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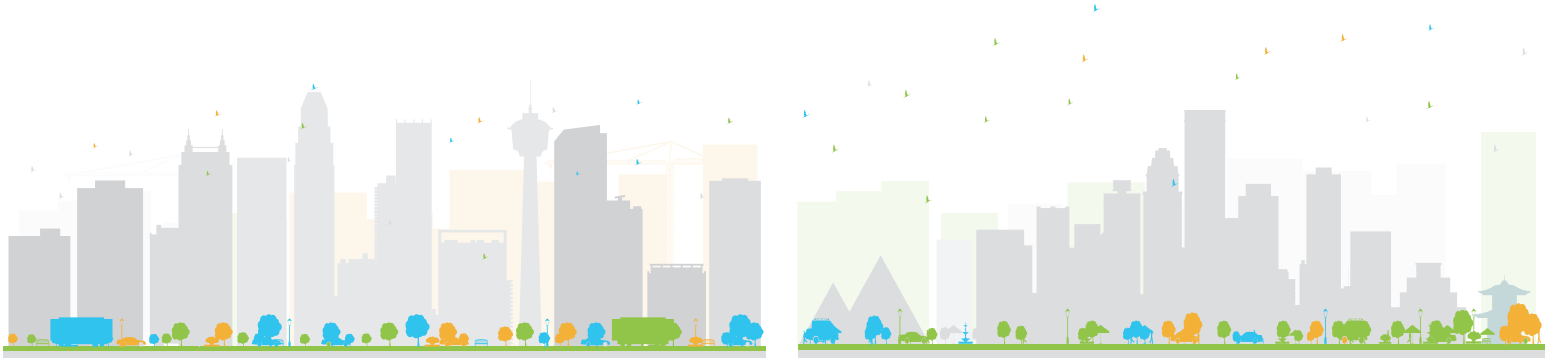


Building a Climate-Resilient City:

Transformational adaptation

KEY MESSAGES:

- Adaptation to climate change may be incremental or transformational in nature. Cities can choose to combine both approaches, depending on their needs and circumstances.
- Transformational adaptation occurs when fundamentally new and innovative responses are required—typically upon realizing that historic approaches are insufficient for current or anticipated climate risks.
- Governance systems that emphasize transparency, integration, flexibility, monitoring, continual learning and knowledge sharing increase the likelihood that transformational adaptation occurs at the necessary and appropriate time.

Alberta's climate is changing: temperatures are rising, particularly in the winter; heat waves have become more frequent; and the growing season has become longer.[1] These trends are expected to continue into the future. Alberta's mean annual temperature could rise by 2.0°C by the 2030s and 4.0°C by the 2060s (compared to the 1990s), depending on future rates of greenhouse gas emissions. At the same time, precipitation levels and patterns will change. Total average annual precipitation is projected to rise, increasing more in the winter and declining in the summer.[2] Alberta's climate is also expected to become more variable, leading to less predictable weather and greater risk of extreme events such as floods, severe rainstorms, heat waves and droughts. While reducing global greenhouse gas emissions would lessen the severity of the climate change experienced by Alberta, significant modification will still occur in the coming decades.

These expected climatic changes have profound implications for Alberta's urban centres, including the cities of Calgary and Edmonton. They have the potential to significantly disrupt and damage core urban infrastructure, such as roads, sewage systems, transmission lines and buildings. They could also adversely affect economic activities, disrupt the provision of social services and have negative impacts on the health and well-being of citizens.

