Subterranean infrastructures in a sinking city: the politics of visibility in Jakarta

Emma Colven

Routledge
Taylor & Francis Group

Check for updates

Subterranean infrastructures in a sinking city: the politics of visibility in Jakarta

Emma Colven

Department of International and Area Studies, University of Oklahoma, Norman, OK, USA

ABSTRACT

Indonesia's capital city of Jakarta is one of the world's fastest sinking cities. Land subsidence, primarily caused by excessive groundwater extraction, damages infrastructure and buildings, and contributes to worsened flood events and tidal inundation. Land subsidence was first identified as an issue in 1989, yet groundwater extraction has only recently been regulated. Meanwhile, city authorities have focused on implementing large-scale infrastructural interventions to reduce the impacts of flooding. This article analyzes why land subsidence remained unaddressed for so long. To do so, it explores the politics of infrastructure in Jakarta through the lens of in/visibility. Scholarship in infrastructure studies has tended to categorize infrastructure as either hyper-visible by design, or invisible until breakdown. This study extends theoretical engagements with infrastructure by examining how visibility, aesthetics, and materiality converge to shape urban and water governance in Jakarta in fundamental ways. Spectacular, visible infrastructures generate public and political attention, while below ground, hidden and invisible infrastructures are overlooked and politically unpopular to address. This "politics of visibility" articulates with a mode of aesthetic governmentality with uneven consequences for Jakarta's residents.

Introduction: the sinking city

In May 2019, President of Indonesia and once-Governor of Jakarta Joko "Jokowi" Widodo announced plans to relocate the nation's capital to the province of East Kalimantan on the island of Borneo. The new capital city, to be built at an estimated cost of USD$ thirty-four billion and slated to be home to seven million people, will be realized with the assistance of McKinsey & Company, and a steering committee that includes former British Prime Minister Tony Blair and Crown Prince of Abu Dhabi Mohammed Bin Zayed Al Nahyan. This policy decision followed the relatively recent acknowledgement by the Indonesian government and provincial government of DKI Jakarta[1] that the city is sinking.[2] With extremely

[1]Jakarta is designated a special capital region (*Daerah Khusus Ibukota Jakarta*) and governed as a province.
[2]While the decision might appear to reinforce perceptions that Jakarta is doomed to be swallowed by the sea, the Indonesian government has maintained that this move does not signal the abandonment of Jakarta; rather, it is intended to reduce population pressures on the city by relocating government ministries. Nonetheless, environmentalists and critics are highly skeptical of the planned relocation, both in terms of its environmental impacts on Kalimantan and for what this means for the future of Jakarta.

high rates of land subsidence – generally between ten and fifteen centimeters annually, but as high as twenty to twenty-eight centimeters in some locations[3] – Jakarta has earned a reputation as one of the world's fastest sinking cities.[4]

While the causes are still debated, the general consensus among scientists is that these extremely fast rates of land subsidence in Jakarta are largely attributable to groundwater extraction. In the absence of an alternative water source, two-thirds of Jakarta residents depend on groundwater resources.[5] Jakarta is not alone in this regard, as excessive groundwater extraction has become a major issue in recent decades in other cities. Groundwater is an essential and foundational water supply for drinking water, irrigation, and industrial needs in many areas around the world. This is because it is available at precise locations close to or at the point of use, is generally of good quality, is cheap to extract, provides a reliable source during dry seasons, and is available over a broad geographical area.[6]

However, as large volumes of water are extracted from deep aquifers, soil and underground materials compact, leading the ground to sink. In some cases, this subsidence is permanent as the storage capacity of aquifers is reduced. Municipal authorities in Bangkok, Shanghai, and Tokyo have all struggled with land subsidence as a result of groundwater extraction. Land subsidence disrupts water supply and drainage networks and causes structural damage to roads and buildings. Subsidence also increases risks of seawalls being breached and exacerbates flooding. This is particularly the case in densely populated and low-lying delta cities across Asia, such as Dhaka, Jakarta, and Ho Chi Minh City.[7]

While land subsidence was first recorded as an adverse effect of groundwater use in Jakarta in a study published in 1989,[8] it is only in recent years that this problem has become widely acknowledged and the government has taken action. When I began fieldwork for this project in 2015, I was unaware of the concerns surrounding Jakarta's sinking and had assumed that sea level rise induced by climate change would be high on the political agenda.[9] Yet after several weeks of meeting with Dutch consultants, it quickly became evident to me that they considered land subsidence, not sea level rise, to be one of Jakarta's greatest challenges. Recorded rates of land subsidence in Jakarta vastly outpace that of annual sea level rise. As then-Deputy Governor of Spatial Planning and Environment, DKI Jakarta, Oswar Muadzin Mungkasa said in an interview in 2016: "Don't talk about the global warming. We have our own problem with the land subsidence."

In this article, I analyze why land subsidence in Jakarta remains unaddressed, despite having been recognized as a primary threat for the past three decades. To do so, I engage with the politics of infrastructure in Jakarta via the lens of in/visibility. A wealth of studies have examined the hyper-visibility of infrastructure projects that are intended to symbolize progress and development, such as dams, satellites, and power plants, while mundane, everyday infrastructural networks are often invisible, except when they

---

[3]Abidin, Andreas, Gumilar, Fukuda, Pohan and Deguchi 2011.
[4]Tarrant 2014; Sherwell 2016; Kimmelman 2017; Lin and Hidayat 2018; Mahomed 2020.
[5]Furlong and Kooy 2017.
[6]Birkenholtz 2014.
[7]Deltares 2015.
[8]Personal communication with foreign water expert, May 2020.
[9]Indeed, the 2007 United Nations Climate Change Conference in Bali, Indonesia had contributed to raising awareness of the risks posed by sea level rise to Indonesia, and particularly for Javanese cities including Jakarta (Katyal and Arga 2007).

fail, such as a bust pipe, power blackout, or collapsed bridge.[10] Scholars working in cities of the global South have shown that disruptions, failures, and breakdowns often constitute the norm in such contexts, meaning that everyday infrastructure is highly visible to urban residents.[11] My goal is to contribute to efforts to move infrastructural studies "beyond the reification of progress and the sensationalization of disruption."[12] Rather than focus solely on instances of visibility, I extend theoretical engagements with infrastructure by examining how both visibility and invisibility matter for how infrastructures are experienced, maintained, and governed. I show how the in/visibility of infrastructure is subjective, contextual, and contingent upon one's social location. While infrastructure typically describes the material networks of steel and concrete that facilitate flows of resources, such as pipes, cables, roads, and ports, Ashley Carse has extended this notion to include nature, such as ecosystem services.[13] From this perspective, nature becomes infrastructure as it is "built, invested in, made functional, and managed," delivering "critical services" to a city.[14] In Jakarta, groundwater becomes infrastructure as it is extracted by residents and large-volume users (commercial, industrial, and real estate actors) using wells and pumps.

I draw on data I collected over multiple fieldwork trips to Jakarta and the Netherlands between 2014 and 2019. During this period, I conducted more than fifty in-depth interviews with provincial and national government officials and ministry staff in Jakarta, water experts in Jakarta and the Netherlands, and Indonesian journalists, activists, and NGO staff. Through these interviews, I sought to understand the political economy of expertise associated with flood mitigation in Jakarta and, more specifically, the decision-making and planning processes associated with a controversial proposal to construct a giant sea wall alongside extensive land reclamation in Jakarta Bay. I also analyze news articles, policy and planning documents, and water management studies.

