RESEARCH ARTICLE

Place-pedagogies of water stress

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This article explores the pedagogical affect of water in a place of water stress and illustrates its entanglement with dynamics of power and control. The current climate crisis is rendering already drought-prone regions ever drier, and it is often the already socially and economically disadvantaged who experience the most immediate impacts. In this article, we describe the

experiences of residents in one township in South Africa's Cape Flats to explore how water literacies have developed and been reinforced by a prolonged period of water scarcity. By analysing assemblages of images and accompanying texts produced through a PhotoVoice process undertaken by co-researchers in this settlement, we show how water's presence as an always imminent absence has profound pedagogical impact. We also explore how water manages to escape and flow outside of attempts to control and constrain it. Finally, we speculate on the implications for place-based water literacies and the pedagogies at work in other places of water stress.

Keywords water literacies • pedagogies of place • assemblage analysis • difference and repetition • lines of articulation and flight

Key messages
- As the planet heats, prolonged water scarcity is becoming an increasingly common experience across the globe.
- We demonstrate how the imminent absence of water in a place can have significant pedagogical power.
- Using PhotoVoice, residents in a township in the Cape Flats region of South Africa show how they experience and respond to water scarcity and restricted water use.
- We suggest that the lessons learned from water stress are intimately connected with dynamics of power and control.

Introduction

I, the first author of this article, write this on a wet Sunday in January in Scotland's Central Belt. It is raining: the prelude to another passing winter storm (the ninth named storm of the season), which is due to arrive in a few hours. Following just a couple of weeks after Storm Henk, Storm Isha is expected to bring more localised flooding and disruption. Water is already very much present. It pools on waterlogged fields; turns the local bowling green into a small inland sea; runs in small rivers along the edges of the streets; and, of course, falls from the sky.

Water is very much present in the photos I am looking at, too. But it is a different kind of presence – one that expresses an always imminent absence. I am looking at photos from Delft, a township in the water-stressed Cape Flats region of South Africa where lives and landscapes are put under pressures and tensions by a combination of climate, geographical and water management challenges. The photos were taken by community-based researchers as part of a project that explored experiences of and responses to three environmental hazards – flood, water scarcity and fire – in three different Cape Flats settlements (Ncube et al, 2023; Wilson et al, 2023; Black et al, forthcoming). Our co-research in Delft focused on water scarcity, which we understand as a 'lack of access to adequate quantities

of water for human and environmental uses' that indicates that a region's water resources are 'under pressure' (White, 2014: 161). Water scarcity reflects demand as well as supply and is thus a 'fundamentally normative, anthropocentric condition' (Jaeger et al, 2013: 4507) that depends upon a complex range of economic, health, environmental and cultural values.

The photos were taken in February 2022, during Cape Town's summer months, and more than three years after the end of Cape Town's worst water crisis. In the following, we use these photos and the texts that were written to accompany them to understand the place-pedagogies of water stress – that is, the pedagogical affects of a place (Brandt, 2013; Wilson et al, 2023) that has come to be characterised by long-term water stress – and the water literacies and practices that are created by them. Our analysis treats the assemblages of images and words as a collective text that illustrates the place-pedagogies of water stress in the form of the constant threat of water scarcity. It thus acts to both exemplify and develop assemblage analysis (Feely, 2020; Wilson, 2021; Wilson et al, 2023; 2024) as a novel approach to the analysis of multimodal and multivocal texts.

The photos show that place-pedagogies of water stress, and the learned behaviours that they lead to, result in both increased constraint and inevitable escape. We see a place patterned with physical striations, infrastructures such as pipes, drains and taps intended to control and manage water's movement. We see social striations in the form of water literacies and the emergence of new social norms. We also see that, in spite of these, water evades control, flowing through fractures and across smooth spaces, both material and social. Finally, we consider the implications of these socio-hydrological dynamics for attempts to cope with water stress and water scarcity.

Background and context

The Cape Flats region of South Africa

The Cape Flats region of South Africa is one of many places around the world that are bearing the brunt of the climate crisis (Satterthwaite et al, 2020; Carrilho and Trindade, 2022). The Flats are part of the metropolitan region of Cape Town in the Western Cape province. Here, settlements that were home to subaltern populations during the Apartheid era have seen exponential growth, and new settlements have developed on what was previously low-productivity farmland and wetlands (Dhupelia-Mesthrie, 2014; Philip, 2014; Cinnamon and Noth, 2023). This population growth is a result of a combination of factors including inward migration from neighbouring countries, rural-to-urban migration, and downward social mobility within the Cape Town region, exacerbated by the COVID-19 pandemic. The last available census data showed that the Cape Flats was home to almost 600,000 people in 2011 (City of Cape Town, 2013) – a number that has undoubtedly increased since then. Residents live in a mix of formal housing (that is, in places recognised as 'planned' by the local authorities and provided with services and infrastructure such as water and sanitation, communications, electricity and waste management) and informal settlements (that is, places that are not legally established and have little or no infrastructural support).

As a consequence of colonisation and Apartheid's racialised legislation, the Cape Flats are largely inhabited by Black African and Coloured residents, racial groups who were legally oppressed, economically marginalised and physically cleared from Cape

Town itself under Apartheid rule. It is now 30 years since the end of Apartheid and its replacement with democratic government, but economic inequality, gang-related shootings and violence, and socio-economic challenges continue in the area (Turok et al, 2021; Shaik, 2023), rendering Cape Flats residents perpetually marginal.

Since the early 2010s, it has become clear that pre-existing environmental hazards associated with the local topology, geography and climate in South Africa have been worsened by climate change (Ziervogel et al, 2014), including in the Cape Flats region. High population growth, poor infrastructure and poor drainage combine to make the region especially prone and vulnerable to environmental and climate-related impacts (Gintamo et al, 2021). Despite significant effort and investment by the local authorities, it has proved difficult to achieve water resilience (Rodina et al, 2024), or a state in which the complex socio-eco-technological water systems of the region can continue to operate and survive both shocks and ongoing stresses.

Although the City of Cape Town has made real efforts to address water resilience, the focus has been largely on engineering, technological and biophysical problems and solutions (Rodina, 2019a; 2019b). There has been a similar focus within the fields of research into water resilience and climate/disaster resilience more generally, leading some authors to call for approaches that are more strongly grounded in (critical) theories and that expose or explore issues of power, control, social justice and equity (see, for example, Fitzgibbons and Mitchell, 2019; Matthewman and Uekusa, 2021; Ncube et al, 2023; Rodina et al, 2024). As Rodina et al put it, 'power dynamics and associated inequities are central to how water insecurities are lived and experienced' (2024: 2). There is thus a real need for research that connects water resilience with social processes (Rodina, 2019a) and that explores how water management strategies and policies unfold in a range of social and cultural contexts. Recent work has started to address this at the urban scale in Cape Town (Rodina et al, 2024). In the following, we turn our attention to the personal scale of day-to-day, lived experience.

The unfolding present in the Cape Flats and similarly climate change–impacted regions may be a primer for future climate impacts in other places (Rodina et al, 2024; Wilson et al, 2024). It is therefore particularly important (and increasingly urgent) that the experiences and responses of people living in such regions are understood and learned from. In the following, we build on previous work (Wilson et al, 2023) exploring the pedagogical affect of a flood-prone place in the Cape Flats through place-based images and texts created by community-based co-researchers. Here, we turn our attention to the pedagogical affect of a place of enduring water scarcity.

Delft

The place where we explore the effects of water scarcity is a formally established township called Delft, located in the Tygerberg district of Cape Town (Figure 1).

The formal status of the settlement means it is a place that experiences far higher levels of both support and control from the local City authorities compared to many neighbouring informal settlements. Situated approximately 30 km north-east of Cape Town's city centre, Delft was established in 1989 at the fall of Apartheid and shortly before the 1991 dissolution of the Group Areas Act, which imposed racially/ethnically segregated living. Indeed, Delft was the first township in Cape Town where the government made efforts to support and encourage desegregated residential areas (Booysen, 2005). As such, an important characteristic of the

Figure 1: The location of Delft

Map created with QGIS (v.3.26.0) using data from OpenStreetMap and Map Tiler Contributors.