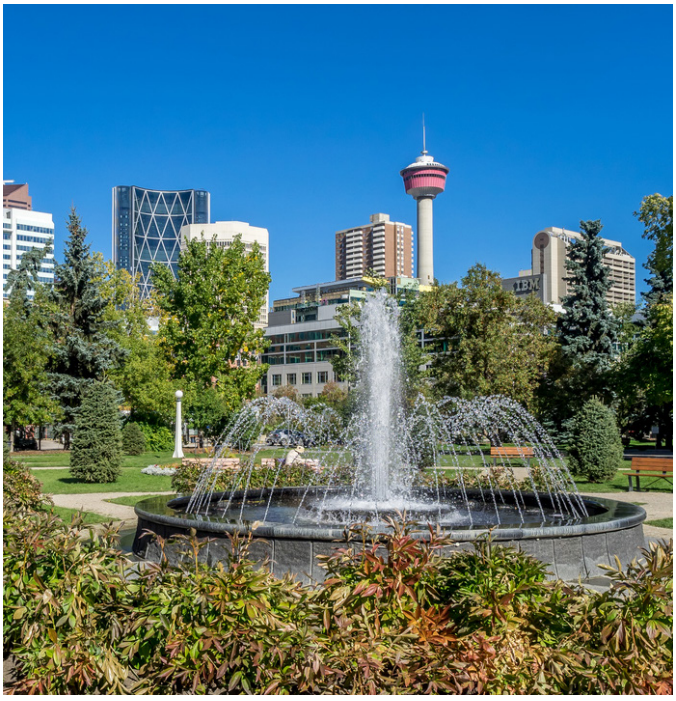
City administrators can choose to respond reactively to these impacts and cope with the immediate consequences of climate-change-induced disasters as they occur. More proactively, they can engage in planned adaptation; in other words, they can make adjustments to natural and human systems in response to the anticipated impacts of climate change, both to reduce potential harm and to take advantage of emerging opportunities.[3]

Efforts to adapt to climate change can be incremental or transformational in nature. *Incremental adaptation* involves building on and improving the efficiency of conventional practices, approaches, technologies and governance structures for climate risk reduction and management. Examples of incremental adaptation actions include strengthening existing flood defenses, increasing the size of water reservoirs, or improving emergency preparedness systems.

As the potential for significant changes in climatic conditions becomes more likely, though, questions are being raised regarding whether this incremental approach will be sufficient over the long term. If multi-year droughts become a common occurrence, or summer river flows significantly decline, will Alberta's cities continue to be able to fulfill their civic functions? By reinforcing established solutions to climate-related threats, are we following unsustainable pathways that will increase our climate risk in the future?

These concerns have given rise to interest in *transformational adaptation*, which may lead to the implementation of fundamentally different approaches to preparing for and responding to climate risks. Transformational adaptation involves a broader and more systemic look at the root causes of the vulnerability of a system (such as a city) to the impacts of climate change—and taking steps to reduce these sources of vulnerability. Transformational adaptation has the potential to turn the need to manage the growing risk associated with climate change into an opportunity to transform cities into more sustainable, climate-resilient places to live and work.

This paper provides an introduction to the concept of transformational adaptation and how cities in Alberta and elsewhere can take steps to enable this approach as part of their efforts to adapt to climate change. It is one of a series of papers prepared by the Prairie Climate Centre to provide the public and government officials with an overview of the means by which to build cities that are resilient to the impacts of climate change, drawing on lived experience and best practices.



What is "Transformational Adaptation"?

Although there is growing interest in the concept of transformational adaptation, it has no commonly agreed upon definition; the concept means different things to different people (see Box 1). Generally speaking, though, it is understood to involve profound, systematic, structural change at different levels (i.e., political, social, cognitive, technological and biophysical systems). It has been described as leading to a change in development pathways, a shift in paradigms, a re-shaping of the status quo and a fundamental restructuring of the system.

At its core, transformational adaptation involves questioning the effectiveness of existing systems and processes in light of changing circumstances, particularly the potentially significant impacts of climate change. It requires looking at the economic, political and/or sociocultural factors that make a region, population or system more vulnerable to climate change shocks and stresses and then applying innovative approaches to reduce vulnerability to current and/or anticipated challenges. Transformational adaptation may occur at a local or national scale, and focus on one or more sectors. Its outcomes could be shifts in power and greater social justice.[4]

Transformational adaptation can be reactive or, some argue, planned. Reactive efforts can be triggered by a system reaching the limits of its ability to engage in incremental adaptation, such as when a disaster demonstrates that existing practices and approaches are no longer adequate to address current risk(s) and new approaches are needed. Such events can open up space for new ideas and innovative policies and approaches.

Planned transformational adaptation involves deliberate efforts to address the underlying failures of existing development approaches and processes that increase vulnerability to climate change. Steps are undertaken to gain a full understanding of the existing system(s), look beyond the surface to the deeper causes of risk, and develop and implement plans for significantly different ways of achieving a desired outcome.

