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Background Paper

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Exploring transformative urban climate adaptation in Durban, South Africa

Transform | make a marked change in the form and nature of
Adapt | adjust to new conditions
Climate | atmospheric conditions prevailing in an area over a long period



<http://www.tourdurban.co.za>



The *Transforming southern African cities in a changing climate* project aims to better understand the pathways to transformative adaptation in southern African cities as a response to climate change that promotes equality, inclusiveness and justice. The project is part of the Leading Integrated Research for Agenda 2030 in Africa programme, which seeks to increase the production of high quality, transdisciplinary, solutions-oriented research on global sustainability by early career scientists in Africa. LIRA2030 is funded by the Swedish Development Agency (Sida), run by the International Science Council (ISC) in partnership with the Network of African Science Academies (NASAC)

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Introduction

Having reviewed the international literature on transformative adaptation (see accompanying Working Paper), we turn attention to the two southern African cities in which this LIRA 2030 project (*Transforming southern African cities in a changing climate*) is working to understand the potential for and makings of transformative adaptation: Durban in South Africa and Harare in Zimbabwe. This background paper presents the findings from reviewing published and grey literature on climate adaptation processes in the city of Durban, focussing particularly on addressing water-related hazards and impacts.

Findings from this review formed the foundation for engagements with stakeholders in case study cities (Durban and Harare). The LIRA2030 team acknowledges the gaps in available literature and the immense amount of knowledge that was still to be gained during the engagement phase.

Climate adaptation context in Durban

Durban is globally recognized as an 'early adapter' because of its strong and early focus on adaptation through the Municipal Climate Protection Programme (MCCP) of the eThekweni Municipality. This sets it apart from many other urban climate change initiatives globally in which climate change mitigation through curbing greenhouse gas emissions has dominated (Roberts et al., 2012; Cartwright et al., 2013; Taylor et al. 2014; Sutherland et al. 2015).

The origins of Durban's climate work can be traced back to the early 2000s. From 2000 - 2006, with the support of external funding, eThekweni Municipality joined the ICLEI Local Government for Sustainability Cities for Climate Protection Programme, which initiated discussions about climate change. The climate change work in the City began gaining significant momentum after the Head of the (then) Environmental Management Department partook in an advanced international environmental management programme in 2004, which led to the initiation of the MCCP (Roberts, 2008). Subsequently it took a period of approximately thirteen years for the importance of climate change adaptation to be widely acknowledged, beyond the City's environmental management team, and to integrate adaptation into municipal planning and implementation to take effect within the eThekweni Municipality as a whole.

A focus on adaptation made sense in Durban because of the high levels of vulnerability in the city and the opportunity to link the adaptation agenda with development objectives within a context of poverty, urbanisation and deteriorating environmental conditions (Roberts, 2010; Roberts and O'Donoghue, 2013). It was the linking of these two agendas - climate adaptation and urban development - that has promoted political support (Taylor et al., 2014). Since the beginning, the approach has been one of trial-and-error through a phased process, with a focus on 'no-regrets' activities, 'learning-by-doing' and a willingness to experiment (Roberts, 2008).

Climate change and its associated impacts are now recognized as one of the key development challenges facing Durban, as articulated in the eThekweni Municipality Integrated Development Plan (IDP), a 5-year plan that drives the budget and operations of the city government (eThekweni Municipality, 2017). Two of the major ways in which the City is facilitating climate adaptation is through:

- 1) The Durban Climate Change Strategy (DCCS), developed as part of the Municipal Climate Protection Programme (MCCP), which lays out a city-wide approach to adapting to climate change and mitigating Durban's contribution to climate change (eThekweni Municipality, 2014). This strategy is achieved through political oversight via the Municipal Climate Change Committee and administrative oversight via the Disaster Management Advisory Forum's DCCS Technical Task Team (eThekweni Municipality, 2017), (now the Municipal Adaptation Planning Technical Task Team); and the strategy addresses ten interrelated climate change themes, namely Water, Sea level rise, Biodiversity, Food security, Health, Energy, Waste and Pollution, Transport, Economic development, and Knowledge Generation and Understanding.
- 2) The Durban Adaptation Charter (DAC) is an international agreement that commits Local Governments to local climate action in their jurisdiction¹. In Durban, the DAC is implemented through the maintenance and advancing of the Central KwaZulu-Natal Climate Change Compact (eThekweni Municipality, 2017). The Hub and Compact approach describes a network of networks engaging in collaborative climate change adaptation action. The Compact is a partnership between Durban and its surrounding local and district municipalities to collaboratively address climate change at a regional scale in an integrated fashion (eThekweni Municipality, 2016). This partnership provides the opportunity for a coordinated climate change adaptation response that transcends local political boundaries.