CRS: EPSG:3857 - WGS 84
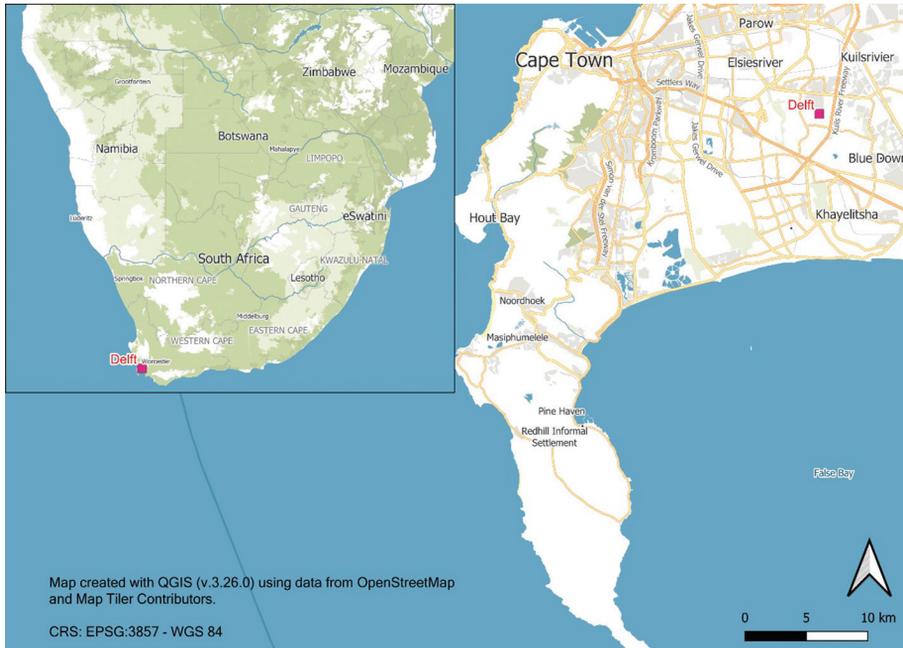
broader Delft community is that it is a planned, mixed-race settlement including predominantly Coloured and isiXhosa populations but also a large African immigrant population. Like most urban township settlements in South Africa, Delft is growing in size and population density. The 2011 census estimated the population of Delft to be around 152,030 people (City of Cape Town, 2013). A recent City of Cape Town report estimates up to 25 per cent population growth in Delft between 2011 and 2018 (City of Cape Town, 2022). Although some residents of Delft are considered to be middle class (Booysen, 2005) it has recently been reported that the majority are unemployed or on low income with median household incomes being 'fairly low' at R800–R3200 per month (City of Cape Town, 2022). Poverty tends to be concentrated in localised areas (Le Roux et al, 2016). Delft has been the recipient of a comparatively large number of government programmes to deliver basic services, utilities and housing (Le Roux et al, 2016). Previous studies report infrastructure in Delft to have been well developed compared to other low-income areas in the Cape Flats (Millstein, 2008). In 2008, more than 80 per cent of the population in Delft lived in formal (brick) housing, with 14 per cent in informal dwellings (Waggie, 2008). Some 90 per cent of the population had access to basic services such as electricity, water and municipal rubbish collection (City of Cape Town, 2013). The fraction of informal inhabitants of Delft is likely to have increased in recent years as unauthorised land occupations increased considerably during COVID-19, with Delft being one of the hotspots. Some of these occupations took place on land ring-fenced for infrastructure and housing projects, threatening the longer-term development plans for the township (Sustainable Livelihoods Foundation TED Project Team, 2021). In 2022 the City of Cape Town reported 'parts' of Delft to have a 'slight' lack of bulk water infrastructure capacity (City of

Cape Town, 2022). Conversely Delft South has been identified as having a severe lack of wastewater capacity (City of Cape Town, 2022).

Delft has several amenities including schools, health centres, a police station, libraries, a shopping mall and a public park named Nelson Mandela Peace Park. While a welcomed asset, this recreation area suffers severe urban management concerns, particularly around cleanliness and safety. The parks infrastructure is in a state of decline and requires substantive revitalisation (Sustainable Livelihoods Foundation TED Project Team, 2021). On the fringes of Delft lies the Symphony Way Temporary Relocation Area, known locally as Blikkiesdorp (Watkins, 2020), a site established in 2007 as an interim settlement to house 700 relocated residents from other township sites. In 2024, Blikkiesdorp remains and is occupied by an estimated 2,400 people. Despite some spatial dislocation, Delft has strong links to the city with various substantive motorways that border the township (Symphony Way on the west, the M12 on the north, and the R300 on the south).

The threat of 'Day Zero'

The research described here took place more than three years after, but still in the shadow of, Cape Town's closest realisation of 'Day Zero', the dreaded day on which municipal water supplies might run out. South Africa is a water-stressed nation, with droughts and water shortages increasingly frequent across several regions including Cape Town (du Plessis, 2017). This combines with the increased urbanisation already described to create an ever-growing demand for urban water supplies that rely on decreasing rainfall, leading to increased water shortages and severe water scarcity (Donnenfeld et al, 2018). At the time of our research, the Western Cape province has a lack of diversity with its water supply system depending on reservoirs filled by rainfall (City of Cape Town, 2018; Parks et al, 2019), making it particularly vulnerable to drought and water scarcity.

From 2015 to 2018, Cape Town experienced the worst drought in its recorded history, resulting in acute water shortages and City-imposed restrictions and controls (Millington and Scheba, 2021). The crisis happened as a consequence of several years of dry weather and poorly and inequitably managed water infrastructure (Donnenfeld et al, 2018; City of Cape Town, 2019; Enqvist and Ziervogel, 2019; Parks et al, 2019). The City of Cape Town faced the prospect of its water supplies running dry and so a new water management strategy was introduced to reduce domestic water consumption. This included increasing water tariffs and more installation of water management devices in people's homes. In 2018, the South African government declared a drought disaster zone in the region and these devices, which had previously been used to assist water budgeting, were used to limit daily water usage to 350 litres per day per household. These actions were an attempt to avoid what the City of Cape Town termed 'Day Zero': a day when dam levels would be practically exhausted and the City would be forced to shut down the domestic water system (Bischoff-Mattson et al, 2020; City of Cape Town, 2019) and distribute any remaining water through communal standpipes, with residents limited to 25 litres per person per day (City of Cape Town, 2019; Parks et al, 2019).

The water crisis ended in July 2018, when there was sufficient rainfall to recharge municipal supplies. While 'Day Zero' was averted, the City of Cape Town municipality has continued with many water-saving strategies and measures to avoid a similar

situation in the future. However, the City announced the gradual phasing out of physically limiting water management devices and began a replacement with free–flow devices in 2020 (City of Cape Town, 2020). The data presented later were generated in February 2022, more than 2.5 years after the aversion of 'Day Zero'. They thus describe behaviours and attitudes that had been learned and deeply embedded during and after the period in which legal restrictions were physically enforced through water management devices.

Much has been written about the inequities of these emergency water–consumption measures, including the reproduction and reinforcement of disadvantage associated with the non–universal, forced roll–out of water management devices in only a subset of socio–economically marginalised neighbourhoods and settlements (see, for example, Enqvist and Ziervogel, 2019; LaVanchy et al, 2021; Millington and Scheba, 2021; Mokoena, 2023). Our intention here is to extend beyond these important critiques with an exploration of what the normalisation of water scarcity teaches in terms of individual and household behaviours and social norms. We thus focus on developing understanding of the longer–term consequences of social and structural changes that were previously made in response to circumstances of acute water crisis.