As transformational adaptation is a relatively new concept, few concrete examples of this approach at the city scale have been described. Pockets of innovation that are transformative in nature, though, can be found in many cities.[5] Examples of possible transformational adaptation efforts led by cities include:

- Applying common risk management strategies at a larger scale, with greater intensity and over a longer period of time, such as by significantly increasing the use of green infrastructure to address climate risks.
- Introducing new practices, either those that are previously used elsewhere or completely new.
- Transforming the composition, nature and/or location of activities, such as by moving people and businesses from locations identified as being particularly exposed to increasing risk of flooding.[6, 7, 8]

BOX 1. DEFINITIONS OF TRANSFORMATIONAL ADAPTATION

The following are examples of definitions of transformational adaptation from the literature:

- "Adaptation that changes the fundamental attributes of a system in response to climate and its effects."[9]
- "A structural change that alters the interplay of institutional, cultural, technological, economic and ecological dimensions of a given system. It will unlock new development paths, including social practices and worldviews"[10]
- "... enabling adaptation that goes beyond incremental 'change at the margins' to build more resilient systems with the capacity for transformation."[11]

Enabling Transformational Adaptation and Resilience

A resilient city is one in which its institutions, communities, businesses and individuals are able to "survive, adapt and grow" in response to any kind of anticipated or unanticipated disruption that they may experience. As outlined in Box 2, creating a resilient city involves enhancing the core qualities that enable it to effectively respond in a timely manner to changing circumstances. These qualities—flexibility, redundancy, robustness, resourcefulness, reflectiveness, inclusiveness and integration—can also enable the pursuit of climate adaptation measures that are transformational in nature. For example, cities can promote transformational adaptation by:

- Favouring measures that are robust under a wide range of potential climatic conditions.
- Building redundancies into systems, making available a breadth of alternative measures that enhance capacity to deal with uncertainties.
- Encouraging resourcefulness through a high reliance on stakeholder involvement.

Efforts to build a resilient city that enables the potential occurrence of transformational adaptation should promote planning and decision-making processes with the following characteristics:

- *Apply a systematic approach to planning and implementation.* A system-wide perspective is needed to understand the implications of planned and unplanned changes across city functions.
- *Be forward looking.* Planning processes should take a longer-term view and give greater focus to future changes to avoid locking a system into development paths that are unsustainable over the longer term.
- *Take an integrative approach.* Climate adaptation should be integrated into sustainable urban planning processes to link climate and non-climate policies and changes.
- *Recognize uncertainty.* How climate change will occur, and its implications for social, economic, ecological and cultural systems, is uncertain. This uncertainty needs to be recognized, embraced and built into decision-making processes.
- *Prioritize flexible solutions.* Invest in approaches that enable changes to be made if climate change becomes more extreme or if there is a change in technological, economic, social or political conditions. This means focusing on soft strategies, not just technical solutions.

BOX 2. QUALITIES OF A RESILIENT CITY[12]

Reflective: People and institutions reflect and learn from past experiences and leverage this learning to inform future decision making.

Robustness: Urban physical assets are designed, constructed and maintained in anticipation of high-impact climate events.

Redundancy: Spare capacity is built into the system to account for disruptions and surges in demand. It also involves multiple ways of fulfilling a need or function.

Flexible: Refers to the willingness and ability to adopt alternative strategies in response to changing circumstances or sudden crises. This can be achieved through new knowledge and technologies.

Resourcefulness: Citizens and institutions are aware of climate risks, able to adapt to shocks and stresses and can quickly respond to a changing environment.

Inclusive: Inclusive processes emphasize the need for broad consultation and many views to create a sense of shared ownership or a joint vision to build city resilience.

Integrated: Integrated processes bring together and align city systems to promote consistency in decision making and investments. Exchange of information between components of the system enables them to function collectively and respond rapidly.

- *Emphasize cooperation, involvement and participation.* The involvement of stakeholders, within and outside of government, should be integrated into planning processes to create synergies, minimize trade-offs, expand the range of options available and benefit from social innovation.
- *Enable continuous learning and re-evaluation.* Adaptation is a learning process. Processes should be established to enable constant examination of events and actions to reveal inefficiencies and adverse outcomes, as well as observing and analyzing the deep structures that sustain a system. This means that monitoring, reporting and evaluation are key to enabling resilience building and transformational adaptation processes.