The paper proceeds as follows. First, I review scholarship in infrastructure studies that explores the visibilities and invisibility of infrastructure in order to lay out my conceptual framework. After this, I provide an overview of Jakarta's waterscape, explaining the causes and uneven socio-spatial impacts of groundwater exploitation. In the third section, I show how what I call a "politics of visibility" that operates at both subterranean and surface levels shapes water governance in Jakarta. I illustrate how the material qualities of invisible and subterranean groundwater resources, and a political preference for hyper-visible infrastructure projects aligned with a world-class aesthetic,[15] have contributed to the failure to address land subsidence and maintain groundwater resources. I also show how the hyper-visibility of riverbank settlements, the aesthetics of which are regarded by the state and middle-class residents as out of place in a modern city, contributes to efforts to evict residents of these settlements. I conclude by considering the theoretical

---

[10]Star 1999; Graham 2010; Howe et al. 2016; McFarlane and Rutherford 2008.
[11]Silver 2015; Schwenkel 2015.
[12]Starosielski 2012, 41.
[13]Carse 2012. Carse also notes the potential harmful impacts on rural communities of payment for ecosystem services.
[14]Carse 2012, 540.
[15]The world-class aesthetic is an idea that features prominently in contemporary studies of urban Asia. It refers to the imaginary of a city (which circulates through urban policy networks) that is experienced as being "modern," based on a narrow, Eurocentric understanding of modernity. On the ground, this typically translates to air-conditioned hotels, expansive highways, and steel and concrete high-rises, and an absence of slums, trash, and poverty. See Baviskar 2003, Ghertner 2015, Roy and Ong 2011, and Harms 2016.

insights to be gleaned from examining the politics of Jakarta's infrastructure via the lens of in/visibility, raising the question of how the invisibility or visibility of particular infrastructures might be leveraged or produced by different groups in order to realize more equitable access to urban water infrastructure.

The in/visibilities of infrastructure

Infrastructure constitutes a primary analytical lens and object of analysis across a range of disciplines, particularly anthropology, political ecology, science and technology studies (STS), and urban studies. Conceptually, infrastructure is understood as "a material assemblage built to support a higher-order project that is at once embedded in and constitutive of social relations."[16] Originating from French and first appearing in the English language in the nineteenth century, early uses of infrastructure referred to "the construction work that was literally conducted *beneath* unlaid tracks ... or was otherwise organizationally *prior* to them."[17] This etymology implies that invisibility is an inherent characteristic of infrastructure. For instance, little material evidence of sewerage networks and other infrastructures laid below the ground is visible on the surface. There is also an absence of out-of-place matter: floodwaters no longer collect, sewage no longer flows through rivers, and trash no longer blocks storm drains. What remains visible is only in "indices, numbers, and reports, which most people do not read."[18]

An oft-made observation within infrastructure studies is that the everyday infrastructures that sustain urban life, such as water, electricity, and sanitation networks, remain invisible up until moments of disruption or failure.[19] The concealment of infrastructure is traced to late eighteenth and early nineteenth-century Europe, when modernist planning paradigms and cultural ideas about public health, sanitation, and hygiene "banished the unruliness of pipes, ducts, wires, and lines to the subterranean strata of the city."[20] Paradoxically, while large-scale infrastructural feats played a central role in the pursuit of urban modernity, such as the construction of the Paris sewer system by Georges-Eugène Haussmann, which were heralded as "symbols of progress,"[21] such infrastructures soon became mundane, melting into the background and becoming taken-for-granted as the underlying structure of urban life. Moments of visibility usually signal "infrastructures in trouble, on the verge of breaking down or having already collapsed."[22] It is in these moments that the "power geometries" underlying infrastructural arrangements are exposed.[23]

Brian Larkin, however, argues that this invisibility is "a partial truth and, as a way of describing infrastructure as a whole, flatly untenable ... it is only one at the extreme edge of a range of visibilities that move from unseen to grand spectacles and everything in between."[24] Infrastructure, therefore, has political, material, aesthetic, and symbolic

[16]Carse and Kneas 2019, 12.
[17]Carse 2016, 29.
[18]Jensen 2016, 9.
[19]Star 1999.
[20]Schwenkel 2015, 523; Gandy 2014.
[21]Gandy 2014, 32.
[22]Jensen 2016, 4.
[23]McFarlane and Rutherford 2008, 368.
[24]Larkin 2013, 336.

dimensions. Indeed, spectacular and monumental forms of infrastructure, such as dams, high rise buildings, power plants, and roads have long been constructed to signal independence, progress, and state power.[25] In Indonesia, the 1976 launch of the Palapa satellite – the first by any postcolonial country – was a major infrastructural event that shaped how Indonesians perceived their nation and themselves, even as the meanings ascribed to the satellite have changed over time.[26] In the latter half of the twentieth century, smokestacks in Vietnam became associated with industry, resilience, technological progress, and the end of colonialism.[27] The study of infrastructures, therefore, provides a lens through which to theorize the state as well as state-society relations.

The argument that infrastructure is invisible until failure is evidently not one that travels well. With regards to large-scale infrastructure projects, Ashley Carse and David Kneas observe that:

> … many – if not most – of the dams, roads, railroads, ports, airports, and pipelines generally classified as infrastructure exist in states aptly characterized as unbuilt or unfinished. Planned, blocked, delayed, or abandoned, such projects are ubiquitous – the norm, rather than the exception.[28]

Far from being the exception, everyday infrastructural networks of water, electricity and other flows in cities of the global South are typically characterized by fragmentation, disruption, and failure.[29] As Christina Schwenkel has observed, "out of order is thus seemingly the natural order of things in worlds where infrastructure disconnections rather than flows predominate."[30] Residents living in cities that never have experienced the modern infrastructural ideal must regularly tinker with and repair infrastructures themselves, or otherwise experience the impacts of disruptions and breakdown on their everyday lives:

> … infrastructure is typically bared, on display, and subjected to manipulation as part of everyday routines and relations: People illicitly tap into water lines or electric grids in makeshift and risky operations to access public utilities that are unavailable, inefficient, or costly.[31]

Building on Stephen Graham and Simon Marvin's influential account of "splintering urbanism," a term they use to capture processes of infrastructural breakdown and decay in the post-Keynesian global North,[32] Michelle Kooy and Karen Bakker observe that Jakarta's piped water network has been "splintered" from its very inception.[33] Sociospatial inequalities in water access that thrived under Dutch rule (1619–1945) continued in the postcolonial era, producing a differentiated, uneven, and fragmented modern-day network.

These insights also raise the question of for whom infrastructure is invisible. Breakdown, for instance, is not necessarily experienced by everyone; some residents may enjoy a continuous water supply and remain largely unaware of the networks supporting

[25]Bunnell 1999; Kaika and Swyngedouw 2000; Harvey and Knox 2012; Akhter 2015; Schwenkel 2015; Sneddon 2015.
[26]Barker 2005.
[27]Schwenkel 2018.
[28]Carse and Kneas 2019, 9.
[29]Wright-Contreras, March, and Schramm 2017; Furlong 2014.
[30]Schwenkel 2015, 522.
[31]Schwenkel 2015, 522–523.
[32]Graham and Marvin 2001.
[33]Kooy and Bakker 2008.

their lives, whereas other residents' taps sputter only for a few hours a day, forcing them to organize their daily lives around water delivery times. Even when a breakdown is citywide, it is not experienced in the same way by all: wealthier residents typically have greater access to resources to adapt than do their poorer counterparts.

Examining how infrastructures are visible for some people but not others calls into question binary conceptualizations of visible and invisible infrastructure. Visibility and invisibility "are not ontological properties of infrastructures; instead, visibility and invisibility are made to happen as part of technical, political, and representational processes."[34] Moreover, this visibility is negotiated. For example, underwater cables are strategically concealed or exposed at different times to different groups – hidden to appease residents or environmentalists, but made visible to fishermen whose anchors could cause damage.[35] Invisibility and visibility are thus socially constructed and materially produced by the state, among other actors. The perceived in/visibility of infrastructure is also situated and contingent. Examining contestations over the reconstruction of a seawall in a Japanese fishing village, Shuhei Kimura has illustrated how differently situated actors hold divergent views as to whether or not the wall should be visible. While government officials and engineers desire a wall that will hide the ocean and go unnoticed, residents have wanted the wall to remain visible, to serve as a "testimony to historical events" such as the 2011 tsunami, as well as a reminder of "future dangers."[36] Infrastructural visibility and invisibility are therefore inherently political processes to which stakes are attached.