A place–based assemblage approach

In what follows, we examine images and texts produced by community–based researchers to try to understand the pedagogical affect of a place of water stress. Our approach is rooted in a socio–material conceptualisation of place that has its origins in Deleuzian assemblage thinking and (decolonial) place–based approaches. These inform not only our understanding of the pedagogical power of place, but also our conceptualisation and analysis of data. The framework draws on the philosophy of Deleuze (1994) and Deleuze and Guattari (1988), especially as described and operationalised by Feely (2020), Wilson (2021) and Wilson et al (2023).

In Deleuze and Guattari's (1988) work, assemblages are complex constellations of people and things in which flows of affect and knowledge are shaped by environmental and sociopolitical forces. They are political, in that they emerge out of specific historical pathways and power dynamics and are thus both evolving and contingent. We combine this assemblage approach with thinking about place that sees knowledge and learning as intimately connected with the pedagogical affect of place and landscape (Agnew, 1987; Gruenewald, 2003; 2008; Johnson, 2012; Barker and Pickerill, 2020; Butler and Sinclair, 2020; Burgh and Thornton, 2022): we thus understand place as a complex, evolving and political assemblage of geography, topology, ecology, architecture, history and human culture.

Drawing further on Deleuze and Guattari's (1988) ontology, the dynamics of knowledge and affect circulating within place–assemblages can be understood using the notions of striated and smooth spaces, or the related notions of lines of articulation and flight (Deleuze and Guattari, 1988). Striations and lines of articulation are associated with repetition, constraint and control. Smooth spaces and lines of flight, in contrast, are associated with differentiation, freedom and loss of control (Deleuze and Guattari, 1988). They thus describe different ways that a place–assemblage can exercise pedagogical affect: on the one hand, evoking deeply engrained learned behaviours and patterns of thought, and on the other, moments or places within the assemblage where there is a potential for difference, change or rupture. They thus help

to understand why knowledge and affect can flow easily between some elements of an assemblage, either by following the well-worn channels or striations that are the result of lines of articulation or moving in unpredictable ways along lines of flight or across smooth spaces. Equally, they help to understand where flows are blocked or lost, as existing lines of articulation favour other pathways, or lines of flight go nowhere or result in dissolution. They thus offer a way of conceptualising learning and the development of literacies within a place-based assemblage.

This theoretical framework facilitates an integrated understanding of embodied and cognitive pedagogies of place (Wilson et al, 2023) as captured and revealed through the collections of images and texts shown later. These photographic images and accompanying texts were produced by co-researcher residents as part of a larger project (UKRI, nd) that aimed to explore local experiences of and responses to climate change–exacerbated environmental risks in marginalised settlements in the Cape Flats. The larger project enrolled local participants in a series of research activities including surveys (Ncube et al, 2023) and digital storytelling (Mpofu-Mketwa et al, 2023) in order to identify and articulate 'resilience actions' that were presented to City officials and others as local priorities and community-driven potential interventions. In the present work, we focus on the hazard of water scarcity and use photographs generated in a PhotoVoice activity (Wang and Burris, 1997) to explore the material landscapes in which these experiences and responses unfold.

As noted earlier, an assemblage is a collection of humans and things through which knowledge, desire and energy can flow. In the following, we deploy this way of thinking not only to conceptualise Delft as a place-assemblage, but also to describe the collections of photographic images and texts created by our co-researchers; and the connections between distanced researchers and the images and texts in the process of analysis.

Creating place–based image–text assemblages

Eight community-based researchers were asked to use digital photography and text annotations to document understandings of water scarcity in Delft. In the following, the community-based researchers are identified by either their first names or pseudonyms: Bulelwa, Eloise, Logan, Luthfiyah, Muneerah, Frederick, Soeraya and Buhle. These Delft residents had been recruited earlier in the project and had already participated in a digital-storytelling process in which they had been asked to recount their experiences during the Day Zero water crisis three years previously (Mpofu-Mketwa et al, 2023), and a community mapping activity. Some weeks after this, after workshopping a series of high-level questions with the research team and one another and with a short technical training course on photography, they were provided with digital cameras and asked to take photos in their neighbourhoods that explored water scarcity in Delft. Although they were free to take any pictures they wished, it was suggested that they include photos that highlighted places and practices where water was wasted or saved, and to make notes about each image taken and how it related to the broader research questions.

The community-based researchers took photographs in Delft over a seven-day period in the middle of February 2022. After this, they attended a participatory workshop facilitated by members of the project team who worked for the local non-profit organisation Sustainable Livelihoods Foundation and who had been

coordinating fieldwork across the project. During the workshop, the co-researchers were asked to select up to 30 of the photographs they had taken and assemble them into an 'album' including titles and captions for each image based on notes made while taking the photographs. In this article, we present a subsequent analysis of the resulting assemblage of 160 images and accompanying texts by a distanced researcher (the lead author) seeking to understand the development of water literacies and the place-pedagogies of water stress – that is, the pedagogical affects of a place (Brandt, 2013; Wilson et al, 2023) that has come to be characterised by long-term water stress – that give rise to them. The dynamics, striations, lines of articulation and flight identified in this analysis were then shared with the wider team, confirmed and refined by local researchers who had participated in all phases of the community-based research, including the PhotoVoice element presented here.

Analysis

In the following sections, we explore how repetitions and differences between and among the image–text assemblages reveal Delft to be a place patterned by both physical and socially emergent striations and lines of articulation, but also containing smooth regions where lines of flight develop. These nested places of differing control are the result of the pedagogies of water in a water-stressed place.

The assemblage analysis approach used here is described in more detail in our previous analysis of experiences of excess, unwanted water in a different Cape Flats settlement (Wilson et al, 2023). This relatively novel, developing approach involves three modes of engagement with image–text assemblages. In the first, the researcher becomes sensitive or attuned to repetitions and differences. In the second, she acknowledges and responds to the affective power of images and written texts on her. In the third mode, she makes a deliberate effort to follow the patterns and disruptions within the assemblages, looking out for repetitions and differences that might correspond to lines of articulation or flight, to uncover new understandings. It is important to note that this is a non-linear process; the researcher can simultaneously experience two or even all three of these modes of engagement. Indeed, the recognition of specific patterns or disruptions in terms of process and behaviours revealed by the photos and texts may result in heightened sensitivity to patterns of visual content that had previously gone unnoticed, just as sensitivity to their emotional and moral affect may lead to clearer articulation of the power differentials that drive flows of knowledge and affect.

In relation to the assemblage of images and texts created by the community-based researchers in Delft, the first mode of the assemblage analysis reveals repeated patterns of content, framing and colour, becoming sensitive to the repetitions and differences within the series of images. The images show both exterior and interior spaces. Exterior images are dominated by yellowish greys and browns, with occasional bursts of brightness – red, blue and green, and flashes of white. The greys and browns are dirt and roads, parched backyards, paving stones and manhole covers, muddy water seeping across surfaces. The reddish browns are Jojo (water storage) tanks. The blue is a hot summer sky. The greens are thriving plants (or more Jojo tanks). The white is sometimes the diamond clear flow of water from an open tap. The images of interiors are dominated by the white of porcelain and plastic bathroom fixtures and the chrome of taps and sinks. Grey-blues appear in the form of buckets and water bottles.

Humans appear in both outdoor and indoor scenes. People are pictured carrying heavy buckets, muscles straining against the weight of water. They are also pictured engaged in water-wasting and water-conserving activities. These, combined with the titles and captions given by the community-based researchers, trigger some of the most important responses in the second mode of analysis. We (researcher-viewers) are affected by the ways images are used to express judgements – disapproval and approval – and by the sheer effort that acquiring and preserving water appears to take.

Finally, we enter the third mode of assemblage analysis, in which we attend to repetitions and differences that might indicate lines of articulation or flight. Meanings start to emerge and we begin to reach an awareness of the complex water literacies being developed in response to the realities of life in Delft. We group these into three dynamics, discussed next. The first is the presence of physical striations and water literacies of physical control. The second is understandings of the co-emergence of new social norms and expectations – a kind of water-moralising related to developing understandings of 'good' water citizenship. The third is evidence of fractures and leakages, and the capacity of water to exploit any opportunity to escape control and constraint.