BOX 3. THE NETHERLANDS' DELTA PROGRAMME

Flooding is a longstanding concern of the low-lying Netherlands, where nearly 30 per cent of the country lies below sea level and a further 30 per cent is vulnerable to flooding along its rivers, including the Rhine, the Meuse and the Scheldt.[13] For centuries, the country has responded to its vulnerability to flooding through a combination of dikes, drainage, sea walls and storm surge barriers. Flooding from the North Sea in 1953, which led to the loss of 1,800 lives, led the government to commit to building higher coastal dikes. However, significant flooding occurred again in 1993 and 1995, when rivers swelled to unprecedented levels; the 1995 event led to the displacement of 250,000 people. At this time, the Government of the Netherlands recognized that its circumstances had changed: its population has grown significantly; more economic infrastructure is exposed to flood risk; the land is subsiding; and climate change will lead to rising seas, higher temperatures, greater risk of drought and potential for greater river discharge. A new approach was needed.[14]

In response, the national government initiated the Delta Programme (*Deltaprogramma*) in 2008. Moving from a reactive to a proactive approach, and enlarging the scale and integration of interventions, the Delta Programme seeks to ensure flood protection and freshwater security in the Netherlands in a changing climate.[15] The program moves away from the country's traditional approach, which focused on flood prevention, to a more systems-based approach focused on minimizing the damage caused by flooding.[16] It incorporates consideration of climate change risk in its decision-making processes, questioning whether or not current water management approaches and policies will be sufficient to meet their stated objectives under different climate scenarios. This approach encourages short-term interventions that build the robustness of the country's infrastructure while promoting flexibility and resilience over the long term.[17, 18]

This new approach is demonstrated through one of the initiatives incorporated into the Delta Programme: the Room for Rivers program (*Ruimte voor de Rivier*). The goal of the Room for Rivers program (2007–2019) is to restore landscapes along the country's rivers to create more room for floodwaters. Actions involved include lowering the floodplain by removing silt deposited during seasonal flooding, creating diversions that move excess river water through a separate route, relocating dikes further inland and restoring marshy riverine landscapes. In implementing these actions, the program recognizes the importance of respecting cultural, ecological, aesthetic and recreational values.[19]

The Delta Programme demonstrates the potential for transformational adaptation arising from fundamentally questioning the historic approach being taken. It also reflects the characteristics required to enable transformational adaptation. The program has a long-term focus, with the Government of the Netherlands committed to continuing the program after 2020. It is backed by strong leadership and political commitment, which is reflected in the establishment of a multi-billion-dollar Delta Fund to finance the work of the Delta Programme and an annual review of the program's work plan by the Netherlands Parliament. The program also engages a wide range of stakeholders, including national ministries, provinces, municipalities, water boards and civil society organizations (social groups, research institutes and the business community). Monitoring and assessment of risks in light of new knowledge is undertaken on a continuous basis.[20, 21]

Potential Limitations

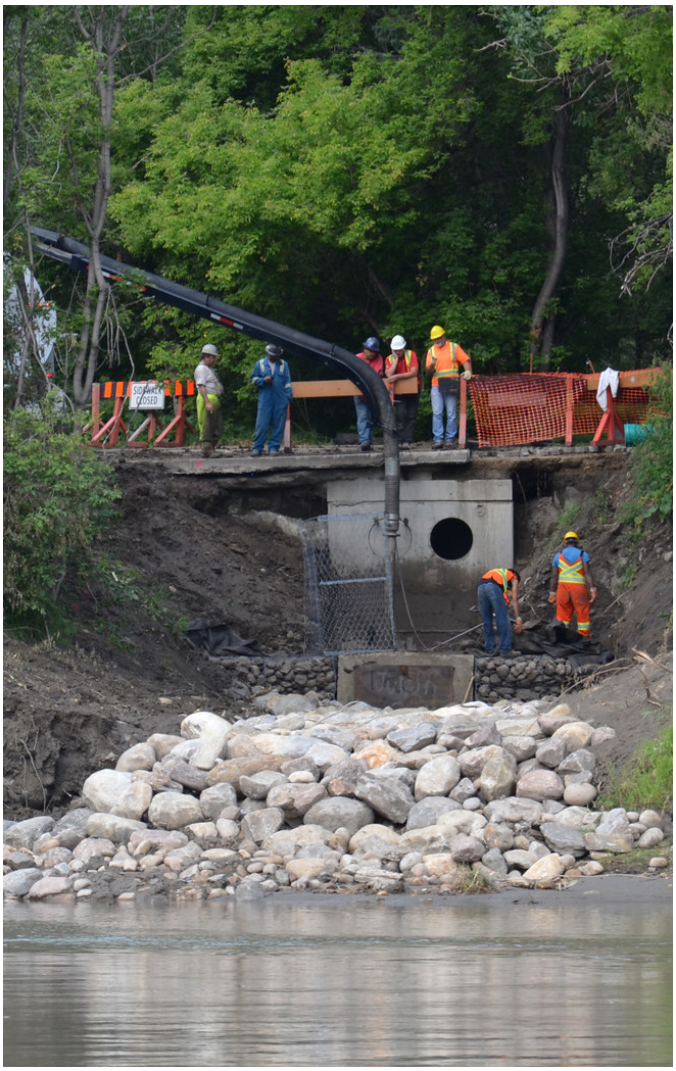
Processes that promote transformational adaptation have the potential to help cities avoid locking themselves into development pathways that are unsustainable and increase their vulnerability to climate change over time.[22] It is important to keep in mind, though, that the complexity and interdependencies of systems mean that poorly designed processes can result in unintended and unforeseen consequences.[23] Due to these factors, the idea of planned transformational adaptation has been questioned. As noted by Lonsdale et al. (2015): "There is some doubt about our ability as humans to adequately anticipate the changes likely to result from a changing climate and allow sufficient time to prepare for the scale of change required for deliberate transformation."[24]