Drawing on these insights, I explore how the in/visibility of infrastructure in Jakarta shapes how it is governed and experienced, with political effects and implications for residents' lives. I draw on the concept of materiality as explored in science and technology studies (STS), political ecology, and critical urban studies, through which scholars have explored the agency and political consequences of the nonhuman.[37] From this perspective, nonhuman actors such as water, pipes, and maps are brought into socio-technical assemblages in ways that influence the social world. Erik Harms (this issue) for instance, demonstrates how maps as cartographic representations become entangled in the politics of urban life, challenging dominant narratives of land ownership in Ho Chi Min City. With regards to electricity, Akhil Gupta has argued that the fact that it "cannot be seen, smelled, or heard" has particular consequences for urban life and governance.[38]

I also draw on scholarship on aesthetics from infrastructure studies and critical urban studies examining the representational and symbolic work that hyper-visible infrastructure projects do. In the context of roads, "three promises – of speed, of political integration, and of economic connection – are central to the political force" of infrastructure.[39] Such work reveals that infrastructural spectacles "are not just technical objects … but also operate on the level of fantasy and desire."[40]

Emerging largely but not exclusively from engagements with India, critical urban scholarship has demonstrated a shift toward an increasingly prominent role for aesthetics in shaping urban governance. This parallels a rich urban history of beautification projects

[34]Larkin 2018, 186.
[35]Starosielski 2012, 38.
[36]Kimura 2016, 26.
[37]Bennett 2010; Meehan 2014.
[38]Gupta 2015, 556.
[39]Harvey and Knox 2012, 524.
[40]Larkin 2013, 333.

implemented in both colonial and postcolonial contexts, underpinned by the valorization of rational planning and order, which typically involves the eviction and demolition of settlements that the state categorizes as slums. For Asian cities, these processes have been central to a more recent "project of 'worlding' Asian cities to meet global aspirations of market competitiveness and aesthetics."[41]

Asher Ghertner describes this new mode of governance as "aesthetic governmentality" wherein the state increasingly relies on sensory registers (smell, sight, affect), visual cues, and aesthetics to govern urban space and its residents.[42] Breaking from methods of enumeration, documentation, mapping, and abstraction that were long central to "the illusion of bureaucratic control and a key to a colonial imaginary," a focus on aesthetic governmentality is driven by an increasingly powerful and influential world-class city aesthetic: an image of a beautiful, clean and – crucially – slum-free city.[43] In Jakarta, the emergence of an aesthetic governmentality has produced powerful cultural understandings and imaginaries, shared and circulated by the state and the middle class, of what is both desirably visible and visibly desirable (high-rises, modern infrastructure, and green spaces) as well as what is not (polluted waters, riverbank settlements, and trash). Crucial to aesthetic governmentality, then, is the visibility of the desirable/undesirable in the first place.

Splintered city

Jakarta's contemporary waterscape is testimony to the fallacy of the modern infrastructural ideal of a fully networked city. The city's water supply network has been fragmented since its inception during the Dutch colonial era when Jakarta was referred to as Batavia. During the late nineteenth century, a racialized hierarchy that differentiated between colonial settlers (civilized and modern) and Indigenous residents (primitive and backward), was mapped onto and reflected in water infrastructures (Kooy and Bakker 2008). Artesian wells were constructed only in European areas, followed later by small piped networks supplied by reservoirs. Indigenous people relied on river water, using taste, visual appearance, and smell to determine water quality.[44] Following independence in 1945, Jakarta's water supply network continued to reflect deep socio-spatial inequalities for many decades.

Following a recommendation by the World Bank to privatize the piped water system, the Indonesian government granted concessions to British company Thames Water International and French company Suez-Lyonnaise des Eaux in 1997. Yet, more than twenty years later, this process has not led to any substantial increases in network coverage. In 1998, the piped water system covered 44.5 percent of the city; by 2019, this had increased to just 59.4 percent, concentrated in wealthier neighborhoods.[45]

---

[41]Graham, Desai, and McFarlane 2013, 118. In this quote, the authors reference "worlding," a term coined by Roy and Ong 2011. See also Erik Harms (2012), who observes how imaginations of an orderly, clean, and beautiful city are used by political elites in Ho Chi Minh City to justify the evictions of urban poor residents as part of an urban redevelopment project, a mode of urbanism he calls "beauty as control."

[42]Ghertner 2015.

[43]Appadurai 1993 cited in Baviskar 2003, 93. See also Scott 1998.

[44]Kooy and Bakker 2008, 1848.

[45]Atika and Aqil 2019. Water privatization remains hotly contested. In 2017, Indonesia's Supreme Court ruled in favor of the Coalition of Jakarta Residents Opposing Water Privatization (KMMSAJ), which had filed a lawsuit against water privatization in 2013, citing the failure to provide clean water for the city's residents. This was challenged by the Finance Ministry in 2018, leading to the ruling being overturned (Atika and Aqil 2019). Nonetheless, Jakarta's current governor, Anies Baswedan, maintains that the city will take over the water supply. See Suhartadi 2019.

As a result, many city residents use a myriad of water sources to fulfill their daily needs. Low-income residents buy bottled water or "refill water" sold in gallon jerry cans from local sellers. The majority of Jakarta's water supply, however, is currently provided by groundwater extracted from wells using pumps. Groundwater is perceived as cleaner and more reliable than piped water and can be extracted at virtually no cost.

Extraction took place largely unabated and was virtually unregulated until the introduction of a groundwater tax in 2008. The following year, Governor Regulation No. 37/2009 on Water Acquisition was introduced with the aim of controlling groundwater use and encouraging the use of piped water. It also priced groundwater above piped water for large volume users.[46] Nonetheless, groundwater use remains poorly regulated and city authorities have yet to provide an affordable alternative supply. Following the recommendations of independent Dutch knowledge institute Deltares in 2015, Jakarta authorities committed to a process that will transition public buildings away from groundwater use. According to one foreign water expert I interviewed, city officials agreed that stopping deep groundwater extraction must be a priority, but then-Governor Basuki Tjahaja Ahok argued that industrial users could not be expected to stop extracting groundwater without the government first halting extraction by public buildings. Both experts and state officials agree that a more comprehensive piped water supply is needed to slow and ultimately stop groundwater extraction. This sentiment was echoed by then-Deputy Governor of Spatial Planning and Environment, DKI Jakarta, Oswar Muadzin Mungkasa in a 2016 interview, who explained to me that: " … we try to decrease the groundwater extraction … we put taxes on the groundwater. But it doesn't matter how high the tax [is] because we don't have water."

The popularity of groundwater, the scale of its extraction, and the failure to replenish groundwater resources and provide a sufficient alternative water supply has led to overexploitation. The impacts of land subsidence are considerable, as well as deeply uneven. Over-pumping of the deep aquifer on which the city is built (which sits more than forty meters below the surface and is difficult to replenish) by large-volume users such as factories, shopping malls, hotels, and government buildings has led to saltwater intrusion as far as eleven kilometers inland.[47] Although groundwater is often perceived as cleaner, in Jakarta it is increasingly contaminated by untreated waste, and leakage from septic tanks.[48] Forty-five percent of the city's groundwater is contaminated with fecal coliform and eighty percent is contaminated with *E. coli*.[49] This directly impacts residents who extract more shallow groundwater and in relatively small volumes. It is therefore not only water supply infrastructure that is splintered in Jakarta, but also the city's groundwater resources and the quality of groundwater, which are splintered vertically in ways that elucidate the topographies of urban infrastructure.[50]

Likewise, flood mitigation infrastructures are also splintered. Situated on a delta and traversed by thirteen rivers, Jakarta is already vulnerable to flooding caused by heavy rains and tidal inundation. Land subsidence has worsened this, as water cannot flow

[46]Furlong and Kooy 2017.
[47]Walton 2015.
[48]Furlong and Kooy 2017.
[49]Asian Development Bank 2016.
[50]See Graham and Hewitt 2013, Harris 2015.

through the rivers and canals to the Java Sea without the assistance of pumping stations. Sea defenses also have subsided, decreasing their effectiveness against tidal inundation, which makes the city more vulnerable to flooding due to high tides and, on a longer time frame, sea level rise.