The DAC and the DCCS have an international, national and local mandate (eThekweni Municipality, 2017). The DAC has advanced the international reputation of eThekweni Municipality through its innovative approach, integrating adaptation and mitigation strategies and aligning them with sustainable local economic development, focussing on the needs of vulnerable communities and prioritizing the role of functioning ecosystems as core municipal green infrastructure. The DAC has also increased the ability of the eThekweni Municipality and other city governments to contribute to international processes, like strengthening the focus on climate change adaptation in the UNFCCC Paris Agreement committing nation states to climate action (eThekweni Municipality, 2016). The DCCS calls for the Municipal Adaptation Planning Technical Task Team (MAPTTT), under the leadership of the Environmental Protection and Climate Change Department (EPCPD), to focus on adapting to the impacts of climate change (eThekweni Municipality, 2014) across all sectors involving all relevant municipal departments (eThekweni Municipality, 2017).

¹ The Durban Adaptation Charter was launched at the United Nations Framework Convention on Climate Change (UNFCCC) 17th Conference of the Parties (COP17) hosted in Durban in December 2011.

Despite the high level integration of climate change into the policies, strategies and plans of the eThekweni Municipality, the term 'transformative adaptation' is not often used yet, even though some examples of implementation of adaptation strategies might be regarded as transformative in nature. Roberts *et al.* (2012) see 'transformation' as synonymous with the concept of "bouncing forward" that has emerged from resilience thinking, i.e. when a system is disturbed (like a city flooded by an intense rainfall event) it does not return to its original state but rather reorganizes to change certain system dynamics and characteristics in order to be less negatively impacted by a similar disturbance (i.e. a shock or stress) in the future. In Durban this concept of bouncing forward is regarded as a key ambition and approach, characterized by creativity, risk taking and innovation, to re-conceptualize natural capital as the "reserve currency" or foundation of a new, adaptive green economy driven by an understanding of deep sustainability, offering greater flexibility, value for money and an alternative to the existing global development model (Roberts *et al.*, 2012). In Durban, which is rich in biodiversity, and where many residents are still directly dependent on ecosystem services, much attention is being placed on Ecosystem-based Adaptation (EbA) as an approach that can reduce climate risks to human communities and create job opportunities, while protecting the habitats of other species and the functioning of ecosystems on which humans rely. According to Roberts *et al.* (2012) the systemic and proactive approach of EbA stands in contrast with the interventionist and reactive nature of many existing adaptation proposals and plans which usually relate to "end-of-the-pipe" infrastructural, land use planning and technological interventions that are responsive to only a narrow range of outcomes and probabilities.

The need for transformative adaptation in Durban

Durban already experiences the impacts of existing climate variability and change (EPCPD, 2011). As in many other global cities (especially in developing countries), Durban is caught in a "perfect storm" of population growth, substantial development deficits, increasing levels of informality, poor governance, environmental degradation, biodiversity loss, poverty and growing inequality, escalating its adaptation needs (Roberts & O'Donoghue, 2013). Climate change in Durban is expected to significantly exacerbate stresses such as poverty, inequality and disease - making it difficult to achieve sustainable development objectives (Douwes, 2018). The overriding concern is that the low income and marginalised communities are poorly equipped and can least afford to adapt to these changes (eThekweni Municipality, 2009). According to the eThekweni Municipality IDP the main challenges in Durban relate to high rates of unemployment, poverty, and crime; low economic growth, skills development and literacy; limited and unequal access to basic household and community services; and unsustainable development practices (eThekweni Municipality, 2017). Many of these deep structural inequalities are rooted in apartheid, colonial modernity and neoliberalism. Therefore it is acknowledged that any adaptation interventions in Durban should avoid reinforcing existing social and environmental inequalities (Leck and Simon 2018). Although South Africans are used to dealing with environmental and social change, the complexity and pace of climate change impacts will require the eThekweni Municipality to provide support to existing adaptation efforts and to

formulate unprecedented responses to existing and new threats (eThekweni Municipality, 2009).

