5. LEAKS

"Water supply is difficult for a normal person to understand," Haresh, a charismatic water engineer based in Mumbai, told me in late 2007 as I spoke with him about the city's water system and its ongoing privatization initiative. He suggested that attempts to measure the quantities of water flowing through city pipes were always already compromised. "When you are dealing with water, you are dealing with an approximation," he explained. "Because management consultants don't understand this most basic fact about water, all their projects fail. Management consultants focus on the financial aspects and lose perspective of the technical constraints of water. That's why the K-East project failed. . . . If you look at privatization . . . anywhere that management consultants have gone, these projects have failed. . . . The government is the other devil. It's not in its interest for water supply to succeed."

In his categorical dismissal of the work of both public and private water managers, I was surprised to hear Haresh speak of water as an approximation. As a rather basic element with little variation, I (like policy makers) had imagined water to be especially amenable to calculation and hydraulic modeling as H_2O—conducive to being governed as a relatively homogenous, known material from a distance.[1] In fact, in learning about Mumbai's water system, I was overwhelmed by the calculations necessary for its production—from figures for daily demand to more mundane numbers of pipe widths, water levels, and pressure needed to make the water flow to diverse residents. Haresh, however, was telling me that it was critical to see water's variously generated numbers as representing not verifiable quantities but approximations. As approximations, the numbers concealed both the city's prolific water leaks and the beneficiaries of these leaks (residents, state officials, and its different wells) in the city.

Haresh had intimate knowledge of water's peculiar ways. On the one hand, he experienced its fickle appearances in his taps as one of Mumbai's residents. On the other hand, he had recently concluded a study as a consultant for the World Bank–sponsored Water Distribution Improvement Project (WDIP) in K-East ward. As part of his study, Haresh found substantive leakages in the city's water network. He and his colleagues provided figures to suggest that over a third of the city's water was "leaking" both into the ground and to residents drawing water through unauthorized connections. Yet the numbers he had provided were tremendously contentious. Embarrassed by the figures of extensive leakage that his study produced, Mumbai's water department engineers dismissed the figures and, by extension, the World Bank project as a fraudulent, thinly veiled attempt to privatize the city's water supply.[2] When we met amid the controversy, Haresh acknowledged that this could be one unanticipated effect of his efforts to audit the ward's water flows. While wishing to distance himself from the political controversies generated by his measurements, he nonetheless continued to emphatically stand by them.

In his work, David Nugent has urged an attention to the moments when political rule stumbles: "Much can be learned about state formation by examining moments in which political rule falters or fails, for it is then that the lineaments of power and control, that otherwise remain masked, become visible" (2010, 681). In this chapter, I investigate how and why engineers have stumbled through efforts to measure and manage leakages. Engineers know about water leakages and yet are unable to either measure or prevent them. As they rush around the city attempting to fix leaks that they are only occasionally able to find, identify, and repair, their difficulties point to the powers of social and material relations that constitute the city's water infrastructure.

The qualities and quantities of leakage slide quickly and perniciously between various types of ignorance—the not-as-yet known, the forgotten, and the unknowable. As such, they become very difficult to map, count, know, and contain through the audit technologies of state officials (Strathern 2000). Leakages are seldom easily brought into control, nor do they always serve as a site for the exercise of state power. Instead, as they also often compromise and interrupt the work and form of the knowing state, leakages trouble the form and formation of government. As unstable, uncontrollable flows of water, leakages interrupt the performances of the authoritative, knowing state with a powerful reminder of the obduracy of water and the infrastructures that form, channel, and deliver it to the city.

In recent years, scholars in science studies and geography have drawn attention to the politics of infrastructural systems we live "with," and have also urged we consider nonhumans as actants in our political cultures.[3] For instance, Jane Bennett has urged an attention to not just the social but also the material actants that form infrastructure. She shows how electricity grids are "living, throbbing confederations" of human and nonhuman relations "that are able to function despite the persistent presence of energies that confound them from within" (Bennett 2010, 24). In this chapter, I draw attention to the way that urban water infrastructures are composed of not only the political regimes of humans in the present, but also the politics accreted in the materials and histories of the city's water infrastructure (Bennett 2010, 29). Yet water and its infrastructures do not act and perform beyond the regimes of human responsibility. Indeed, the very appearance and disappearance of leaking water in the city demonstrates how its form cannot be disaggregated from the humans who manage it in everyday life.

