SUDS, managed realignment and ecosystem based approaches where CCA and DRR aims are being achieved coherently. However, it is also noted that these resulting actions have not necessarily been achieved through explicit intentions to integrate CCA and DRR but have manifested from other motives. To some extent, this demonstrates the inherent interconnectedness of CCA and DRR, but also suggests that linkages between CCA and DRR need to be made more explicit and intentional if further integration is to be achieved.

Appendix 1: Interviews conducted

All interviews were conducted during the period 2017/2018. Table 1 presents the association and/or area of expertise of each interviewee.

Table 1: List of interviews and association and/or area of expertise of the interviewee.

Interview code	**Association/ area of expertise**
IV1	Disaster Risk Reduction
IV2	UK Committee on Climate Change
IV3	Researcher; DRR/CCA
IV4	Consultant; Climate Change Adaptation
IV5	Consultant; Climate Change Adaptation
IV6	Natural England; Climate Change
IV7	London Climate Change Partnership
IV8	Academic; Flood Risk
IV9	Environment Agency; Flood Risk
V10	National Flood Forum; Flood Risk
IV11	Academic; Disaster Risk Reduction
IV12	Academic; Climate Change and Flood Risk
IV13	NGO; Disaster Risk Reduction
IV14	Climate Change Adaptation
IV15	Climate Change Adaptation

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