A risk based approach to adaptation monitoring and evaluation to support London's response to climate change and improved adaptation decision making

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A disconnect exists between climate change risk and vulnerability assessment, adaptation monitoring and evaluation (M&E) and adaptation decision making in cities worldwide, including London. In this briefing we present a risk based framework developed by Kingsborough et al. (in press) that links adaptation M&E, risk assessment and adaptation decision-making. We show how the framework has the potential to improve adaptation in London by better integrating M&E with risk assessment and decision making processes, using the Thames Estuary 2100 project as an example. We then outline recommendations related to adaptation M&E that the mayoral bodies may consider to ensure London can effectively adapt to climate change.

Adaptation monitoring and evaluation

M&E is a well-established practice utilised in a wide range of sectors and contexts that can inform the development of adaptation M&E systems and approaches. There is a critical role for adaptation M&E to play in informing the development of adaptation policy and practice, the identification of priorities, and ensuring the financial and technical resources committed to adaptation are used effectively and efficiently. In London there is significant potential for adaptation M&E to evaluate the effectiveness of adaptation mechanisms; communicate with the public about adaptation; learn about and improve the process of adaptation; identify adaptation priorities; justify adaptation expenditure; understand how climate risk is changing; and inform decision making processes.

Indicators can play an important role in informing adaptation M&E by providing evidence that a certain condition exists or certain results have or have not been achieved. Adaptation typically requires a broader set of indicators than less complex interventions. A portfolio of indicators can be used to provide evidence that a certain condition exists or certain results have or have not been achieved (Pringle, 2011). In the UK, the Committee on Climate Change's Adaption Sub-Committee (ASC) monitors changes in climate risks at the national level using indicators for exposure and vulnerability to climate risk, adaptation action and realised climate impacts. It evaluates preparedness through an analysis of ongoing decision making processes (ASC, 2012). The presentation of the trends identified in a range of indicators has been recognised internationally as a 'very useful way to summarise the results of the assessment' (Hammill et al., 2013). In New York City indicators to monitor the resilience of infrastructure and the built environment have been developed (NYC, 2013). Both these examples highlight the potential contribution adaptation M&E could make in London.

Adaptation M&E in London

To date, there is no published adaptation M&E framework in London. Without appropriate M&E, it is difficult to assess the effectiveness of the London Climate Change Adaptation Strategy or measure how London's climate risk profile is changing through time. The majority of monitoring relevant to adaptation has been carried out by stakeholders responsible for the management of specific risks, such as private a sector water company monitoring of water supply and demand within their water supply districts. Whilst this reflects the existing institutional responsibilities, this means that at a city scale some critical risks, such as the risks associated with heat waves and surface water, are less effectively monitored and managed.

The London State of the Environment Report (2013) details the monitoring of a number of environmental variables since 2000. It does not identify any explicit climate change adaptation indicators, but does include indicators that could contribute to the monitoring of climate risk and adaptation, such as flood risk, water supply and green space. The difficulty in monitoring climate change adaptation is cited as the reason for not including explicit adaptation indicators, which is consistent with international experience (Rosenzweig et al., 2010, Hammill et al., 2013, Hunt and Watkiss, 2010, Kingsborough et al., in press). Cities such as London, however, need to continue innovating and advancing climate change adaptation and through experimentation overcome such challenges.

Linking adaptation monitoring and evaluation, risk assessment and decision making

Traditional decision-making tools were not developed to manage the high degrees of uncertainty associated with long-term climate projections and existing planning frameworks and approaches need to be modified to account for the increased levels of uncertainty (Hallegatte, 2009). Adaptation planning approaches that

embrace flexibility and can incorporate uncertainty into the decision making process will be the most effective in managing future risks in complex systems. 'Adaptation pathways' approaches seek to maximise flexibility and minimise sensitivity to climate change scenarios by delaying decisions until critical thresholds are achieved (Reeder and Ranger, 2011, Haasnoot et al., 2012). Such approaches are increasingly relevant to adaptation planning in London. They are utilised in the Thames Estuary (as discussed below) and being developed in response to heatwaves, droughts and surface water flooding. Critical components of assumption based planning are the identification of adaptation thresholds or levels or tolerable risk and the incorporation of ongoing monitoring to inform the prioritisation of future actions. The emphasis upon reacting flexibly to change as it materialises reduces the reliance on assumptions about future scenarios but increases the importance of effective M&E.