24/7 Mumbai

Over the last one and a half centuries, Mumbai's water system has been extended and managed amid heightened concerns over water scarcity (see chapter 1). Engineers frequently rearrange the city's water network and schedules so as to ensure that water continues to reach its residents. When engineers spoke of severe, citywide water shortages, they described how these schedules were frequently rearranged to ensure some kind of equity. They took these schedules very seriously—combining their intuition and experience to determine how a particularly bewildering combination of valves, pipes, and timings would work for their districts (see chapter 3). Faced with the state of this leaky infrastructure, municipal administrators, state government politicians, and central bureaucrats have recently initiated dramatic urban development programs to "fix" the system and make water available continuously.

The project to ensure continuous water supply is not merely an attempt to make water available for more hours in a day. Thus, for Srinivas Chary, director of the Centre for Energy, Environment, Urban Governance and Infrastructure Development (and one of India's most prominent proponents for 24/7 water supply), 24/7 is not an outcome whereby more water becomes available to residents anytime. Instead, it is a result of a series of steps, including hydraulic and technical modeling, leakage reduction transformations in customer attitudes, and financial restructuring, that are essential to modern water supply systems.

As such, 24/7 water systems entail new relations among engineers, consultants, and residents. They call for new relations between the state, the consumer, the citizen, and the market (see von Schnitlzer 2008). For Chary, and indeed many of the project's advocates, a 24/7 water system is just not about providing unlimited water to residents. It is a water system that also promises to shift the locus of regulation from city water engineers (who regulate water supplies by regulating water time in Mumbai) to the city's residents (who as consumers, would regulate their consumption by trying to reduce their water bills). Thus, the proposal to create a 24/7 water system is also a proposal to create a new kind of political subject in the city—the careful consumer who is aware of and moderates his or her consumption based on water's price.[4]

Despite Chary's enthusiasm, the "series of steps" required to make water supply "continuous" have been deeply contested not only by urban citizens unwilling to pay higher prices for water (see chapter 3) and by state officials in urban administrations. The 24/7 water projects have also been challenged by the significant degree of water leakages in the city. Left unchecked, leaky pipes lose significantly more water in a 24/7 system than in an intermittent system (where leaky pipes are turned off for most of the day), and quickly make the regime unviable.[5] Accordingly, Chary and many other experts agree that leakage reduction is a necessary first step for making a 24/7 water network.

Nevertheless, in Mumbai and indeed in many other cities around the world, it has been very difficult to even measure leakage (let alone reduce it).[6] Confronted with intransigent water officials, difficult water flows, and a public that is ambivalent about the effects of 24/7 water supply, one official at the Ministry of Urban Development in Delhi confessed that the situation was "hopeless" and that he has urged his colleagues to "forget about 24/7 supply."

Why are hydraulic engineers, who spend their professional lives operating and maintaining urban water infrastructures, opposed to 24/7 water or to leakage reduction? Why are those pushing for urban "reforms" so invested in 24/7 supply? And finally, what might leaking pipes tell us about the constitution and contestation of political responsibility in the city? To explore these questions, and what they mean for our understanding of urban government, it is important to investigate the ways in which infrastructure and leakage are managed and maintained in everyday life.

Knowing Leakage

Engineers have repeatedly cited inadequate sources and the "scarcity problem" to explain why 24/7 projects cannot work. Yet, through preliminary calculations based on government documents I have reviewed, it appears that there is enough water entering Mumbai for *all* residents of the city. Consistent with the diagnosis provided by Haresh (quoted at the beginning of this chapter), the "water shortage" problems can be largely attributed to "leakages"—flows of water in city pipes that are not fully authorized, controlled, and known by city authorities.

Formally, the BMC has reported leakage figures of approximately 25 percent. Yet, with over half the city's water meters out of service, it is unclear how this figure has been calculated. I heard the figure in several interviews with city engineers, and saw it cited in city papers. Yet during more than a year of fieldwork, I never learned how the water department calculated leakage when the tools and meters of measurement were silent and unreliable.

I gained some insight as to how this figure was determined when I visited Mr. Karmarkar's office at the municipal headquarters one day. Karmarkar was a deputy hydraulic engineer in Mumbai, second only to the city's chief hydraulic engineer. His office was responsible for calculating and projecting the large numbers that moved Mumbai's water system. Though he was quite senior, Karmarkar's office was small, and since we last met he had rearranged his furniture. His desk was turned ninety degrees and no longer faced the door. When I entered, Karmarkar was going over some figures with his junior engineer. Trying to make conversation, I asked about the new office arrangement. Without looking up from his papers, Karmarkar pointed to the place above where his desk once sat. The column had a deep structural crack, and above it, the ceiling was beginning to give way. Pieces of plaster had fallen off, revealing the rusty iron *salias* (rebar) that lay below them. "Why take a chance?" he said wryly. Noticing the precarious state of his workspace, where the roof could, quite literally, fall on his head, I wondered aloud whether remaining in the office was taking a chance. Yet the state of his office did not seem to bother Karmarkar *too* much. Like many engineers who had worked for decades in city offices, he did not make a fuss about his working conditions. He managed.