Physical striations and controls: water management in a place of water stress

The images and texts reveal Delft as a place-assemblage full of physical striations, technologies of control that attempt to block, interrupt and divert flows of water.

Containers for storing water are repeated over and again. Many photos include the brown or green cylinders of Jojo tanks, installed by the City authorities. Some of these reveal not only large-scale storage, but also the exploitation of alternative water sources, no longer relying entirely on the city's (now reasonably full) dams. For example, Figure 2 shows Jojo tanks at a local clinic.

Bulelwa's caption for this image describes the use of boreholes:

Figure 2: *Clean water*, by Bulelwa

These are water tanks that the government has installed to provide water at Delft Community Health Centre. The water comes up from boreholes in the ground. It is purified before it goes through to the Clinic for taps and toilets and for drinking. If a visitor to the clinic wants a drink of water, they have to drink this water from the tap in the toilets as there are no water dispensers. The security say the water is salty sometimes but it's safe. There are no leaks at all.

Other photos show smaller containers, used by residents and households: buckets, bottles, tubs and even a fishpond, as in Figure 3.

Figure 3: *Fish*, by Luthfiyah

Luthfiyah's caption explains this image as follows:

> The owner emptied his fishpond when the drought happened. They could no longer try to refill the pond with fresh water as there was none available to still fill the pond. They have the 350 L Meter installed in their property and cannot make provision for ensuring that the fish has sufficient clean water. The pond was then used to fill with grey water in order to flush the toilets; mop the floors etc.

The images show residents developing practices that go beyond storage and attempt to collect water from outside the piped water system. One example of this is Eloise's image, shown in Figure 4.

Figure 4: *Urn capture*, by Eloise

Eloise explains that this photo shows her own efforts to capture water:

> An old Urn was used to catch water. The outside gutters lead into the urn and to make it easier to access the water the urn was used – as they only need to open the tap and the water will come out freely … This is done to save water. It is used for watering plants, cleaning, flushing toilets etc.

Another repeated series within the images shows an understanding of the need to ensure free flows, as well as to block them. For example, photos show blocked sinks and basins, which Luthfiyah explains as 'because there is fat stuck in the pipe and

also hair so it is mixed up', emphasising a perceived connection between domestic hygiene and free-flowing water.

There is also a sequence of images that show efforts to move water when there are no pipes to do so. Again and again, the images show people carrying water in buckets, often to the pockets of informal settlement that have grown in the gaps and empty spaces between sections of more formal, serviced housing. Figure 5 is one member of this series.

Figure 5: *Fill up for washing*, by Bulelwa

Bulelwa's caption explains that the woman is using the bin next to her as well as the bucket:

> This photograph was taken in 'Temporals', a temporary housing location where people are supposed to live for just a few months while they are waiting for their RDP [Reconstruction and Development Programme] houses. This woman stays across the road from Temporals, in the [informal] settlements where there are no taps or toilets. So, she fills up the rubbish bin to wash her clothes. She also borrowed the rubbish bin as they don't have bins on the other side. At night it is difficult for the people from the informal settlement to get water. They cannot cross the road as it is not safe.

Other images repeatedly demonstrate an emphasis on the need to reduce consumption. Some focus on using showers instead of baths – as Muneerah explains, 'the shower cap has very thin water outlet holes making use of water very conservative. There is no doubt that people have become more aware of the need to save water although a lot more still need to change'. Showerheads are echoed in garden sprinklers, such as that shown in Figure 6.

The caption to this image explains that it is part of the school's fruit and vegetable project: 'A community lady doing gardening in the school yard. She is watering the

Figure 6: *Garden at Roosendal High*, by Soeraya

garden with a sprinkler rather than a hose pipe. This ensures less water is used for the portion under cultivation'. Other images focus on efforts to reduce water used for washing cars, for example as illustrated in Figure 7.

Figure 7: *Car wash saving water*, by Muneerah

As the caption shows, this image also illustrates how people in Delft have learned to think of water as a valuable resource:

> This guy is using a machine for his car wash where they throw 20 litres of water in the machine and then he washes up to 8 cars with that 20 litres. The machine is designed to save water. The owner of the car wash is aware of the water challenges and he also knows that using too much water would cost him more money. He realised that wasting water is like flushing down his profit.

A final series of images relating to acquired water literacies focuses on reuse. Over and again, the images show practices that allow for water to be used more than once, for example grey water being used to flush toilets. Figure 8 shows that high standards of cleanliness are coupled with awareness of the need to conserve water:

Luthfiyah's caption explains the layers of reuse captured here:

Figure 8: *Takkies*, by Luthfiyah

> The bucket is filled with grey water, where takkies are being washed. Mr M is washing the takkies [trainers] but he does not waste the water, he re-uses it for flushing of the toilet as well as cleaning of the outside area of his Wendy House [backyard dwelling]. Mr M does not have any running water inside of his house, but needs to use a tap outside the house.

In fact, reuse is often associated with personal care and washing clothing. Another example of careful reuse comes with Figure 9, which is part of a series of repetitions of twin-tub washing machines.

Figure 9: *Rotation of water from the washing machine*, by Frederich

Frederich describes the reuse practice here as follows:

> Those households in Delft who are using twin-tub washing machines, can
> reuse their rinse water by draining the water into a bath or buckets. A twin
> tub is an automatic washing machine where you get a tub where you can
> wash your clothes in, and a tub where you can rinse the clothes. Here you
> can see how this woman is reusing the water used for rinsing, to fill up the
> tub for a next wash. Many households only receive 350 litres per day, which
> is not enough.

Between them, these images show how residents in Delft have developed and
deployed a range of technologies and practices for physically controlling water
and water use. These suggest that the water literacies promoted by the City
during and since the water crisis of 2018 have been effectively embedded
within Delft, forming lines of articulation that shape daily life, well beyond
the crisis period.

Social striations and controls: the emergence of water moralisation

The images and captions reveal social striations shaping the flows of water through
the Delft place-assemblage just as significantly as physical ones. These social striations
may be described as 'water moralisation' – the development of strong moral stances
that deem some water practices as good and other as wasteful and bad. Indeed, several
related series of images show the act of waste, accompanied by highly critical captions.

Perhaps the longest two of these series are representations of washing – either of cars, as in Figure 10, or of clothes, as in Figure 11.

Logan accompanies this photo with the following comments:

Figure 10: *Car wash*, by Logan

Figure 11: *Washing the clothing*, by Logan

> She is washing her car from the other side of the road. Huge amounts of water is being wasted here. They think they live in Constantia where they can do whatever they want and that they own the world. When they earn money to like that, they think they can waste water like this.

Constantia is one of Cape Town's affluent suburbs, a wine-producing area and tourist hub bordering on the Kirstenbosch National Botanical Garden. It lies approximately 20 km west of Delft.

Figure 11 is one of a series that both connect to and counter images such as that shown in Figure 9, indicating that twin-tub washing machines can be a source of wastage as well as a location for the exercise of water literacies.

This image of water flowing quietly across the tarmac in front of a garage door is connected to Figure 9 through its creator, Logan, and through her criticism of the person responsible: 'An unnecessary amount of water is being wasted here, for a household of only three people. This woman does her washing all the time … It is not necessary for them to use so much water. Some people clearly need to be limited to 350 litre per day'.

These two images and captions reveal the presence of a moralising dynamic, in which some people are judged not to live up to the standards of responsible water citizenship that others demand. This dynamic leads to criticisms of other commonplace practices such as use of paddling pools, as illustrated in Figure 12.