The lack of M&E used in decision making is not limited to adaptation, but the challenge is compounded by long timeframes, inherent uncertainty and difficulties with attribution. A *risk based adaptation monitoring, evaluation and decision making framework*, shown in Figure 1, could contribute to overcoming a number of existing adaptation challenges. The proposed framework explicitly links adaptation M&E, and climate risk and vulnerability assessment to adaptation decision making. The iterative framework's components and linkages are described in (Kingsborough et al., in press).

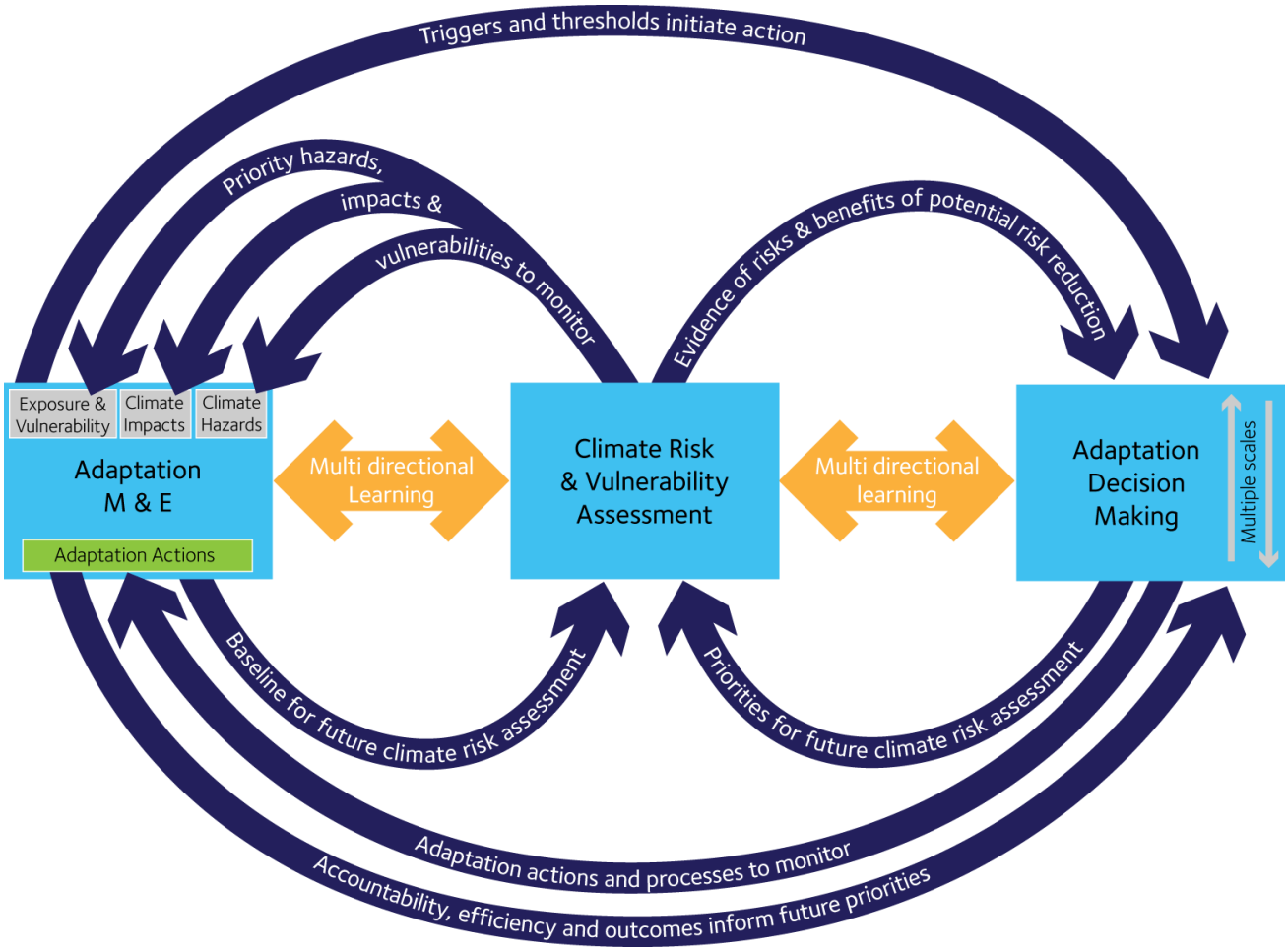

Figure 1 Framework for risk based adaptation monitoring, evaluation and decision-making (Kingsborough et al., in press)

The specific design and implementation of any *risk based adaptation monitoring, evaluation and decision making framework* will depend on the adaptation context. The next section shows how the framework could be implemented in the context of the Thames Estuary 2100 (TE2100) plan.

Risk based adaptation monitoring, evaluation and decision making for the Thames Estuary

The TE2100 Plan is the plan for long-term tidal flood risk management for London and the Thames Estuary; it includes specific flood risk management actions and pathways (EA, 2012). The Environment Agency and Greater London Authority have increasingly recognised the importance of risk assessment, the development

of adaptation pathways and M&E as critical components in adaptation planning, and TE2100 is an example of how they have begun to be integrated. Figure 2 demonstrates how these elements fit into our framework, and highlights the explicit linkages and components that will be critical in ensuring learning is captured and M&E contributes to future iterations of adaptation decision making.