Loss of natural capital is also highlighted in the City's IDP, and includes the abundant and important aquatic resources of the city. Durban's biodiversity and its ecosystem services have been severely impacted by landscape transformation, habitat fragmentation, invasive alien species, overexploitation and pollution (EPCPD, 2017). Climate change is expected to not only amplify these stressors, but add to them as well by inducing a rapid change in the distribution, movement, and behaviour of species, the spread of invasive and alien species, a shift in tree-grass dynamics, and an impact on water quality and quantity (eThekweni Municipality, 2014). There is thus a need for the eThekweni Municipality to facilitate transformation in environmental governance - not only to enhance the protection and management of the city's natural environment, but also to facilitate opportunities to address the inequities that are compromising a large portion of the wellbeing of Durban's population (Douwes, 2018). This suggests the need for a shift in the way biodiversity is managed as conventional mechanisms for environmental management are generally hierarchical, while tackling climate change requires collaborative efforts across scales (Leck and Simon, 2018).

Gathering evidence of potentially transformative adaptation in Durban with a focus on water

Current eThekweni Municipality policies have been developed in a post-apartheid context, thereby striving for inclusiveness as well as economic growth (Sutherland et al. 2015). This ethic is also being integrated into adaptation efforts. According to Douwes (2018), the eThekweni Municipality's climate adaptation work is positioned at a critical transitional stage on the transformative adaptation journey. The transformative intention that is strong in Durban, its deliberate emphasis on building learning and knowledge, and its significant focus on the vulnerable communities and the natural environment, suggest that the foundations are being established for longer-term systemic shifts that could help to challenge underlying causes of climate risk in a much more fundamental way than is currently being seen.

According to Douwes (2018) many of the changes relating to climate change adaptation have taken place at the level of policy and strategy development within the eThekweni Municipality. The development of the Municipal Climate Protection Programme (MCP), without formal obligation or funding by national or provincial government, was the first of its kind in South Africa to focus predominantly on adaptation rather than mitigation (Leck and Roberts, 2015). Key features of the MCP include (Roberts & O'Donoghue, 2013; Leck and Roberts, 2015): municipal adaptation plans (MAPs); adaptation activities focused on understanding and improving the adaptive capacity of local communities; a strong ecosystem-based component in interventions; urban management interventions addressing specific climate change challenges; the mainstreaming of climate protection action; knowledge and data generation; and networking at the local, sub-national, national and international levels. Further to the MCP, climate adaptation has been fully incorporated

into both the IDP and Spatial Development Framework, and a dedicated climate protection branch has been resourced.

The implementation of initiatives under the DCCS and the DAC has brought on local, national and international shifts in thinking and practical collaborations, which indicates that the City has begun to influence and shape the global agenda, as well as national and local adaptation agendas (Douwes, 2018). The biggest achievement of the City in terms of transformative change on a local level has been the facilitation of cross-sectoral interactions (mostly through the MAPs) and the strong focus on EbA to deliver environmental and community benefits for socially just and environmentally sustainable outcomes (Douwes, 2018). These initiatives have been approached in a phased manner and have been regarded as experimental, encouraging learning through trying new approaches and interventions, which has been useful in ensuring that the experience and knowledge gained through early interventions has been used to inform subsequent thinking and actions (Roberts et al., 2012).

The sub-sections below highlight the various climate adaptation related processes and activities underway in Durban, linking the local to regional, national and global initiatives. It suggests where to dig deeper when collecting evidence on what constitutes transformative urban climate adaptation. The LIRA 2030 project will explore further, with stakeholders involved, the ways in which these processes and activities exhibit the potential for contributing to transformative change. A dedicated effort will also be focused on exploring how similar interventions in southern African cities could be more transformative, in both intent and impact.