Muneerah's caption acknowledges the hot weather but insists that the owner must find a way of saving water:

Figure 12: *Pool wasting water*, by Muneerah

The pool has to be refilled regularly because there are no chemicals added and this water gets mucky and smelly fast. This is wasting of water, because when the water is dirty, you need to throw it out and refill again. The pool owner must find a way of saving water. In this hot weather people do not have access to swimming pools so they improvise. It is a waste considering that a lot of people own these inflatable pools.

Such image–caption combinations ultimately give the impression that play and leisure are themselves acts of waste or negligence, as illustrated in Logan's image of a child playing with a hose pipe (not included because the child is identifiable), which is captioned:

Here you see a child of Delft, wasting water with a hose pipe. He is watering the garden and washing the dog, called Jimmy. This child is wasting a lot of clean water. Parents should keep a watching eye over the children, to make sure that precious resources are not being wasted unnecessarily.

Social controls and striations are illustrated by images that are praising, as well as criticising, practices. Figure 13 and its caption show the effectiveness of one of the slogans developed during the Day Zero campaign.

Soeraya's caption reads:

Figure 13: *Potty posh*, by Soeraya
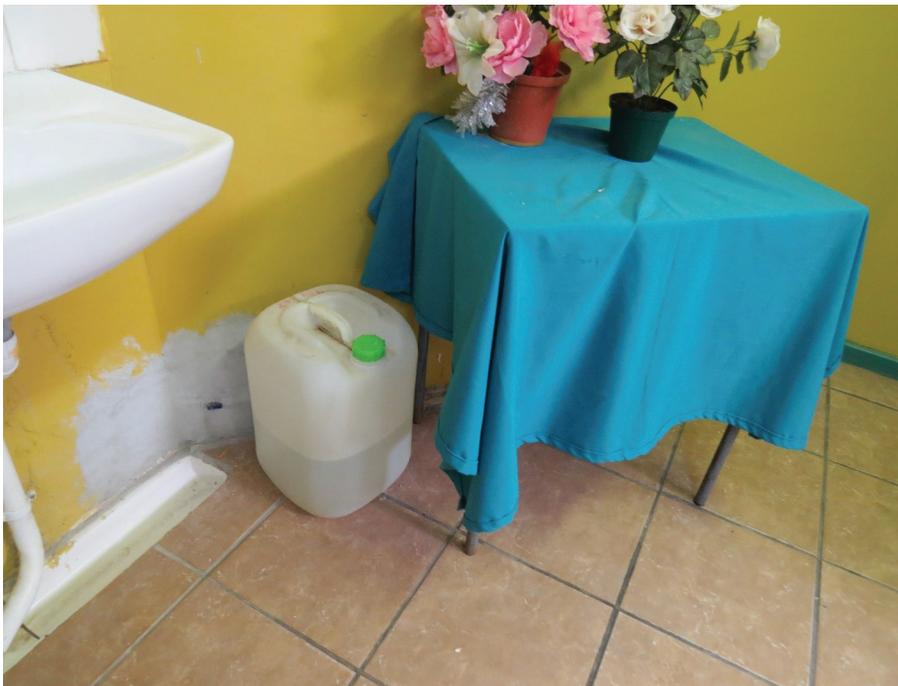
This is Roosendal High ladies toilets. Here is a 25 litre can filled with water to use in the cistern of the toilet. They put the water supply to the cistern off, to save water. Then, after 3 people go then they fill cistern up with the water. They have a slogan 'When it's yellow let it mellow'.

Habits that might previously have been thought of as unpleasant or unsanitary – in this case, leaving a toilet unflushed – have thus effectively been rendered virtuous by the persistent threat of a return to drought conditions.

Blockages, fractures and leaks: points of failure and escape

Other complex dynamics at play within the place-assemblage of Delft are made visible in the image–text assemblages. The lines of articulation shaping water practices that have been illustrated are dominant threads within the albums of all eight of the community-based researchers. However, the albums also present dynamics that operate to create smooth spaces – lines of flight that allow water to escape from efforts to control and contain its flow.

In direct contrast with the images of City-supplied water tanks, another series of images shows blockages and breakdowns of City-owned infrastructure that act as points of failed control. Water bubbles up from manhole covers and runs down streets, visibly escaping control and productive use. The community-based researchers ascribed such images to a range of reasons, including neglect by the City: 'the drainage system not being properly maintained – it needs to be cleaned properly – but that does not happen' (Eloise) and inadequate capacity: 'because of the influx of people building new homes and back yard dwellers now the pipes get too small for all the wastes' (Soeraya).

Sometimes these blockages are tackled with methods that waste even more water, as was revealed in the albums of both Eloise and Muneerah and shown in Figure 14.

The caption explains what is going on:

The caretaker has to rinse the drains on the school (×3 drains) every morning before school using municipal water. He needs to start at 7 am in order to avoid the sewerage pipes being blocked and the toilets not being able to be used at all. The school installed a borehole that was used to clean these drains on a daily basis. Unfortunately the borehole pump was stolen and now the municipal water needs to be used to clean the blockage. This, however, is NOT a community issue, but instead a maintenance issue on the side of the City.

Perhaps the most frequently occurring repeated images relating to breakdowns and escapes are those of water metering or management devices themselves, such as that shown in Figure 15.

These are revealed as points of fracture and leakage that ultimately fail to control the flows of water within Delft. As Eloise describes: 'during the drought in 2018 the government rolled out a massive replacement of these water meter readers and it has proven to be faulty. A private company was contracted to do this and these owners stopped the truck for assistance and it was declined'.

Figure 14: *Delft school drain blockage*, by Eloise

Figure 15: *Leaking blue meter*, by Luthfiyah

The location of devices within the space also poses challenges. Luthfiyah uses the image shown in Figure 15 to tell this story:

> [The installers] opted to put it inside of her property as on the outside it is all paved and there are no way that they would be able to install it inside the concrete. This however places Ms C in a very unfair position as when she complains about the water meter being faulty, she is informed that as it is inside of her property, she needs to fix it.

For some, externally located meters are also problematic, as Frederich relates: 'The long grass surrounding the water meter indicates that this meter has been broken for quite a while now. These meters are supposed to be inside the yard, so owners can't protect these outside meters from vandalism'. Ultimately, the inaction of the City seems to be a key way water escapes. As Frederich explains in his caption to an image of 'clean water running down the road':

> We as a community reported the meter several times, but all we received was a reference number … For more than a year now, this water is running down the road. It's the City Council's responsibility to fix this … When the municipality saw me taking pictures of the meter, they came to fix the meter within two days.

Domestic leaks also feature as a recurring element within the Delft water assemblage. Drips and leaks continue for long periods of time, resulting from a range of social fractures and breakdowns. Residents cannot afford a plumber, and promised help from the City never arrives. Poverty intersects with other social problems, such as exorbitant charges for plumbing services, drunkenness and theft. Figure 16 shows one of many pictures of leaking taps inside houses.

Logan's caption gives the story behind the image:

> The tap has been leaking since installation. The tap has never been fixed, because it's too expensive to pay for a qualified plumber. It's been leaking for quite a while now. Buckets and buckets of water are being wasted. In the mornings the sink can be overflown and can flood the kitchen, should the plug be left in the sink. The qualified plumber is always drunk, and charges too much also.

Other images of leaking taps tell stories of theft and poverty, such as the one that Luthfiyah captioned as follows:

> This is a tap inside the kitchen that has been dripping since the house was first occupied. The owner … tried to get someone to fix it but they robbed her and took her money. The tap was never fixed and she has tried to do it by herself but she is a single mother with 4 kids and just do not have the ability to do so or save up money again to get someone to repair it.

The consequences of these breakdowns include attempts to fix them that are often ineffectual, and sometimes do more damage, as described by Bulelwa's caption to a pair of images of a broken pipe: 'When the pipe was open it got blocked up with

Figure 16: *Leaking tap*, by Logan

rubbish, so it overflowed. They were trying to close it with the large heavy stone, but it cracked the pipe and made the situation worse'. The continued loss of metered water costs residents money and so increases poverty, as Buhle explains:

> in a household of an old lady that lives with her two beautiful daughters. Their toilet has been leaking since they arrived in 2018. She said it started from the bathroom and the sink pipes burst. She tried to contact the City of Cape Town people to seek for help but nobody came through for her. She said she is losing so many litres because of the leakage. She is restricted to 350L per day and the leakage is part of the 350L. She is getting charged for the wasted water.