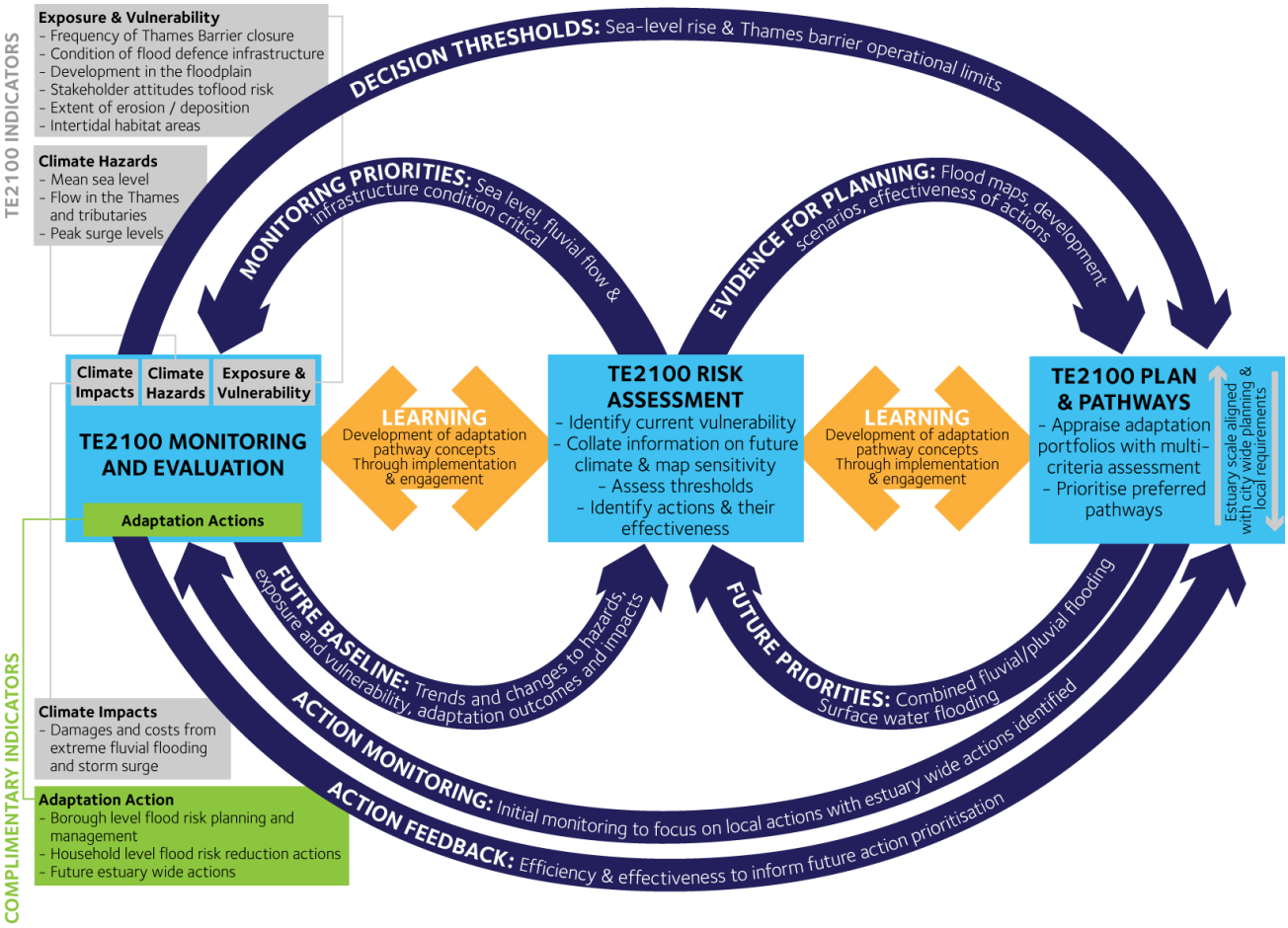

Figure 2 Framework for risk based adaptation M&E and decision making applied to TE2100 (Kingsborough et al., in press)

Monitoring of climate indicators for climate hazards, exposure and vulnerability is proposed in TE2100, and intended to track when decision thresholds are being approached. We propose M&E should be expanded to the monitoring and reporting of adaptation actions (e.g. tracking the number of properties with property level flood defences) and climate impacts (e.g. costs and damages from extreme fluvial flooding and storm surge events). Potential indicators for adaptation action and climate impact are included in Figure 2. As many elements of the proposed adaptation framework were utilised in TE2100 it serves as a useful example of how the components and linkages may be implemented. It is observed, however, that there is further potential to strengthen the role of adaptation M&E in the Thames Estuary.

Recommendations

Given the challenges faced in adapting to climate change, approaches that embrace flexibility and can incorporate uncertainty into the decision making process are required. The emphasis on reacting flexibly to change as it occurs reduces the reliance on assumptions about future scenarios, but increases the need for enhanced understanding of existing levels of risk and vulnerability. In addition, the limited financial resources available for adaptation make utilising available resources as efficiently and effectively as possible critical.

There has been limited adaptation M&E related to London-wide surface water flooding, heat risk and water scarcity. The proposed framework could be used as a structure for risk based adaptation monitoring, evaluation and decision making that addresses priority climate threats. The framework could be used to highlight the components and linkages that are well established and those that require strengthening.