Municipal Adaptation Plans (MAPs)

The MAPs aim to assist sectors and departments in the eThekweni Municipality to consider and adapt to projected climate impacts. Preparedness and the ability to cope with adverse consequences and respond to new opportunities can radically reduce the costs that are associated with climate change. The eThekweni Municipality has taken the route of prioritising the most urgent and beneficial adaptation interventions following a flexible “no regrets” approach that yields multiple benefits regardless of the climate scenario (EPCPD, 2011). The MAPs seek to provide responses to challenges that are likely to prove successful, indicate who should be collaborating with whom, and what decisions should be taken, by whom, and with what information. Although the MAPs document focuses on specific actions, it places greater emphasis on the institutional prerequisites for effective decision making and actions in the context of adaptation (eThekweni Municipality, 2009). The Water Sector Adaptation Interventions include:

- protecting infrastructure against flooding through interventions such as: regularly updated revision of rainfall data in line with latest projections; protection and restoration of riparian vegetation so as to protect the integrity of river banks and retain biological buffers against flooding; and elevate Flood Annexure to Council Policy;
- protecting infrastructure against Sea Level Rise through interventions such as: preparation of Coastal Management Plans for Durban’s coastline;

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- securing water availability through interventions such as: incorporating a requirement that Umgeni Water (the state-owned entity supplying bulk potable water to eThekweni Municipality) consider the impact of climate change on rainfall and run-off into eThekweni Municipality's water purchase agreement.

uMngeni Ecological Infrastructure Partnership (UEIP)

The UEIP is a multi-stakeholder, trans-municipal boundary partnership to address the role of ecological infrastructure² in increasing water security and adaptive capacity in the uMngeni River catchment. The initiation of this programme reflected a significant shift in thinking towards a “social-ecological systems approach” to managing water, biodiversity, climate and poverty challenges within the context of one of Durban's critical water supply catchments (Douwes, 2018). This project is implemented in Durban by the EPCPD along with researchers at the University of KwaZulu-Natal through the Palmiet Catchment Rehabilitation Project, which aims to address the deterioration of the water quality and quantity in the Palmiet River. The focus is on co-production of knowledge and improved, participatory governance through developing a good relationship with catchment stakeholders to understand the socio-economic and political dynamics, particularly in the informal settlements around the Palmiet River (Martel and Sutherland 2019, Vogel et al. 2016). Challenges on this part of the catchment include solid waste management in the informal settlements, sewer leaks and illegal industrial effluent discharge.

100 Resilient Cities (100RC)

This international network and programme is dedicated to helping cities around the world become more resilient to their physical, social and economic challenges by supporting the adoption and incorporation of a view of resilience that includes not just shocks (i.e. sudden, sharp events that threaten a city) but also stresses that weaken the fabric of a city on a day-to-day or cyclical basis, such as unemployment, violence, food and water shortages (<https://www.100resilientcities.org/>). Cities in the 100RC network are provided with the resources necessary to develop a roadmap to resilience. Durban initially joined the 100RC through their focus on the water-biodiversity-climate change nexus, which built strongly on the existing biodiversity and climate adaptation work of the EPCPD. Although Durban has left 100RC, the work that was initiated continues to broaden in scope, with potentially important implications for transforming city governance (e.g. work on informal settlements and traditional authority areas).

Durban Climate Change Strategy (DCCS)

The DCCS (eThekweni Municipality, 2014) addresses ten interrelated themes, one of which is Water. The DCCS acknowledges that water treatment, storage and distribution infrastructure is required to prepare for and protect against the impacts of climate change,

² “Ecological infrastructure refers to naturally functioning ecosystems that deliver valuable services to people, such as fresh water, climate regulation, soil formation and disaster risk reduction” (SANBI 2013)

make provision for vulnerable communities and assure adequate yields of good quality water to service all sectors of the economy. Within the goal of “Durban’s water resources and infrastructure are effectively managed to ensure optimal protection from climate change impacts”, two objectives are identified: 1) The impacts of climate change on the secure, clean and safe supply of water to Durban are minimised; and 2) The impact of amplified flooding and increased levels of storm water as a result of climate change is limited through risk-averse planning and appropriate infrastructure, building standards and enhancement of ecological infrastructure.