And although taking place in domestic contexts, these leaks reveal further fractures embedded in the wider social structures, as indicated by Frederich:

> The way the house has been built tells the whole story of cheap housing developments. The pipes are leaking water, and it is the responsibility of the house owner to replace the pipes, but due to unemployment house owners can't afford to fix the plumbing. A lot of clean water goes to waste due to a broken toilet. The owner doesn't have the money to fix the toilet. What to do next?

Other images show water escaping because of a combination of negligence, vandalism, profligacy or criminal acts, as efforts to control and contain water are either ignored or actively resisted. For example, Figure 17 shows leaking water that results from theft followed by neglect.

Figure 17: *Voorbrug soccer field, Delft*, by Logan

This photo has been taken at a soccer field in Leiden, Delft. Here you can see a broken water pipe, and now there is an unstoppable supply of water. Thieves stole the pipes, to sell the copper and get a quick fix. We call them one-day millionaires – they have lots of money for one day, and the next day they are broke again. The water just keeps on running and running. This was reported by the security at the soccer field, but not fixed for couple of weeks.

Many images show water flowing freely from outdoor taps – standpipes for local community use, especially in the informal areas of Delft. Buhle's caption to one such picture reads: 'people use it and leave it just like that. You will find so many of them passing this free flow without closing it properly, water being wasted, but they are the ones who need water'. This series of related images often blames the 'underclass' of informal settlement dwellers, as illustrated in Figure 18.

Muneerah gives this the caption:

This tap was open there was no bucket there was nobody by the tap but the water was running … The informal settlement residents are the ones doing this, but it affects everyone because this is water wasting. There is no sense of ownership, everyone thinks it is someone else's responsibility to look after the tap and in the end no one does.

However, sometimes this perceived irresponsibility was linked to additional underlying social fractures, such as criminality and gangsterism. One example of this series of images is given in Figure 19.

As Buhle explained in the accompanying caption:

Figure 18: *Running outside tap*, by Muneerah

> As you can see, the buckets belong to the community in Covid [informal settlement]. The pipe is left unattended and the water is being wasted. Seems like nobody cares about saving water. I asked one of the ladies that were waiting in a queue for her turn to gather water. She said the tap was chopped last night by one of the tsotsis [gangsters] that lives nearby to sell it to the scrap yard.

Illegality sometimes creates connections, as well as absences. For example, residents are described as not reporting leaks because the broken connections are 'informal'. Illicit connections are sometimes made to give people access to water that they might otherwise not have access to, such as people who live in informal settlements, but the result can also benefit those whose household water supply would otherwise be limited by City-imposed water management devices. As Bulelwa describes, 'homemade plumbing … means that the people who live in the house that the water meter belongs to are getting free water and so do the informal settlements dwellers'. Even though the homemade plumbing includes a clip on the end of the pipe, the clean, good, municipal water still escapes.

As illustrated in the previous two subsections, all of these leaks and losses occur within an assemblage dominated by dynamics of striation and control. It is therefore unsurprising that additional technologies of control are introduced into Delft's place-assemblage. Several images repeat an element visible in Figure 2 – fences, aimed at protecting water sources or storage tanks. Luthfiyah describes the situation at a local school:

Figure 19: *Chopped pipe*, by Buhle

The school installed two Jojo Tanks and a working pump. This was used to water the grounds as well as provide greywater to the flushing of the toilets. The connection that provides a link between the tanks; pump and outside tap was stolen. The school then had to install a fence around the tanks and the water pump to ensure that it does not get stolen. If we want these type of systems to work especially in disadvantaged communities then we unfortunately also need to add in the security element.

But sometimes theft is related to power, rather than disadvantage, as illustrated by Logan with the photo shown in Figure 20.

Logan's caption explains:

> Here you can see the main gate to the municipal offices … These offices are just opposite my house. During the water shortage of 2018 our neighbourhood had to go and buy water, R5 for 5 litre bottle, 7 pm, in the dark, we queued in the dark here to buy water from a security guard working at the municipality. Water is life, and if I didn't have a R5 for water, I had no life … This is why the municipality owns government, because they steal water from the normal person – R5 for free water. But what happens in the dark must come out in the light.

Amid these controls, fractures and countermeasures, people's need for water persists.

Discussion and conclusions

The image–text assemblages reveal a complex form of place-based learning that is neither as strengthening and affirming as the landscape pedagogies described by others (for example, Somerville, 2007; 2013; Johnson, 2012) nor as demanding and etiolating as those described in our previous study of nearby Sweet Home Farm (Wilson et al, 2023). They also show how 'power dynamics and associated inequities are central to how water insecurities are lived and experienced' (Rodina et al, 2024: 2). Our assemblage analysis approach, informed by a Deleuzo-Guattarian ontology (Deleuze and Guattari, 1988; Deleuze, 1994), conceptualises Delft as a socio-material assemblage through which water flows, sometimes through well-regulated striations or along deeply etched lines of articulation, and sometimes uncontrolled, across smoother spaces and along lines of flight.

Figure 20: *Municipality*, by Logan

The images suggest that not only is water always imminently absent, but that its absence has become immanent (Deleuze and Guattari, 1988; Deleuze, 1994) within its presence. Even when scarcity is not actualised, it is the dominant condition of the virtual, imagined but not yet realised future. Our analysis shows how this constant potential for water's absence creates place-based pedagogical affects (Brandt, 2013; Wilson et al, 2023) within Delft's place-assemblage which drive ingenious efforts to control and contain water, and a heightened awareness of it as a valuable resource. The images reveal both exterior and interior landscapes that are patterned with technologies and devices of management and control intended to produce deeply striated physical and social spaces (Deleuze and Guattari, 1988). Within these, residents develop water literacies and practices that extend management and control beyond water and into their own lives, practices and bodies.

One might conclude that the City of Cape Town's strategies and public information campaigns around water literacies (Rodina, 2019a; Rodina et al, 2024) have been largely successful, as they combine with the pedagogical affects of perpetual anticipation of scarcity to create lines of articulation that reinforce certain water practices that have been identified as desirable by the authorities. However, it is also evidence that pockets of smooth (Deleuze and Guattari, 1988), uncontrolled space within the Delft water place-assemblage give rise to unanticipated consequences, such as the potential for conflict over water wastage, and lines of flight that lead to new opportunities for a black market in water. At the same time, the images reveal contradictory momenta in the City's physical efforts, with increased investment in storage tanks undermined by faulty or broken meters and other infrastructure.

Whereas in Sweet Home Farm water had 'been transformed from life-giving to life-threatening' (Wilson et al, 2023: 14), here in Delft, it is the always-possible absence of water – absence's immanence within presence – that creates a pedagogical power that drives these water literacies and norms of water citizenship. It seems that the pedagogies of a place-assemblage under water stress can produce complex, paradoxical thinking around access to water, and ambivalence towards illegality; for example, the security guard in Logan's narrative above was stealing water, but at the same time giving people access to water they would not otherwise have had. He is resented for selling the water, which has already been stolen by the City. Thus lines of articulation aimed at constraining flows twist together with lines of flight that enable both water and people to evade control.

It is important to note that the water management devices used by the City of Cape Town were originally deployed on a voluntary basis at least a decade before the Day Zero crisis (Rodina et al, 2024), in an attempt to help financially precarious households manage their expenditure on water, and not increase debt levels because of water use. When they were forcibly installed on a far more widespread basis in Delft and other settlements during the crisis, they were strongly opposed by Cape Flats residents, who argued that this water rationing was unfair and impractical as township households are often much larger than in more affluent districts. Residents also reported a lack of prior information or clarity on why the devices were installed and whether they were allowed to dispute the installation of the water meters (Matikinca et al, 2020). Water cut-offs still occur in Delft in the present day and severely affect the way in which low-income communities respond and adapt to the COVID-19 pandemic (Sokanyile, 2020). And yet residents have absorbed the fundamental dynamic of control

represented by the water management device and apply it to their own daily lives. They also use it as a yardstick against which to make (moral) judgements about what constitutes good 'water citizenship'.