Floodwaters do not discriminate between communities, and flood events are experienced across socio-economic groups. In a documentary produced by ABC Australia, World Bank infrastructural specialist Honjoo Hahm noted that

> flooding does not distinguish between wealth … the President [of Indonesia] himself gets affected by flooding. In the way we commute to the office, the roads all get flooded, the rich with their Mercedes Benz are still going to be dramatically affected by the floods.[51]

Yet, the impact on wealthier residents, who have the resources to adapt and to recover their losses, are comparatively minimal and infrequent when compared to the impact on residents living alongside the city's riverbanks and coastline.

Increased flood risk disproportionately impacts North Jakarta's urban poor, whose neighborhoods are at a lower elevation and are protected by a sinking, crumbling sea wall.[52] At the same time, flood mitigation efforts have been accompanied by evictions of riverside communities already most impacted by flooding.[53] Meanwhile, wealthier neighbors construct private sea walls to protect their properties at the direct expense of their poorer neighbors. The splintered nature of Jakarta's piped water system, groundwater extraction process, and flood mitigation infrastructures reflect deep socio-spatial inequalities, which in turn produce different experiences of infrastructure and degrees of visibility.

The politics of visibility

Attending to the politics of visibility in Jakarta elucidates how infrastructures act as mediators of power. To understand why land subsidence remains a problem in Jakarta requires understanding how visibility operates to drive surface projects forward while reducing the impetus to address groundwater extraction. In the discussion that follows, I show not just how in/visibility come into being and operate in Jakarta, but how particular forms of visibility articulate with aesthetic governmentality to shape how water is governed.

Slow violence

The respective and divergent temporalities of land subsidence and flood events shape water governance in Jakarta in fundamental ways. Land subsidence and flood events occur over vastly different time scales, with implications for their visibility, how they are identified as problems requiring solutions, and how and whether they generate political action. Rob Nixon uses the term "slow violence" to describe environmental threats that occur over time and generate less attention and action by the state, such as climate change and deforestation:

---

[51]ABC Australia 2008.
[52]Andreas et al. 2018.
[53]Leitner, Colven and Sheppard 2017; Colven and Irawaty 2019.

> By slow violence I mean a violence that occurs gradually and out of sight, a violence of delayed destruction that is dispersed across time and space, an attritional violence that is typically not viewed as violence at all … a violence that is neither spectacular nor instantaneous, but rather incremental and accretive, its calamitous repercussions playing out across a range of temporal scales.[54]

Land subsidence in Jakarta is most aptly conceptualized as slow violence. In contrast to the violence of flood events, enumerated in death tolls and dollars, land subsidence is not experienced as a kind of violence that would galvanize action in the same way. Land subsidence takes place gradually and invisibly. Even Jakarta's astoundingly high rates of subsidence remain imperceptible to the human eye. Journalists, water experts, and academics have documented land subsidence, for example, by using photographs of a particularly well-known location in Pluit, North Jakarta, where the top of the sea wall (and the sea level itself) visibly loom above ground level (Figure 1). But this powerful image is not stable. When I visited this sea wall in 2019, new concrete had been poured, raising the height of the road and obscuring the full extent of land subsidence that had actually occurred. Although intended to mitigate flooding, the sea wall obscures the process and the extent of land subsidence.[55]

Flood events are temporally discrete, seasonal, and on occasion, spectacular events. When they occur, they dominate the media and occupy the minds of residents and politicians alike. Jakarta has experienced a series of increasingly more frequent and intense major flood events in recent decades. These events are highly disruptive to the lives and livelihoods of Jakarta's residents as well as the economy. Flooding is an important political issue, particularly in the lead up to gubernatorial elections; incumbent governors and candidates stand to lose or win on the basis of their flood preparedness and response. Flooding in February 2007 – the city's greatest flood event in three centuries and a pivotal moment in Jakarta's flood management trajectory – was significant not only because previously unflooded areas of the city were inundated, but also because 2007 was the first time that the governor of Jakarta was elected. According to Anto Mohsin, "to Fauzi Bowo and Adang Daradjatun, who ran as candidates … the stake was the outcome of the election. They wanted Jakartans to think that they cared and had solutions to the flood problem."[56] Following flooding in January 2020 which killed sixty-six people over ten days, residents filed a lawsuit against the current governor, Anies Baswedan, for failing to protect them, In addition, a petition also circulated online, calling for his dismissal. The visibility of flood events and their impacts provide evidence of the state's failure to protect its citizens.

However, the visibility of flood events is not predetermined. Rather, visibility and invisibility are brought into being. Flooding is experienced much less frequently by some neighborhoods than others. Temporarily and spatiality thus intersect, with consequences for how visible flooding is and to whom. For instance, when the wealthy expatriate neighborhood of Kemang in South Jakarta experienced flooding for the first time in 2016, the story hit city papers. In contrast, the impacts of flooding on the urban poor are rarely visible to Jakarta's middle class: while their wealthier neighbors live in gated

---

[54]Nixon 2011, 2.
[55]Thanks to Sylvia Nam for fleshing out this observation.
[56]Mohsin 2015, 43.

Figure 1. The sea wall in Pluit, North Jakarta in 2015. Credit: Emma Colven.

communities, behind walls erected against both the city and the sea, poorer residents in North Jakarta neighborhoods such as Muara Baru and Muara Angke experience tidal flooding once or twice a week as a result of the sea wall being topped.[57] What counts as a flood event depends, therefore, upon where flooding occurs, how visible floodwaters are and to whom, and who is affected.

The temporalities and spatialities of progress

Whereas maintaining, managing, and regulating groundwater extraction and land subsidence is largely invisible work with "very little public relations value"[58] or evidence of success, surface water projects are hyper-visible forms of infrastructure that carry symbolic value as representations of progress and development. The latter provide material evidence that politicians are working to improve the city, keep their campaign promises, and create jobs, at least in the short-term.[59] For instance, Jakarta's Public Facility Maintenance Agency (*Pekerja Penanganan Sarana dan Prasarana Umum*) was particularly highly celebrated during former Governor Ahok's administration (2014–2017). Dubbed Jakarta's "orange troops" for their tangerine work shirts, the agency's teams manually clear out waste, plastic, and other trash from the canals and waterways that threatens to block the flow of water (Figure 2). Presented as "frontline workers" against flooding,

---

[57]Haryanto 2016 cited in Sedlar 2016.
[58]Bruun 2016, 9.
[59]Birkenholtz 2014, 23.

Figure 2. Jakarta's "orange troops" manually clear trash from the canal connecting the Ciliwung Lama to the Java Sea. Credit: Emma Colven.

the teams respond to real-time reports of flooding. In the absence of a comprehensive waste collection infrastructure, they also play a crucial role in preventing trash from entering the city sewerage system and open clogged drains. Their manual labor helps to prevent inundation by keeping water flowing during the rainy season.[60] The *Jakarta Post* recently declared them "heroes."[61] The visibility of these workers and their labor – accentuated by their highly recognizable work shirts – contributed to a public perception that Ahok's administration took flooding seriously. It also fit into a broader political and popular narrative that the unsightly trash floating in the rivers, and the riverbank settlers misleadingly blamed for disposing of it, are the real cause of flooding.