Karmarkar was busy with an engineer from the billing and metering office, going over the city's water distribution figures. The city had recently begun charging metered users "telescopic" water rates, according to which consumers with higher volumes of consumption paid more per unit of water used. He then went on to calculate leakage, writing out figures on a piece of paper.

i.	Water supplied through metered connections	2079 MLD
ii.	Water supplied through unmetered connections	500 MLD
iii.	Therefore total supply	2579 MLD
iv.	Total water delivered to Mumbai	3280 MLD
v.	Unaccounted for water	700 MLD
		=20 percent of total supply

This very basic calculation of water leakage was frequently iterated in newspaper stories about the city's water. The leakage figure was a sum of the water quantities from a series of different connection types (metered/unmetered), measured against the water delivered to the city. What these figures pretended to know are the quantities of water that are distributed throughout the city. However, these measures are dependent on reliable technologies of counting, which, simply put, are not at work in Mumbai.

For instance, most of the meters on the city's water connections (60 percent by one estimate) are not working. Without access to a reliable measure of how much water has been consumed by customers on these connections, water department officials frequently estimate these quantities for the purposes of billing. As a result, many residents get water through metered connections by paying what is effectively a flat (estimated) rate. Second, water meters have been installed only on newer water connections (i in Karmarkar's list above). For connections that were approved and granted prior to the implementation of water meters, customers pay fixed water rates (based on the ratable value of their property, ii). While these water connections frequently deliver significant revenues to the government, the water quantity they disperse is not measured by volume and is frequently estimated. As I watched Karmarkar tentatively pencil in a value in the row for unmetered connections, I wondered whether this neat, round number—500 million liters per day (MLD)—was inscribed by estimating what would eventually ensure a comfortable and respectable figure for the city's "total water supply" (iii) and, by extension, its unaccounted-for water (v).

Numerical fictions such as these are powerful, not least because they produce the city water department as a well-performing water utility. International norms, including those that are used by the World Bank as well as those used by the Centre for Energy, Environment, Urban Governance and Infrastructure Development in Hyderabad, indicate that unaccounted-for water should be around 20–25 percent and not significantly higher. In fact, this is likely why the city's water leakage figure is said to be 20 percent. By producing a figure in this range, the city water department is able to demonstrate its efficacy as a utility that does not need any external intervention from the federal Ministry of Urban Development or the World Bank.

Not accidentally, the fiction began to unravel when Haresh and the World Bank consultants began to conduct water audits as part of the reform initiative. By measuring water flows in non-supply hours in a single ward, the consultants calculated that approximately 35 percent of K-East ward's water was leaking. Yet, in the absence of universal, working water meters, the consultants, like the city engineers, were also compelled to derive the quantities of water consumption (and thereby also water leakage), using speculative modes of reasoning. Thus, even in the audits conducted by the consultants, water was more frequently estimated than measured.[7] In this respect, the consultants' extrapolations of leakage appear rather similar to engineer Karmarkar's derivations of water loss noted at the beginning of this chapter. They were brought into being by the assumptions embedded in their protocols (see Anand 2015).

Particularly given their political potency, the consultants' leakage figures were relentlessly scrutinized by the engineers of the water department. Engineers questioned the assumptions embedded in the consultants' leakage measurement protocols, the methods used to calculate leakage, and tools to measure water flow. City engineers questioned the objectivity of the numbers. They wondered aloud whether the significant measure of leakage derived by the consultants had anything to do with their desire for a water distribution contract. In the press conferences that followed the release of the study, engineers announced that the consultants were not able to successfully measure water leakages in the city. When newspapers featured the story in the following days, they announced to the city's public that Castalia Strategic Advisors, the consultancy firm, "has been unable to calculate the amount of water the ward [lost] to leakages" (S. Rao 2007).

The measurement of leakage, therefore, was not independent of the social-political context in which it was sought to be established. For the consultants, measurement promised a point of entry for a much larger intervention on the water distribution system (Bowker 1994). City engineers, meanwhile, insisted on the veracity of their measuring practices, in part that they could continue to claim an effective management of the city's water distribution infrastructure. In this controversy, both engineers and consultants found it difficult to stabilize quantitative facts about the city's water (Harvey and Knox 2015).