Despite this profusion of lines of articulation (Deleuze and Guattari, 1988) around both the physical and social, water (perhaps inevitably) continues to escape, leaking and flowing through both physical and social fractures created by other dynamics operating within the Delft place-assemblage: neglect, poverty, addiction, insecurity crime. Somerville (2007: 150–1) suggested that '[t]hrough place it is possible to understand the embodied effects of the global at a local level'. Like climate change, these dynamics are global problems affecting many places, and thus the pedagogical affects of water stress at work on residents of Delft may play out in similar ways elsewhere, resulting in unintended tensions and exploitations, and the potential for new inequalities and imbalances of access.

Data availability statement
The authors take responsibility for the integrity of the data and the accuracy of the analysis. The data are available to other researchers on request to the lead author.

Conflict of interest
The authors declare that there is no conflict of interest.

References
Agnew, J.A. (1987) *Place and Politics: The Geographical Mediation of State and Society*, Boston, MA: Allen & Unwin.

Barker, A.J. and Pickerill, J. (2020) Doings with the land and sea: decolonising geographies, Indigeneity, and enacting place-agency, *Progress in Human Geography*, 44(4): 640–62. doi: 10.1177/0309132519839863

Bischoff-Mattson, Z., Maree, G., Vogel, C., Lynch, A., Olivier, D. and Terblanche, D. (2020) Shape of a water crisis: practitioner perspectives on urban water scarcity and 'Day Zero' in South Africa, *Water Policy*, 22(2): 193–210. doi: 10.2166/wp.2020.233

Black, G., Petersen, L., Mpofu-Mketwa, T., Dick, L., Wilson, A., Ncube, S. et al (forthcoming) Participatory visual methods and the mobilization of community knowledge: working towards community-derived disaster risk management in the context of advancing climate change, *Journal of Participatory Research Methods*.

Booysen, F. (2005) *Delft SAPS as an Instrument for Community Development, Doctoral Dissertation*, Stellenbosch University, https://scholar.sun.ac.za/handle/10019.1/20913.

Brandt, C.B. (2013) Landscapes as contexts for learning, in R.B. Stevenson, M. Brody, J. Dillon and A.E.J. Wals (eds) *International Handbook of Research on Environmental Education*, New York: Routledge, pp 275–83.

Burgh, G. and Thornton, S. (2022) *Teaching Democracy in an Age of Uncertainty: Place-Responsive Learning*, Abingdon: Routledge.

Butler, A. and Sinclair, K.A. (2020) Place matters: a critical review of place inquiry and spatial methods in education research, *Review of Research in Education*, 44(1): 64–96. doi: 10.3102/0091732x20903303

Carrilho, J. and Trindade, J. (2022) Sustainability in peri-urban informal settlements: a review, *Sustainability*, 14(13): art 7591. doi: 10.3390/su14137591

Cinnamon, J. and Noth, T. (2023) Spatiotemporal development of informal settlements in Cape Town, 2000 to 2020: an open data approach, *Habitat International*, 133: art 102753. doi: 10.1016/j.habitatint.2023.102753

City of Cape Town (2013) City of Cape Town – 2011 Census Suburb Delft, https://resource.capetown.gov.za/documentcentre/Documents/Maps%2520and%2520statistics/2011_Census_CT_Suburb_Delft_Profile.pdf, (Accessed: 24 Jul 2024).

City of Cape Town (2018) Report to Subcouncil 5, 2018: Progress Update ACSA Symphony Way Proposed Human Settlement Development, Cape Town: City of Cape Town.

City of Cape Town (2019) Cape Town Resilience Strategy, https://resource.capetown.gov.za/documentcentre/Documents/City%20strategies%2C%20plans%20and%20frameworks/Resilience_Strategy.pdf, (Accessed: 24 Jul 2024).

City of Cape Town (2020) SEP: Socio-economic Profile, https://www.westerncape.gov.za/provincial-treasury/sites/provincial-treasury.westerncape.gov.za/files/atoms/files/SEP-LG%202020%20-%20City%20of%20Cape%20Town_0.pdf, (Accessed: 24 Jul 2024).

City of Cape Town (2022) Tygerberg Integrated District Spatial Development Framework. Volume 1 Baseline and Analysis Report: Demographics, Cape Town: City of Cape Town, https://resource.capetown.gov.za/documentcentre/Documents/City%20research%20reports%20and%20review/Tygerberg_DSDF_EMF_Vol_1_2022.pdf, (Accessed: 24 Jul 2024).

Deleuze, G. (1994) *Difference and Repetition*, P. Patton (trans), New York: Columbia University Press.

Deleuze, G. and Guattari, F. (1988) *A Thousand Plateaus: Capitalism and Schizophrenia*, London: Athlone.

Dhupelia-Mesthrie, U. (2014) Speaking about building Rylands (1960s to 1980s): a Cape Flats history, *Social Dynamics*, 40(2): 353–70. doi: 10.1080/02533952.2014.932174

Donnenfeld, Z., Crookes, C. and Hedden, S. (2018) A Delicate Balance: Water Scarcity in South Africa, Institute for Security Studies Southern Africa Report 13, https://issafrica.org/research/southern-africa-report/a-delicate-balance-water-scarcity-in-south-africa.

du Plessis, A. (2017) Water scarcity and other significant challenges for South Africa, in A. du Plessis (eds) *Freshwater Challenges of South Africa and its Upper Vaal River: Current State and Outlook*, Cham: Springer, pp 119–25.

Enqvist, J.P. and Ziervogel, G. (2019) Water governance and justice in Cape Town: an overview, *WIREs Water*, 6(4): art e1354. doi: 10.1002/wat2.1354

Feely, M. (2020) Assemblage analysis: an experimental new-materialist method for analysing narrative data, *Qualitative Research*, 20(2): 174–93. doi: 10.1177/1468794119830641

Fitzgibbons, J. and Mitchell, C.L. (2019) Just urban futures? Exploring equity in '100 Resilient Cities', *World Development*, 122: 648–59. doi: 10.1016/j.worlddev.2019.06.021

Gintamo, T.T., Mengistu, H. and Kanyerere, T. (2021) GIS-based modelling of climate variability impacts on groundwater quality: Cape Flats aquifer, Cape Town, South Africa, *Groundwater for Sustainable Development*, 15: art 100663. doi: 10.1016/j.gsd.2021.100663

Gruenewald, D.A. (2003) Foundations of place: a multidisciplinary framework for place-conscious education, *American Educational Research Journal*, 40(3): 619–54. doi: 10.3102/00028312040003619

Gruenewald, D.A. (2008) Place-based education: grounding culturally responsive teaching in geographical diversity, in D.A. Gruenewald and G.A. Smith (eds) *Place-Based Education in the Global Age*, Mahwah, NJ: Lawrence Erlbaum, pp 161–78.

Jaeger, W.K., Plantinga, A.J., Chang, H., Dello, K., Grant, G., Hulse, D. et al (2013) Toward a formal definition of water scarcity in natural-human systems, *Water Resources Research*, 49(7): 4506–17. doi: 10.1002/wrcr.20249

Johnson, J.T. (2012) Place-based learning and knowing: critical pedagogies grounded in Indigeneity, *GeoJournal*, 77: 829–36. doi: 10.1007/s10708-010-9379-1

LaVanchy, G.T., Kerwin, M.W., Kerwin, G.J. and McCarroll, M. (2021) The optics of 'Day Zero' and the role of the state in water security for a township in Cape Town (South Africa), *Water International*, 46(6): 841–60. doi: 10.1080/02508060.2021.1946763

Le Roux, L., du Trevou, C., Calvo, B., Claasen, E., Nozewu K., Mchunu, N. et al (2016) Residential Property Market Processes as Found in Delft, Western Cape, Cape Town: Centre for Affordable Housing Finance in Africa, https://peoplesenvironmentalplanning.org.za/wp-content/uploads/2018/10/Delft-Research-Report-Final_-29-aug-2016-sb.pdf, (Accessed: 24 Jul 2024).