To be effective, transformational adaptation may also need to occur at more than one scale simultaneously—from the personal level to organizational, sectoral, municipal, regional, national and, potentially, international scales—if its outcomes are to be reinforced and strengthened.[25] In the absence of effectively coordinated action, there is the potential for transformation to occur on different timelines and to different degrees in different locations.

The perceived cost of implementing transformational approaches can also be a barrier to its pursuit, particularly when there is also uncertainty about the potential benefits that will be achieved. Proposed measures often involve large, upfront investments in actions expected to yield positive benefits years or even decades in the future.[26]

A further challenge to transformational adaptation is the existing systems and power structures it questions, as stakeholders that benefit from the current system are likely to resist change. Incremental adaptation is more suited to working within existing political time frames and in situations where it is necessary to pursue pragmatic interventions as opportunities arise, as there is limited appetite for a more significant response.[27]

Transformational adaptation may seem like a daunting concept. Yet, our society is already undergoing profound transformational processes stimulated by, for example, technological developments like the Internet of Things.[28] As well, at the policy level, cities are exploring new ways of addressing long-standing problems such as homelessness and drug addiction. Climate change provides an additional impetus for thinking through the long-term sustainability of existing policies and practices across a range of sectors and issues, and considering the need to transform current approaches.



Recommendations

The cities of Calgary and Edmonton can help ensure their economic and social resilience in the coming decades by creating an environment conducive to the occurrence of transformational adaptation. This objective can be achieved by establishing systems that emphasize transparency, integration and flexibility; focus on continual learning from practice and knowledge sharing; promote monitoring and evaluation of interventions; build capacity within people and systems to engage in systematic inquiry and be comfortable with uncertainty; and encourage leadership that values new ways of thinking and doing.

Potential actions for building a resilient city in which transformational adaptation is possible include:

Strategic

- Document and share examples of past and present efforts in Alberta to transform practices and approaches to climate and non-climate related problems, such as EndPoverty Edmonton, to both understand the factors that enabled these efforts and demonstrate their potential.
- Undertake an assessment of current municipal policies and programs to determine if they are flexible and adaptable in and of themselves, and therefore have the potential to enable adaptation and avoid locking cities into approaches and practices that are maladaptive or unsustainable over the longer term.
- Regularly (e.g., annually or biannually) engage in participatory scenario processes that explore potential future conditions (economic, social, climatic) in the medium term, their implications and the means by which vulnerabilities might be reduced. This process should engage a cross-section of municipal departments as well as representatives from the broader community (e.g., private sector, social services, community organizations and academia).

Regulatory/Administrative

- Mainstream near- and medium-term climate risk considerations into existing planning and budgetary processes.
- Establish effective systems for monitoring, reporting and evaluating climate risks and adaptation actions to better enable identification of when "tipping points" are close to being reached, or have been reached, and therefore there is a need for transformational adaptation.
- Introduce or strengthen leadership training for city administrators in areas that build the qualities needed for resilience, such as systems thinking, the interrelationship between the environment and society, cross-sectoral collaboration, climate change adaptation, and the management of risk and uncertainty.

Voluntary/Community Linkages

- Strengthen existing processes for engaging the public in municipal planning to better ensure that a broader range of voices and perspectives is reflected in decision-making.
- Initiate community-level processes focused on envisioning what a resilient or transformed Calgary or Edmonton might look like, building on past and ongoing work within each city. Such an initiative could draw inspiration from ecodistrict initiatives, such as the United Kingdom's Transition Towns movement and R-urban in France, as well as the 100 Resilient Cities movement.