Surface water projects are closely aligned with an imagined world-class city aesthetic, making them highly attractive to politicians with ambitious urban development agendas. Large-scale infrastructure projects also offer an opportunity to gain the international spotlight and attract foreign investment. Indeed, cities across the world seek to attract private investments in large-scale, highly visible water infrastructure projects. Jakarta is no exception to this trend. Recent efforts to reduce the impacts of flooding have been directed at controlling and directing floodwaters. Supported by the national government and Dutch consultancy firms, DKI Jakarta has undertaken hyper-visible, large-scale infrastructural interventions intended to alleviate and reduce the impacts of

---

[60]Elyda 2016.
[61]Andapita 2019.

flooding. River normalization (*normalisasi*) projects including the Ciliwung River Normalization project and the Jakarta Urban Flood Mitigation Project (partially funded by the World Bank) involve dredging, straightening, and concretizing the city's main waterways in order to facilitate river discharge and therefore reduce flooding from the rivers due to heavy rain (see Figure 3).

Illustrating the power of aesthetics, in 2017 then-governor Ahok posted on his Facebook and Twitter accounts a photograph of the Ciliwung River following normalization and the eviction of two riverbank communities, Kampung Pulo in East Jakarta (2015) and Bukit Duri in South Jakarta (2016). The photograph captured the visual improvement of the Ciliwung River: notably wider, straighter, and empty of riverbank settlers. The efficacy of normalization has been contested by activists, however, who claim that the use of concrete combined with the straightening of rivers increases the speed of river flows, contributing to both riverbank erosion and increased risk of flooding downstream.[62]

Plans for a giant sea wall to protect the city from tidal inundation, to be funded by private investments in land reclamation along the city's north coast, have been in the works for decades. The project has attracted enormous local and international media attention, and has been critiqued by activists, academics, and environmentalists for failing to address land subsidence.[63] While the project has yet to materialize, numerous iterations of architectural renderings of the project from the master plan and other sources have widely circulated. These images – which operate as "performative objects," as their circulation in government ministries, presentation at conferences, and reproduction online and in print media make the project hyper-visible, despite not existing in any material sense.[64]

Regulation, informality and illegality

A final point of comparison between subterranean and surface Jakarta pertains to regulation, informality, and illegality. In/visibility dictates to a large extent how easily informality and illegality can be regulated or eradicated by the government. The biophysical and material qualities of groundwater resources fundamentally shape how they are governed. Flowing beneath the surface of the Earth, groundwater resources constitutes a "fugitive and invisible resource."[65] Groundwater experts suggest that this invisibility contributes to policies that largely overlook groundwater despite its fundamental role as a water resource worldwide.[66] Groundwater is also a "horizontal" resource, an unbounded public good that can be broadly accessed and extracted by many widely dispersed users and pumps.[67] These qualities make it "difficult or very costly to monitor who is pumping how much and to arrive at collective agreements on reductions in extractions."[68] The invisibility and illegibility of groundwater use facilitates a lack of accountability,

---

[62]In fact, Jakarta governor Anies was criticized following the 2020 floods by Minister of Public Works and Public Housing (PURR) Basuki Hadimuljono for stalling the Ciliwung River Normalization project. However, Anies and others have contended that this year's flooding was caused by a lack of retention space, pointing to some areas that flooded despite being adjacent to normalized stretches of the Ciliwung. See Onggokusumo and Carr-Catzel 2020.

[63]Colven 2017.

[64]Wade 2018, 159.

[65]Hoogesteger and Wester 2015, 119.

[66]Alley, Beutler, Campana, Megdal and Tracy 2016.

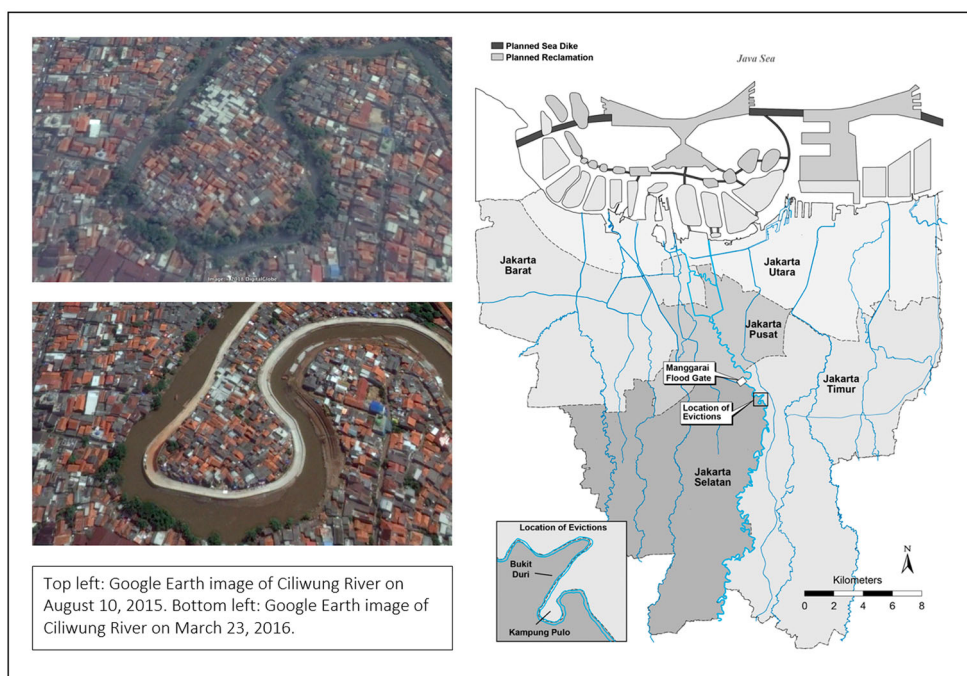[67]Hoogesteger and Wester 2015.

[68]Hoogesteger and Wester 2015, 119.

Figure 3. Google Earth images show the Ciliwung River before and after normalization (left). A map shows the location of the river and the communities evicted as part of this project. Credit: Emma Colven.

incentivizing users to maximize their withdrawals. In 2016, there were 4,720 registered wells in Jakarta, an increase of 5.5 percent from the prior year.[69] Many estimate that the number of wells is in fact far greater, however, as much extraction is illegal and unregistered. In 2017, the Indonesian Corruption Eradication Commission reported over 10,000 illegal points of extraction.[70] Additionally, many actors do not accurately report the number of their wells or the volumes of water they are pumping.

Yet this invisibility is not experienced by everyone. While the state struggles to render groundwater and its extraction legible, groundwater resources are visible to and known by users. This includes knowledge of how to extract groundwater, the necessary depth of wells, water quality, and increasing rates of salinization and contamination. In contrast to this intimate knowledge of groundwater resources, others are able to go about their daily lives paying little attention to the issue of subsidence. The real estate industry, for example, has shown little indication that groundwater extraction and subsidence are important issues that might pose a financial risk. As a consultant based at global real estate consultancy Knight Frank's Jakarta office remarked in a 2019 interview: "I go into meetings two, three, four, five times a day, right? … none of the topics [are] around flooding, Jakarta sinking."