Matikinca, P., Ziervogel, G. and Enqvist, J.P. (2020) Drought response impacts on household water use practices in Cape Town, South Africa, *Water Policy*, 22(3): 483–500. doi: 10.2166/wp.2020.169

Matthewman, S. and Uekusa, S. (2021) Theorizing disaster communitas, *Theory and Society*, 50(6): 965–84. doi: 10.1007/s11186-021-09442-4

Millington, N. and Scheba, S. (2021) Day zero and the infrastructures of climate change: water governance, inequality, and infrastructural politics in Cape Town's water crisis, *International Journal of Urban and Regional Research*, 45(1): 116–32. doi: 10.1111/1468-2427.12899

Millstein, M. (2008) Challenges to community organising in a context of spatial fragmentations: some experiences from Delft, Cape Town, *Critical Dialogue: Public Participation in Review*, 4(8): 34–40, https://www.academia.edu/21364983/Challenges_to_community_organising_in_a_context_of_spatial_fragmentations_Some_experiences_from_Delft_Cape_Town1.

Mokoena, A. (2023) Questioning day zero: rights, provision, and water inequality in South Africa, *Human Organization*, 82(3): 223–34. doi: 10.17730/1938-3525-82.3.223

Mpofu-Mketwa, T.J., Abrams, A. and Black, G.F. (2023) Reflections on measuring the soundness of the digital storytelling method applied to three Cape Flats vulnerable communities affected by drought, fire and flooding in Cape Town, *Social Sciences & Humanities Open*, 7(1): art 100407. doi: 10.1016/j.ssaho.2023.100407

Ncube, S., Wilson, A., Petersen, L., Black, G., Abrams, A., Carden, K. et al (2023) Understanding resilience capitals, agency and habitus in household experiences of water scarcity, floods and fire in marginalized settlements in the Cape Flats, South Africa, *Social Sciences & Humanities Open*, 8(1): art 100710. doi: 10.1016/j.ssaho.2023.100710

Parks, R., McLaren, M., Toumi, R. and Rivett, U. (2019) *Experiences and Lessons in Managing Water from Cape Town, Grantham Institute Briefing Paper 29*, https://www.imperial.ac.uk/media/imperial-college/grantham-institute/public/publications/briefing-papers/Experiences-and-lessons-in-managing-water.pdf, (Accessed: 24 Jul 2024).

Philip, K. (2014) A history of townships in South Africa, in S. Mahajan (ed) *Economics of South African Townships: Special Focus on Diepsloot*, Washington, DC: World Bank Group, pp 31–49.

Rodina, L. (2019a) Defining 'water resilience': debates concepts, approaches and gaps, *WIREs Water*, 6(2): art e1334. doi: 10.1002/wat2.1334

Rodina, L. (2019b) Planning for water resilience: competing agendas among Cape Town's planners and water managers, *Environmental Science & Policy*, 99: 10–16. doi: 10.1016/j.envsci.2019.05.016

Rodina, L., Harris, L., Ziervogel, G. and Wilson, J. (2024) Resilience counter-currents: water infrastructures, informality, and inequities in Cape Town, South Africa, *World Development*, 180: art 106619. doi: 10.1016/j.worlddev.2024.106619

Satterthwaite, D., Archer, D., Colenbrander, S., Dodman, D., Hardoy, J., Mitlin, D. et al (2020) Building resilience to climate change in informal settlements, *One Earth*, 2(2): 143–56. doi: 10.1016/j.oneear.2020.02.002

Shaik, N. (2023) Transforming teaching and learning in early childhood care and education during COVID-19 in a poor community of the Cape Flats, South Africa, *Early Childhood Education Journal*, 51: 791–800. doi: 10.1007/s10643-022-01329-y

Sokanyile, A. (2020) Cape Flats elderly, kids 'without water supply' after city turns off the taps, Independent Online (IOL), 4 April, https://www.iol.co.za/weekend-argus/cape-flats-elderly-kids-without-water-supply-after-city-turns-off-the-taps-46175843, (Accessed: 24 Jul 2024).

Somerville, M. (2007) Place literacies, *Australian Journal of Language and Literacy*, 30(2): 149–64. doi: 10.1007/bf03651788

Somerville, M. (2013) Thinking through country: new literacy practices for a sustainable world, in B. Green and M. Corbett (eds) *Rethinking Rural Literacies: Transnational Perspectives*, New York: Palgrave Macmillan, pp 179–96.

Sustainable Livelihoods Foundation TED Project Team (2021) Cities Support Programme: Township Economy Development Project Situational Analysis Report – Project Site: Delft, City of Cape Town, version 2.6, Pretoria: National Treasury, Republic of South Africa, https://csp.treasury.gov.za/DocumentsConferencesWorkshops/Delft%20Situational%20Analysis%20Report%20v2.6.1.pdf, (Accessed: 24 Jul 2042).

Turok, I., Visagie, J. and Scheba, A. (2021) Social inequality and spatial segregation in Cape Town, in M. van Ham, T. Tammaru, R. Ubarevičienė and H. Janssen (eds) *Urban Socio-economic Segregation and Income Inequality: A Global Perspective*, Cham: Springer, pp 71–90.

UKRI (United Kingdom Research and Innovation) (nd) Water and Fire: Enhancing capacity and reducing risk through 15 'Best Bets' for transformative adaptation with vulnerable residents on the Cape Flats, UK Research and Innovation Gateway, https://gtr.ukri.org/projects?ref=ES%2FT003561%2F1, (Accessed: 12 Apr 2023).

Waggie, F. (2008) *Delft: An Overview of a Culturally Diverse Community*, Cape Town: University of the Western Cape, https://www.researchgate.net/publication/298395202_Delft_An_overview_of_a_culturally_diverse_community.

Wang, C. and Burris, M.A. (1997) Photovoice: concept, methodology, and use for participatory needs assessment, *Health Education & Behavior*, 24(3): 369–87. doi: 10.1177/109019819702400309

Watkins, A. (2020) *Sonic Apartheid: Ecoracism, Apartheid Geographics and Noise Pollution in Cape Town's Blikkiesdorp, Master Thesis*, University of Cape Town, http://hdl.handle.net/11427/32488, (Accessed: 24 Jul 2024).

White, C. (2014) Understanding water scarcity: definitions and measurements, in R.Q. Grafton, P. Wyrwoll, C. White and D. Allendes (eds) *Global Water: Issues and Insights*, Canberra: Australian National University Press, pp 161–5.

Wilson, A., Dick, L., Ncube, S., Dickie, J., Abrams, A., Black, G. et al (2023) Living the life of floods: place-based learning in an Anthropocene harmscape, *Geoforum*, 147: art 103914. doi: 10.1016/j.geoforum.2023.103914

Wilson, A., Robertson, G. and Dickie, J. (2024) Future ordinaries: assembling place-based knowledges and literacies in real and imagined harmscapes, *Futures*, art 103376. doi: 10.1016/j.futures.2024.103376

Wilson, A.N. (2021) Learning to see with Deleuze: understanding affective responses in image–viewer research assemblages, *Qualitative Research*, 21(6): 906–22. doi: 10.1177/1468794120946979

Ziervogel, G., New, M., Archer van Garderen, E., Midgley, G., Taylor, A., Hamann, R. et al (2014) Climate change impacts and adaptation in South Africa, *WIREs Climate Change*, 5(5): 605–20. doi: 10.1002/wcc.295