Further reading:

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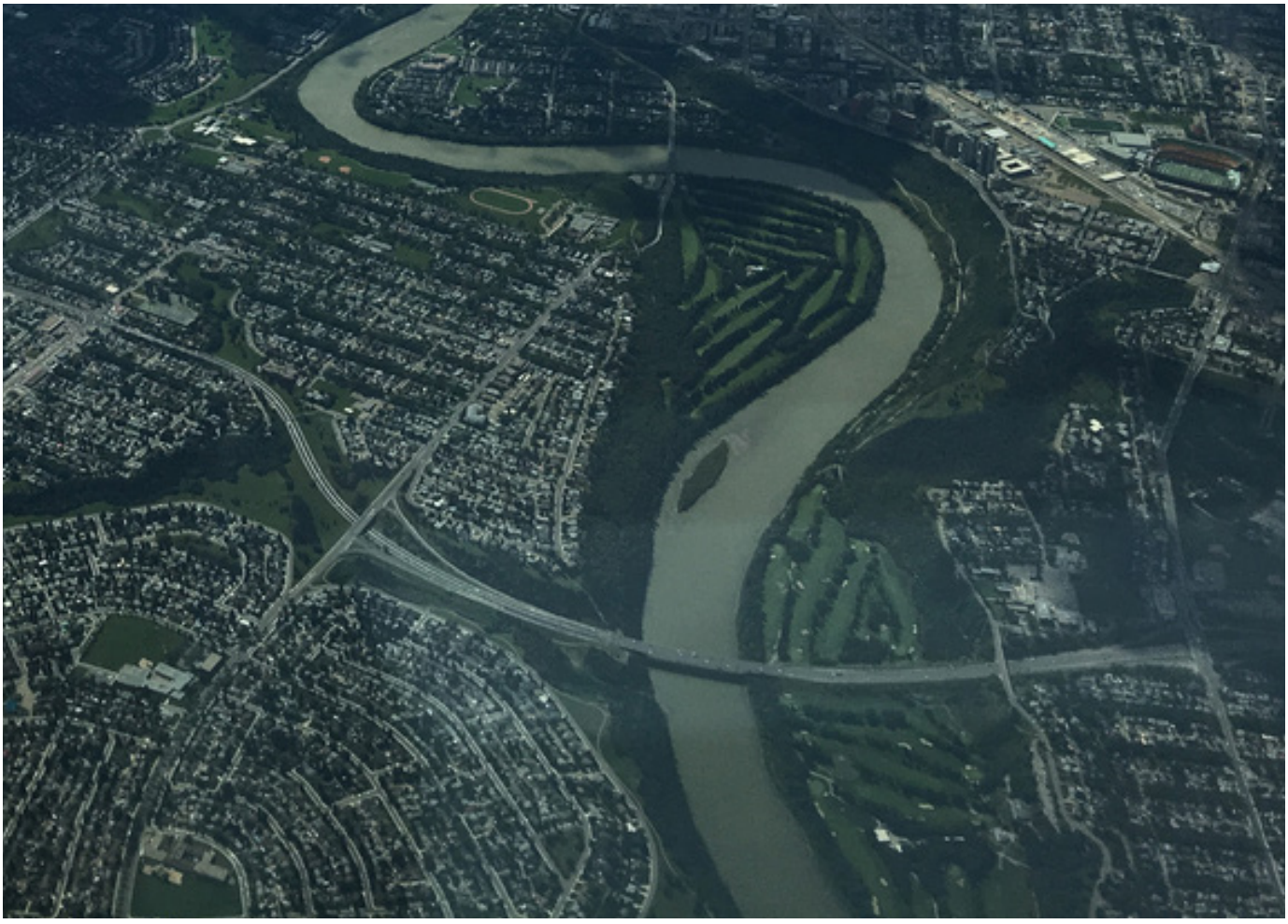

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[25] Lonsdale et al. (2015). Ibid.

[26] Kates et al. (2012) *supra* note 6.

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[28] Refers to the networking of things (washing machines, cell phones, wearable devices, buildings, etc.) to one another via sensors, software etc. embedded within the devices that enable them to collect and exchange enable them to collect and exchange data and to be controlled remotely through, for instance, the Internet. Examples include smart-grids and smart homes.

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