The DCCS has the potential to be transformative in nature because it identifies and brings together a variety of stakeholders (local governments, national authorities, Business, Residents, Civil Society, and Researchers) involved in the theme of water and give them the responsibility to implement a list of 17 responses relating to the above mentioned objectives. It becomes a platform through which to facilitate co-operation between relevant agencies to jointly manage climate change impacts on catchments that supply water to Durban.

Sihlanzimvelo

The Sihlanzimvelo project is an integrated and systematic approach to the maintenance of streams in the eThekweni region, through a contractor development component targeted at creating employment opportunities for the youth from within the various communities where it is to be implemented (eThekweni Municipality, 2011). This project involves a number of departments working collectively with community co-operatives to improve stormwater management through invasive alien plant clearing, litter removal and community education. This project, supported by the C40 Cities Finance Facility, is a form of community ecosystem-based adaptation (CEbA) by assisting Durban’s infrastructure to cope with the increase in storms and heavy rainfall caused by climate change. Furthermore such ecological restoration initiatives provide job creation opportunities for communities that are adjacent to the project area (Douwes, 2017), and can therefore be seen to be transformative in its ‘green job’ creation approach that generates urban economic opportunities in regenerating and conserving the functioning of ecosystems.

Ecosystem-based adaptation via Durban Metropolitan Open Space System (D'MOSS)

This work focused primarily on the implications of climate change for the design and management of the Durban Metropolitan Open Space System (D'MOSS) - a 95,000-hectare system designed to protect the city’s globally significant biodiversity and ensure a sustainable supply of the related ecosystem services (Roberts & O'Donoghue, 2013). D'MOSS consist of an open space plan which ensures representation and persistence of the city’s biodiversity resources, as prioritised through a systematic conservation assessment. These open spaces are protected through various approaches and tools such as land acquisition, “special rating areas” (an additional levy on property taxes agreed to by the affected owners to improve management in an area), and formal incorporation into

the municipal planning scheme through the introduction of a controlled development layer, and through the split-zoning of private properties affected by D'MOSS into residential and conservation portions to protect endangered ecosystems (Roberts & O'Donoghue, 2013). Where biodiversity and ecosystem assets have already been lost, rehabilitation is implemented. Examples of this the rehabilitation of natural dunes as a no-regrets and cost-effective measure against storm surges, as well as the 'greening' of the Buffelsdraai landfill site - an award-winning Community Ecosystem-Based Adaptation (CEBA) concept (Roberts & O'Donoghue, 2013).

eThekwini Water and Sanitation (EWS)

Some of the plans, programmes and projects of the eThekwini Water and Sanitation (EWS) unit are inherently aligned with climate change adaptation, despite not being framed in this way. Tasked with managing the city's water in the short, medium and longer terms, accounting for variations and changes in rainfall and temperature patterns that shape both the availability and usage patterns of water, the EWS is a primary actor in the climate adaptation space. Douwes (2018) suggests that, despite facing ongoing challenges, water service provision in Durban (through the Water Service Unit) can be considered transformative because of their approach to differentiated provision and approaching water as a human right, fostering strong connections with research institutions, and platforms for inclusive dialogue (Sutherland et al. 2014).

The EWS unit is a powerful and innovative player in the municipality (Taylor et al. 2014) and was the first Water Service Authority (WSA) in South Africa to provide free water to the poor, which set an example for national government. Furthermore, EWS has developed strong partnerships (including with research institutions) to develop innovative technologies and pro-poor policies, which have fed back up to influence national policies for water provision (Sutherland et al. 2015). Sutherland et al. (2014) present four dominant discourses of water governance in Durban, namely: water as an economic good; water as a social good; the spatially differentiated approach to service provision; and the discourse of experimental governance and social learning. A fifth emerging discourse at the municipal level is 'water as a scarce resource'. The discourse of 'experimental governance and social learning' is relatively progressive when considering the importance of experimentation and innovation for transformative interventions. Knowledge related to water governance in Durban is also influenced by both international and local experiences. Local knowledge is gathered through Focus Groups and User Platforms that have been set up by EWS (Sutherland et al. 2015).

Investigating transformative adaptation in Durban

The activities and programmes reviewed above, and the work of Douwes (2018), suggest that Durban is a city with a considerable track record of attempting to shape and realize a local, cross-sectoral climate adaptation agenda that includes strong foci on water, ecological functioning, economic upliftment, and equity. This makes Durban a prime city for empirically investigating the characteristics of and potential for transformative adaptation.