Enhanced institutional linkages will be necessary to strengthen the linkages between risk assessment, monitoring and decision making. The flexible nature of the framework means, however, information can be incorporated as it becomes available. This allows new data collected from long term monitoring of climate risks and impacts and exposure and vulnerability to improve baseline data for future risk assessments, and show the tangible benefits of adaptation in terms of reduced climate risk and increased resilience.

The design of London's M&E approach will require extensive consultation and sharing of information between stakeholders including the Greater London Authority (GLA) and its functional bodies, Environment Agency, Met Office, London's boroughs and the City of London, water and drainage utilities, the London Climate Change Partnership (LCCP) and London Resilience. Figure 3 outlines a structure for the development of indicators for adaptation M&E in London. Such a structure is consistent with the *risk based adaptation monitoring, evaluation and decision making framework* and if populated effectively will inform a number of critical yet poorly understood adaptation processes such as the identification of tolerable levels of climate risk and the identification of when decision relevant adaptation thresholds are being approached.

Adaptation M&E should build on existing monitoring activities and capitalise on increasingly accessible spatially disaggregated data, some of which now exists in the London data-store but many are dispersed. There is a critical role for the GLA and LCCP to play in structuring and coordinating adaptation M&E. The provision of adaptation information and coordination between stakeholders are public goods that private sector organisations are not well placed to carry out. This is a critical role that the mayoral bodies are able play and it will help to facilitate future adaptation investment and support London's adaptation economy.