While groundwater resources and infrastructures are largely hidden from view, the surface level elements of Jakarta's waterscape, such as floodwaters, canals, large-

[69]ASEAN Post 2019.
[70]Kompas 2017.

infrastructure projects, riverbank settlements, and trash, are highly visible and therefore garner great political and public attention. The aesthetics of particular *kinds* of visibility shape whether they are coded as illegal and informal, or legal and legitimate, thus determining whether they are subject to state regulation and force. For instance, people with few or no choices other than to live along the city's riverbanks, which are often located in central areas of the city, are highly visible to other residents in the city. Their materiality and visual appearance – their high density, the use of particular materials, and housing design – contribute to their classification as illegal, informal, and out of place. Today, after four decades of planning policy, Jakarta's urban villages (*kampungs*) are largely conflated with slums.[71] Riverbank settlements are presented as violating the desired aesthetics and environment of the city; these settlements and their residents are subsequently rendered both illegal and environmentally illegitimate.[72] Hyper-visibility identifies aspects of Jakarta's waterscape that do not align with a world-class city aesthetic and are thus out of place. Acutely aware of the way that aesthetics legitimize or illegitimatize particular forms of urban development in Jakarta and following the high-profile eviction of Kampung Pulo Bukit Duri residents (see above), residents of *kampung* Tongkol in North Jakarta have sought to avoid becoming a target for eviction by promoting an image of a green and culturally valuable neighborhood.[73]

Yet while trash is indeed a significant problem as it clogs storm drains and waterways, a narrative that holds riverbank settlers wholly responsible for this ignores other structural factors that contribute to flooding. Land subsidence causes the city's rivers to sink, inhibiting their flow; until recent years, annual dredging work had not been carried out for many years, enabling silt to build up in the rivers and reduce their capacity; and many residents are not served by trash collection systems. This narrative also belies the fact that residents often possess land certificates, such as customary land rights (*girik*), free hold rights (*hak milik*), or proof of ownership issued during the Dutch colonial era (*Eigendom Verponding*), details that remain invisible to those pointing the finger at riverbank settlers.

Also invisible are planning violations by private developers, many of which contribute to Jakarta's worsened flooding. For instance, following the recent flood event in Kemang, South Jakarta, the planning and development of this neighborhood came under scrutiny. Though the area had already been identified as vulnerable to flooding, a hotel had nonetheless been constructed next to the Kruket River. Indonesian environmental NGO WALHI[74] identifies five areas in Jakarta originally designated as green space (important for absorbing rainwater and enabling groundwater recharge) that have been developed into shopping malls, commercial buildings, and residential areas. Together these areas total some 9,700 acres – nearly six percent of Jakarta's total acreage. While this may seem a small figure, consider that green space in Jakarta currently constitutes just under ten percent of the city's total land today and the city's Spatial Planning Law stipulates that this should be thirty percent.[75] Yet since these hotels, shopping malls, and apartment buildings meet the visual and aesthetic standards appropriate for a world-class city, they were permitted; violations such as these of Jakarta's 1985–2005 spatial plan were validated

---

[71]Tri Irawaty 2018.
[72]Tri Irawaty 2018.
[73]Munk 2016.
[74]*Wahana Lingkungan Hidup Indonesia* (Indonesian Forum for Environment).
[75]Wijaya 2018.

in the city's 2000–2010 spatial plan.[76] Thus while the aesthetics of riverbank settlements denies their residents any possibility for their informality to go unnoticed, the visibility of these spatial plan violations is absent from formal records, making these transgressions invisible.

Conclusion

Drawing together ideas about materiality, aesthetics, and visibility, I have shown how a politics of visibility articulates with a mode of aesthetic governmentality in Jakarta, fundamentally shaping what is deemed possible and desirable by the state with regard to water infrastructure. Contrasting what is made hyper-visible with what lies beneath the surface (in this case, groundwater resources), I have shown how visibility and invisibility are relational: the visibility of one infrastructural network necessarily draws attention and political will away from another. In Jakarta, the spectacular nature of hyper-visible surface water projects and their immediate consequences for urban poor have garnered the attention of the public and the press. Meanwhile, more mundane, less visible efforts to stop groundwater extraction and slow land subsidence have been neglected. The politics of visibility is, therefore, an essential part of understanding the lack of attention to groundwater extraction and why Jakarta's sinking continues largely unabated nearly three decades after it was first identified as a problem.

This case study yields important insights for understanding contemporary Asian urbanism more broadly. Cities across Asia are experiencing increasingly severe water crises that disproportionately affect their poor citizens.[77] Yet water infrastructure remains deeply splintered and flood mitigation efforts are often accompanied by evictions.[78] In Jakarta, an aesthetic governmentality contributes to coding what is desirably visible and visibly desirable, as well as what as what is considered out-of-place. Hotels and shopping malls constructed in water catchment areas in violation of the city's spatial plan are ultimately permitted because they meet unspoken aesthetic requirements, while residents living in informal settlements are deemed deserving of eviction; similarly; floodwaters are acceptable in some spaces (riverbank settlements and poor coastal communities) where they remain unseen by the general public, but not others (the Mercedes Benzes and homes of the middle class).

Given the significant role of groundwater resources for Asian cities and the considerable challenges of governing such resources, urban scholars, practitioners, and policymakers should pay greater attention to subterranean flows of water. Critical social science research on Asian cities has overwhelmingly focused on piped water infrastructure and supply, with comparatively little attention to groundwater.[79] More research is needed to extend our understandings of why and under what conditions groundwater resources are threatened, over-exploited, or sustainably managed, as well as the impacts of groundwater exploitation on different communities.

---

[76]Rukmana 2015.
[77]Tokyo is an interesting counter example. The city experienced severe land subsidence during the early twentieth century but by the 1970s had successfully addressed the problem by introducing new groundwater regulations.
[78]Alvarez and Cardenas 2019.
[79]See Ranganathan 2014, Furlong and Kooy 2017 for notable exceptions. This also stands in contrast to a wealth of scholarship from the fields of geology, hydrology and the geospatial sciences.

Jasper Jensen's call to "[look] to the ground"[80] creates opportunities for academics, policymakers, and activists to shift public discourse in ways that generate greater political will to address land subsidence caused by excessive groundwater extraction. This can counterbalance the overwhelming attention to surface water projects, which often have more to do with politics and capital than with the infrastructural needs of residents. By telling stories about the invisible, the subterranean, and the obscured, we can better understand how visibility and invisibility are socially constructed by particular actors, providing insights into how actors can engage in the politics of visibility to achieve more equitable and just water infrastructures.

Disclosure statement

No potential conflict of interest was reported by the author(s).

Notes on contributor

Emma Colven is an assistant professor in the Department of International and Area Studies at the University of Oklahoma. As an urban geographer and political ecologist, her research explores themes of water politics, real estate, and urban development, adaptation to environmental threats, and environmental justice in Asian cities. She received her Ph.D. in Geography from UCLA in 2018. She holds a B.A. in Geography from University College London and M.A. in Cities from King's College, London.

ORCID

Emma Colven http://orcid.org/0000-0002-4072-6303

---

[80]Jensen 2016, 10.

References

ABC Australia. 2008. "Are Years of Neglect to Blame for Jakarta's Flooding?" January 20, 2014. Accessed May 29, 2020. https://www.youtube.com/watch?v=rExcI0oCFpE.

Abidin, Hasanuddin Z., Heri Andreas, Irwan Gumilar, Yoichi Fukuda, Yusuf E. Pohan, and Tono Deguchi. 2011. "Land Subsidence of Jakarta (Indonesia) and its Relation with Urban Development." *Natural Hazards* 59 (3): 1753–1771.

Akhter, Majed. 2015. "Infrastructure Nation: State Space, Hegemony, and Hydraulic Regionalism in Pakistan." *Antipode* 47 (4): 849–870.

Alley, William M., Lisa Beutler, Michael E Campana, Sharon B. Megdal, and John C. Tracy. 2016. "Making Groundwater Visible." *Water Resources IMPACT*. Accessed April 20, 2020. https://wrrc.arizona.edu/sites/wrrc.arizona.edu/files/pdfs/making-groundwater-visible.pdf.

Alvarez, Maria Khristine, and Kenneth Cardenas. 2019. "Evicting Slums, 'Building Back Better': Resiliency Revanchism and Disaster Risk Management in Manila." *International Journal of Urban and Regional Research* 43 (2): 227–249.

Andapita, Vila. 2019. "Orange Troops, Keeping City Clean While People KEEP Littering." *Jakarta Post.* Accessed June 30, 2020. https://www.thejakartapost.com/news/2019/07/26/orange-troops-keeping-city-clean-while-people-keep-littering.html.