This LIRA project will build on the work already undertaken by Douwes (2018) suggesting that three critical catalysts have contributed to progressing the integration of climate adaptation into municipal planning and implementation spheres, and thereby building transformative potential, namely the role of champions (both technical and political), external events as triggers for action (such as the destructive coastal storms in 2007), and 'windows of opportunity' (like hosting COP17 for example). The work of Leck and Roberts (2015), highlighting the important role of 'invisible aspects', or 'shadow systems', of municipal institutions for innovation, learning and decision-making processes, will also inform this transdisciplinary investigation of transformative adaptation in the context of Durban. They found that local governments rely considerably on 'shadow systems' and informal spaces of information and knowledge exchange across their operations to introduce and sustain new ideas that go beyond formal institutional requirements or policy (Leck and Roberts, 2015). According to Douwes (2018), the ability to form departmental networks and shadow spaces for deliberation and collaboration have enabled innovation in the eThekweni Municipality to emerge in a context where there is no formal mandate for climate action, and established a landscape of actors, initiatives and partnerships that have provided a firm foundation for future work to grow and deepen the local adaptation agenda in a way that brings together developmental and environmental concerns and actions.

The existing literature on Durban's climate adaptation journey also surfaces a number of challenges that need to be understood in the context of shifting from incremental to transformative adaptation. These include:

- Navigating the dual governance system; 38% of the land associated with the city is administered by the municipality alongside traditional authorities (eThekweni Municipality, 2016/2017, in Sutherland et al., 2018)
- The fragmented and sprawling spatial structure of the city undermines efforts to alleviate poverty and enhance social justice (Sutherland et al. 2013, in Sutherland et al. 2015);
- Misalignment or non-alignment between environmental and social agendas of eThekweni municipality and its neighbouring municipalities, which undermines the potential to work across scales, necessary for transformative action (Leck and Simon 2018);
- Claims that the existing water governance model, within which EWS operate, divides the eThekweni municipality into rural and urban areas and thereby continue to separate people based on their social status, which is neither inclusive nor equitable (Lewis 2013, Meyer 2013, Sutherland et al. 2014, in Sutherland et al. 2015).
- The intention of EWS to engage many groups in water governance, including civilians, is undermined because the focus groups and user platforms that have been established to integrate knowledge from a wider group of stakeholders are implemented in a managerial, top-down way, and thereby do not provide the deliberative, democratic space necessary for constructively addressing differing opinions and priorities between government, civil society groups and business (Sutherland et al. 2015).
- Despite post-apartheid legislation and policies driving an inclusive, social and economic transformation agenda, many governance cultures and practices in

eThekwini and South Africa at large remain conservative and technocentric in nature (Sutherland et al. 2015; Leck and Simon 2018).

- There are inherent contradictions in many local and national policies, including water policy, between the pro-poor and cost-recovery agendas (McDonald and Pape, in Sutherland et al. 2015).
- Political will for addressing climate change is often undermined by perceived public priorities, which emphasise basic needs and economic growth, and the misconception that climate change is an environmental management problem and not a development issue (Taylor et al., 2014).
- Despite progress on establishing networks and shadow spaces, the municipality and national government still operates to a large extent in silos, working separately on specific problems, rather than addressing concerns systemically, and heavily constrained by bureaucratic procedures (e.g. procurement, performance management) that undermine innovation, experimentation and learning (Douwes, 2018).
- An over-reliance on existing champions such that when individuals leave their role the work is set back considerably (Douwes, 2018).
- Limited budget associated with implementing priority adaptation actions (Douwes, 2018).
- Difficulties associated with monitoring and evaluating adaptation impacts, including some measure of transformation, due to the systemic and long-term nature of the problem and thereby the interventions (Douwes, 2018).
- Changing the macroeconomic patterns that drive inequality in the city, the region and the country.

The findings from reviewing existing literature on climate adaptation in Durban, as described above, will form the basis for designing and facilitating the collection of evidence and the co-production of new knowledge on transformative adaptation in Durban within the LIRA2030 project, as well as informing parallel investigations in Harare, Zimbabwe.