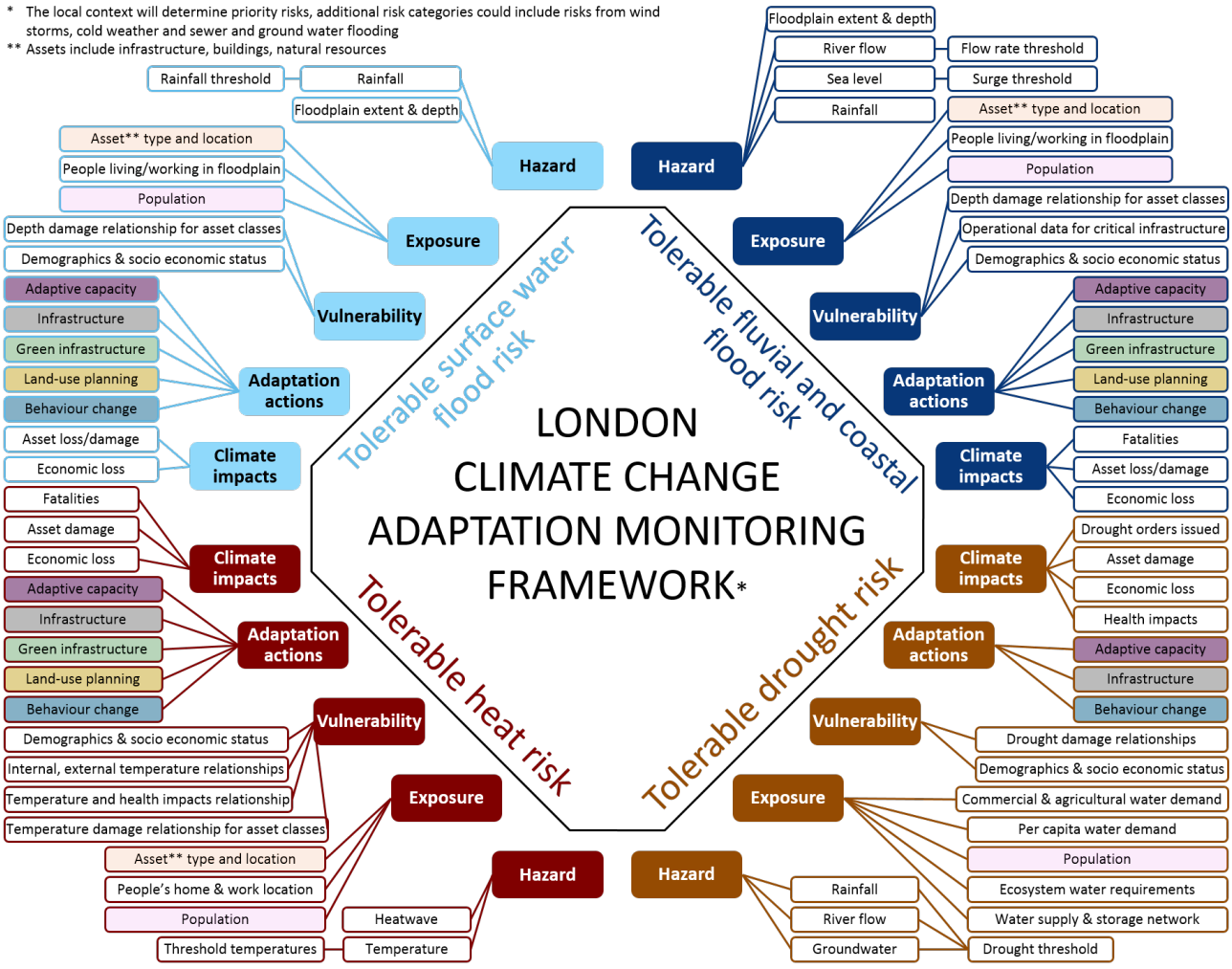

Figure 3 Monitoring and evaluation, indicator framework for urban climate resilience in London.

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