Andreas, Heri, Hasanuddin Z. Abidin, Irwan Gumilar, Teguh P. Sidiq, Dina A. Sarsito, and Shota Pradipta. 2018. "Insights into the Correlation between Land Subsidence and the Floods in Regions of Indonesia." Accessed April 27, 2020. https://www.intechopen.com/books/natural-hazards-risk-assessment-and-vulnerability-reduction/insight-into-the-correlation-between-land-subsidence-and-the-floods-in-regions-of-indonesia.

Appadurai, A. 1993. "Number in the Colonial Imagination." In *Orientalism and the Postcolonial Predicament*, edited by C. Breckenridge and P. van der Veer. Philadelphia: University of Pennsylvania Press.

ASEAN Post Team. 2019. "Studies Show Jakarta Quickly Sinking." *ASEAN Post*, January 26. Accessed April 27, 2020. https://theaseanpost.com/article/studies-show-jakarta-quickly-sinking.

Asian Development Bank. 2016. "Indonesia Country Water Assessment." Accessed May 5, 2020. https://www.adb.org/sites/default/files/institutional-document/183339/ino-water-assessment.pdf.

Atika, Sausan, and A. Muh Idbu Aqil. 2019. "Jakarta to Take over Water Management from Aetra, Palyja Despite Court Decision." *The Jakarta Post*, February 11. Accessed June 22, 2020. https://www.thejakartapost.com/news/2019/02/11/jakarta-to-take-over-water-management-from-aetra-palyja-despite-court-decision.html.

Barker, Joshua. 2005. "Engineers and Political Dreams: Indonesia in the Satellite Age." *Current Anthropology* 46 (5): 703–727.

Baviskar, A. 2003. "Between Violence and Desire. Space, Power, and Identity in the Making of Metropolitan Delhi." *International Social Sciences Journal* 175: 89–98.

Bennett, Jane. 2010. *Vibrant Matter: A Political Ecology of Things*. Durham, NC: Duke University Press.

Birkenholtz, Trevor L. 2014. "Recentralizing Groundwater Governmentality: Rendering Groundwater and Its Users Visible and Governable." *Wiley Interdisciplinary Reviews: Water* 2 (1): 21–30.

Bunnell, Tim. 1999. "Views from Above and Below: The Petronas Twin Towers and/in Contesting Visions of Development in Contemporary Malaysia." *Singapore Journal of Tropical Geography* 20 (1): 1–23.

Carse, Ashley. 2012. "Nature as Infrastructure: Making and Managing the Panama Canal Watershed." *Social Studies of Science* 42 (4): 539–563.

Carse, Ashley. 2016. "Keyword: Infrastructure: How a Humble French Engineering Term Shaped the Modern World." In *Infrastructures and Social Complexity: A Companion*, edited by Penny Harvey, Casper Bruun Jensen, and Atsuro Morita, 45–57. London: Routledge.

Carse, Ashley, and David Kneas. 2019. "Unbuilt and Unfinished: The Temporalities of Infrastructure." *Environment and Society* 10 (1): 9–28.

Colven, Emma. 2017. "Understanding the Allure of Big Infrastructure: Jakarta's Great Garuda Sea Wall Project." *Water Alternatives* 10 (2): 250–264.

Colven, Emma, and Dian Tri Irawaty. 2019. "Critical Spatial Practice and Urban Poor Politics: (Re) imagining Housing in a Flood-Prone Jakarta." *Society and Space*, August 26. Accessed March 12, 2020. https://www.societyandspace.org/articles/critical-spatial-practice-and-urban-poor-politics-re-imagining-housing-in-a-flood-prone-jakarta.

Deltares - Taskforce Subsidence. 2015. "Sinking Cities: An Integrated Approach Toward Solutions." *Deltares.* Accessed March 20, 2020. https://www.deltares.nl/app/uploads/2015/09/Sinking-cities.pdf.

Elyda, Corry. 2016. "Orange Troops Keep Heavy Inundations at Bay." *Jakarta Post*, February 27. Accessed May 9, 2020. https://www.thejakartapost.com/news/2016/02/27/orange-troops-keep-heavy-inundations-bay.html.

Furlong, Kathryn. 2014. "STS Beyond the 'Modern Infrastructure Ideal': Extending Theory by Engaging with Infrastructure Challenges in the South." *Technology in Society* 38: 139–147.

Furlong, Kathryn, and Michelle Kooy. 2017. "Worlding Water Supply: Thinking Beyond the Network in Jakarta." *International Journal of Urban and Regional Research* 41 (6): 888–903.

Gandy, Matthew. 2014. *The Fabric of Space: Water, Modernity, and the Urban Imagination*. Cambridge, M.A.: MIT Press.

Graham, Stephen. 2010. "When Infrastructures Fail." In *Disrupted Cities: When Infrastructure Fails*, edited by Stephen Graham, 1–26. New York: Routledge.

Graham, Stephen, Renu Desai, and Colin McFarlane. 2013. "Water Wars in Mumbai." *Public Culture* 1 (69): 115–141.

Ghertner, A. 2015. *Rule by Aesthetics: World-Class City Making in Delhi*. Oxford: Oxford University Press.

Graham, Stephen, and Lucy Hewitt. 2013. "Getting off the Ground: On the Politics of Urban Verticality." *Progress in Human Geography* 37 (1): 72–92.

Graham, Stephen, and Simon Marvin. 2001. *Splintering Urbanism: Networked Infrastructures, Technological Mobilities and the Urban Condition*. London: Routledge.

Gupta, Akhil. 2015. "An Anthropology of Electricity from the Global South." *Cultural Anthropology* 30 (4): 555–568.

Harms, Erik. 2012. "Beauty as Control in the New Saigon: Eviction, New Urban Zones, and Atomized Dissent in a Southeast Asian City." *American Ethnologist* 39 (4): 735–750.

Harms, Erik. 2016. *Luxury and Rubble: Civility and Dispossession in the New Saigon*. Oakland, CA: University of California Press.

Harris, Andrew. 2015. "Vertical Urbanisms: Opening up Geographies of the Three-Dimensional City." *Progress in Human Geography* 39 (5): 601–620.

Harvey, Penny, and Hannah Knox. 2012. "The Enchantments of Infrastructure." *Mobilities* 7 (4): 521–536.

Haryanto, Ulma. "Breached Levee Leads to More Floods in Muara Baru | Jakarta Globe." *Jakarta Globe.* Accessed March 17, 2016. http://jakartaglobe.beritasatu.com/archive/breachedlevee-leads-to-more-floods-in-muara-baru/.

Hoogesteger, Jaime, and Philippus Wester. 2015. "Intensive Groundwater Use and (In)Equity: Processes and Governance Challenges." *Environmental Science & Policy* 51: 117–124.

Howe, C., J. Lockrem, H. Appel, E. Hackett, D. Boyer, R. Hall, M. Schneider-Mayerson, et al. 2016. "Paradoxical Infrastructures: Ruins, Retrofit, and Risk." *Science, Technology, & Human Values* 41 (3): 547–565.

Irawaty, Dian Tri. 2018. "Jakarta's Kampungs: Their History and Contested Future." MA thesis, UCLA.

Jensen, Casper Bruun. 2016. "Pipe Dreams: Sewage Infrastructure and Activity Trails in Phnom Penh." *Ethnos* 82 (4): 627–647.

Kaika, Maria, and Erik Swyngedouw. 2000. "Fetishizing the Modern City: The Phantasmagoria of Urban Technological Networks." *International Journal of Urban and Regional Research* 24 (1): 120–138.

Katyal, Sugita, and Adhityani Arga. 2007. "Climate change May Wipe Some Indonesian Islands off Map." *Reuters*, December 2, 2020. Accessed May 30, 2020. https://uk.reuters.com/article/environment-climate-indonesia-islands-dc/climate-change-may-wipe-some-indonesian-islands-off-map-idUKJAK15507820071203.