References

- Cartwright, A., Blignaut, J., De Wit, M., Goldberg, K., Mander, M., O'Donoghue, S. & Roberts, D. 2013. Economics of climate change adaptation at the local scale under conditions of uncertainty and resource constraints: the case of Durban, South Africa. *Environment & Urbanization*, Vol 25(1): 1-18. DOI: 10.1177/0956247813477814
- C40 Cities Climate Leadership Group, 2017. eThekwini (Durban) Sihlanzimvelo Programme. Available online at: <https://www.c40cff.org/projects/ethekwini-durban-sihlanzimvelo-programme> [accessed 02/05/2019]
- Douwes, J. (2018) Exploring transformation in local government in a time of environmental change and thresholds : A case study of eThekwini Municipality. University of KwaZulu-Natal.
- EPCPD (2011) Climate change adaptation planning for a resilient city. eThekwini Municipality.
- EPCPD (2017) Durban: State of biodiversity report (2016/2017).

- Transforming southern African cities in a changing climate, Durban background paper (June 2019)
- eThekweni Municipality (2009) eThekweni Municipality Municipal Adaptation Plan: Health and Water. Durban.
- eThekweni Municipality (2011) EtheKweni Municipality State of Local Innovation Report. Durban.
- eThekweni Municipality (2014) Durban Climate Change Strategy. Durban.
- eThekweni Municipality (2016) DAC 2016 Annual Report. Durban. Available at: https://www.unrefugees.org.au/media/2270/australia-for-unhcr-annual-report-2016-final_low-res.pdf.
- eThekweni Municipality (2017) 'eThekweni Municipality Integrated Development Plan: 5 year plan: 2017/18 to 2021/22', (May 2017). Available at: http://www.durban.gov.za/City_Government/City_Vision/IDP/Documents/IDP_2017_2018.PDF.
- Leck, H. and Roberts, D. (2015) 'What lies beneath: Understanding the invisible aspects of municipal climate change governance', Current Opinion in *Environmental Sustainability*. Elsevier B.V., 13, pp. 61-67.
- Leck, H., and Simon, D. (2018). Local Authority Responses to Climate Change in South Africa: The Challenges of Transboundary Governance. *Sustainability*, 10(7), 2542.
- Martel, P. and Sutherland, C. 2019. Governing River Rehabilitation for Climate Adaptation and Water Security in Durban, South Africa. *The Geography of Climate Change Adaptation in Urban Africa*, 355-387.
- Roberts, D. (2008) 'Thinking globally, acting locally - Institutionalizing climate change at the local government level in Durban, South Africa', *Environment and Urbanization*, 20(2), pp. 521-537.
- Roberts, D. (2010) 'Prioritizing climate change adaptation and local level resilience in Durban, South Africa', *Environment and Urbanization*, 22(2), pp. 397-413.
- Roberts, D. and O'Donoghue, S. (2013) 'Urban environmental challenges and climate change action in Durban, South Africa', *Environment and Urbanization*, 25(2), pp. 299-319.
- Roberts, D., Boon, R., Diederichs, N., Douwes, E., Govender, N., McInnes, A., Mclean, C., O'Donoghue, S., Spires, M. 2012. Exploring ecosystem-based adaptation in Durban, South Africa: "learning-by-doing" at the local government coal face. *Environment and Urbanisation*, 24(1): 167-195
- Sutherland, C., Nel, E. and Nel, A. 2018. Conceptualizing 'the Urban' Through the Lens of Durban, South Africa. *Urban Forum*, 29(4), 330-350
- Sutherland, C., Scott, D., & Hordijk, M. (2015). Urban Water Governance for More Inclusive Development: A Reflection on the "Waterscapes" of Durban, South Africa. *European Journal of Development Research*, 27(4), 488-504.
- Taylor, A., Cartwright, A. and Sutherland, C. (2014) 'Institutional Pathways for Local Climate Adaptation : A Comparison of Three South African Municipalities', *Focales*, 18(March), pp. 1-142.
- Vogel, C., Scott, D., Culwick, T. and Sutherland, C. (2016). Environmental problem solving in South Africa: Harnessing creative imaginaries to address 'wicked' challenges and opportunities. *Journal of South African Geography*, 98 (3), 515-530.