Kimmelman, Michael. 2017. "Jakarta Is Sinking so Fast, It Could End Up Underwater." *New York Times*, December 21. Accessed April 5, 2020. https://www.nytimes.com/interactive/2017/12/21/world/asia/jakarta-sinking-climate.html.

Kimura, Shuhei. 2016. "When a Seawall Is Visible: Infrastructure and Obstruction in Post-Tsunami Reconstruction in Japan." *Science as Culture* 25 (1): 23–43.

Kompas. 2017. "Pencurian Air Tanah Diduga Terjadi di 10 Ribu Titik di Jakarta." *Kompas*, July 31. Accessed May 16, 2020. https://megapolitan.kompas.com/read/2017/07/31/20060041/pencurian-air-tanah-diduga-terjadi-di-10-ribu-titik-di-jakarta.

Kooy, Michelle, and Karen Bakker. 2008. "Splintered Networks: The Colonial and Contemporary Waters of Jakarta." *Geoforum; Journal of Physical, Human, and Regional Geosciences* 39 (6): 1843–1858.

Larkin, Brian. 2013. "The Politics and Poetics of Infrastructure." *Annual Review of Anthropology* 42 (1): 327–343.

Larkin, Brian. 2018. "Promising Forms: The Political Aesthetics of Infrastructure." In *The Promise of Infrastructure*, edited by Nikhil Anand, Akhil Gupta, and Hannah Appel, 175–202. Durham, NC: Duke University Press.

Leitner, Helga, Emma Colven, and Eric Sheppard. 2017. "Ecological Security for Whom? The Politics of Flood Alleviation and Urban Environmental Justice in Jakarta, Indonesia." In *The Routledge Companion to the Environmental Humanities*, edited by Ursula K. Heise, Jon Christensen, and Michelle Niemann, 194–205. York: Routledge.

Lin, Mayuri Mei, and Rafki Hidayat. 2018. "Jakarta, the Fastest-Sinking City in the World." *BBC*, August 13. Accessed May 15, 2020. https://www.bbc.com/news/world-asia-44636934.

Mahomed, Raheela. 2020. "Most of Jakarta's Coastal Areas Could Be Submerged By 2050." *Al Jazeera*, January 11. Accessed May 10, 2020. https://www.aljazeera.com/news/2020/01/jakarta-submerged-2050-200111104332173.html.

McFarlane, Colin, and Jonathan Rutherford. 2008. "Political Infrastructures: Governing and Experiencing the Fabric of the City." *International Journal of Urban and Regional Research* 32 (2): 363–374.

Meehan, Katie M. 2014. "Tool-power: Water Infrastructure as Wellsprings of State Power." *Geoforum* 57: 215–224.

Mohsin, Anto. 2015. "Jakarta Under Water: The 2007 Flood and the Debate on Jakarta's Future Water Infrastructure." *Journal Wilayah dan Lingkungan* 3 (1): 39–58.

Munk, David. 2016. "Jakarta's Eco Future? River Community Goes Green to Fight Eviction Threat." *The Guardian*, November 24. Accessed June 20, 2019. https://www.theguardian.com/cities/2016/nov/25/jakarta-kampung-tongkol-eco-future-river-community–green-to-fight-eviction-threat.

Nixon, Rob. 2011. *Slow Violence and the Environmentalism of the Poor*. Cambridge, MA: Harvard University Press.

Onggokusumo, Ricky, and Julia Carr-Catzel. 2020. "Jakarta Under Water." *SBS*, January 3. Accessed June 22, 2020. https://www.sbs.com.au/language/english/audio/jakarta-under-water.

Ranganathan, Malini. 2014. "'Mafias' in the Waterscape: Urban Informality and Everyday Public Authority in Bangalore." *Water Alternatives* 7 (1): 89–105.

Roy, Ananya, and Aihwa Ong. 2011. "Introduction." In *Worlding Cities: Asian Experiments and the Art of Being Global*, edited by Ananya Roy, and Aihwa Ong, 1–26. Chichester: Wiley.

Rukmana, Deden. 2015. "The Change and Transformation of Indonesian Spatial Planning After Suharto's New Order Regime: The Case of the Jakarta Metropolitan Area." *International Planning Studies* 20 (4): 350–370.

Schwenkel, Christina. 2015. "Spectacular Infrastructure and its Breakdown in Vietnam." *American Ethnologist* 42 (3): 520–534.

Schwenkel, Christina. 2018. "The Current Never Stops: Intimacies of Energy Infrastructure in Vietnam." In *The Promise of Infrastructure*, edited by Nikhil Anand, Akhil Gupta, and Hannah Appel, 102–129. Durham, NC: Duke University Press.

Scott, James. 1998. *Seeing Like a State: How Certain Schemes to Improve the Human Condition Have Failed*. New Haven: Yale University Press.

Sedlar, Frank. 2016. "Inundated Infrastructure: Jakarta's Failing Hydraulic Infrastructure." *Michigan Journal of Sustainability* 33–45. Accessed June 3, 2020. https://quod.lib.umich.edu/cgi/p/pod/dod-idx/inundated-infrastructure-jakartas-failing-hydraulic.pdf?c=mjs;idno=12333712.0004.004;format=pdf.

Sherwell, Philip. 2016. "$40bn To Save Jakarta: The Story of the Great Garuda." *The Guardian*, November 22. Accessed April 20, 2020. https://www.theguardian.com/cities/2016/nov/22/jakarta-great-garuda-seawall-sinking.

Silver, Jonathan. 2015. "Disrupted Infrastructures: An Urban Political Ecology of Interrupted Electricity in Accra." *International Journal of Urban and Regional Research* 39 (5): 984–1003.

Sneddon, Christopher. 2015. *Concrete Revolution: Large Dams, Cold War Geopolitics, and the US Bureau of Reclamation*. Chicago, IL: University of Chicago Press.

Star, Susan Leigh. 1999. "The Ethnography of Infrastructure." *American Behavioral Scientist* 43 (3): 377–391.

Starosielski, Nicole. 2012. "Warning: Do Not Dig': Negotiating the Visibility of Critical Infrastructures." *Journal of Visual Culture* 11 (1): 38–57.

Suhartadi, Imam. 2019. "Anies: Water Privatisation in DKI Faces Three Main Problems." *PwC Indonesia*, February 13. Accessed June 22, 2020. https://www.pwc.com/id/en/media-centre/infrastructure-news/february-2019/water-privatisation-in-dki-faces-three-main-problems.html.

Tarrant, Bill. 2014. "Special Report: In Jakarta, That Sinking Feeling Is All Too Real." *Reuters*, December 22. Accessed May 10, 2020. https://www.reuters.com/article/us-sealevel-subsidence-jakarta-sr/special-report-in-jakarta-that-sinking-feeling-is-all-too-real-idUSKBN0K016S20141222.

Wade, Matt. 2018. "Hyper-planning Jakarta: The Great Garuda and Planning the Global Spectacle." *Singapore Journal of Tropical Geography* 40 (1): 158–172.

Walton, Brett. 2015. "Here Comes the Sea: The Struggle to Keep the Ocean out of California's Coastal Aquifers." *Circle of Blue*, September 23. Accessed May 4, 2020. https://www.circleofblue.org/2015/world/here-comes-the-sea-the-struggle-to-keep-the-ocean-out-of-californias-coastal-aquifers/.

Wijaya, Callistasia Anggin. 2018. "Expert Urges Jakarta To Focus on Adding More Green Spaces." *The Jakarta Post*, March 8. Accessed April 24, 2020. https://www.thejakartapost.c/news/2018/03/08/expert-urges-jakarta-to-focus-on-adding-more-green-spaces.html.

Wright-Contreras, Lucía, Hug March, and Sophie Schramm. 2017. "Fragmented Landscapes of Water Supply in Suburban Hanoi." *Habitat International* 61: 64–74.