Thus the difficulty of measuring water was not an effect of technical incompetence. Neither were the fuzzy numbers generated to measure leakage solely the result of a politically motivated ignorance and knowledge.[8] As I watched both the consultants and engineers work hard and fail to stabilize the measure of water leakage in the city, it seemed apparent that their difficulties also brought into view the difficulties of measuring water embedded in the subterranean pipes of the city's water infrastructure (Muehlmann 2012). Measuring water in pipes is difficult for a variety of reasons—reasons that also constantly compromise the power engineers have to govern water by measure.

Measuring Responsibility

In her work with the epistemology of physicist Niels Bohr, Karen Barad has insisted that measurement practices are not as clear and distinct as Newtonian approaches would suggest. Barad challenges classical assumptions that objects and observers occupy distinct physical and epistemological locations and that matter, as such, is available for measurement by humans wielding tools, meters, or microscopes. She suggests that the technologies of measurement are not independent of but part of the phenomena they seek to apprehend. Water, meters, engineers, and pipes, for Barad, are but parts of a single-acting phenomena, where "the objects of knowledge are participants in the production of knowledge" (Barad 1996, 163). For concepts such as leakage to appear evident, stable, and objective, a Cartesian cut that defines fixed subject, object, and context needs to be able to be performed consistently and reliably enough that the conditions necessary for measure appear fixed, constant, and taken-as-given (see Latour 2005; Poovey 1998).

Barad's insights on the labor and conditions necessary for measurement are helpful to understanding the difficulty of measuring water leakages in Mumbai. Leakage emerges as such in a particular, historical effort to govern the flow of water. Without engineered pipes that are designed to be water tight, there is no such "thing" as leakage (Schrader 2010).[9] Water wells, for instance, do not leak; that water seeps through earth is a condition of their possibility. Leakage is brought into existence through certain technological imaginary of controlling water flows. Further, even in engineered systems, the concept of leakage is not ahistorical or natural but emerges as a "matter of concern" in Mumbai at a particular historical moment (Latour 1996). The interest in measuring and governing water leakage in Mumbai (and indeed in the world) proliferated amid projects to make things countable by neoliberal technologies (see also Bjorkman 2015).[10] For water leakages to be made visible and measured by water meters, however, the proponents of leakage reduction need to assume that water flows are discrete and knowable through independent, verifiable measurement practices. They need to assume that the tools of measurement—water meters—are reliable, objective, uncontroversial devices that can apprehend and deliver reliable results through their operation.

Mumbai's water infrastructure is anything but a stable, knowable form that enables uncontroversial flows. Instead, as water is made to flow through the system in pulses of intermittent supply, changing direction every few minutes and leaking to unauthorized human and nonhuman others, the political situation of the city's water infrastructure regularly muddies the distinction between objects, subjects, and context. Water only flows in certain pipes at certain times, and water pressure at any given location spikes and tapers throughout the day, making it difficult to measure volumes using flow calculations.

Water also appears and disappears in ways that are difficult to map. Because over a million settlers are denied water through city water rules, residents work with engineers, plumbers, and city politicians to ensure they quietly receive water through special and discreet favors, the measure of which engineers, politicians, and plumbers alike are actively involved in concealing. Even water meters are not stable and neutral arbiters of measure. They are known to be unreliable across the world.[11] In the water audit, the fickleness of the meter became visible when engineers and consultants argued about which *kind* of meter was more reliable and appropriate to use in the measurement exercise. Finally, the engineers disagreed with consultants about the boundaries of the system they proposed to study when the network of city water mains did not neatly map onto the political boundaries of the municipal ward. The water the meters measured was not just consumed in the political boundaries of the ward but also traveled from one ward to the next. This resulted in a bitter dispute about how much water was being consumed by residents of K-East ward, how much leaked, and how much water "moved on" to be consumed by residents in other wards.

Taken together, engineers and consultants found it difficult agree on the techniques of measurement, the assumptions of their measurement models, and the choice of meters that were used. Amid an unstable set of enabling conditions and technologies of measurement, both the engineers and the consultants could only generate figures that were too provisional, and too interested, to be considered reliable.[12] Not wanting to be embarrassed by the degree of water leakages in the city that the consultants were finding, engineers relentlessly questioned the assumptions and context of the measurement models the consultants used. Given the unstable situation of their measurements, the consultants did not always have the answers. While they were unable to stabilize leakage figures in the city, the controversy over the leakage figures did succeed in straining relations between the engineers and the World Bank consultants.

Yet if the controversy over water leakages revealed the precarity of measure, it also called for a different accounting of responsibility for water leakages in the city—one in which we may consider the role of nonhuman actors.[13] In his examination of engineering and expertise in Egypt in the early twentieth century, political theorist Timothy Mitchell has critiqued the tendency in the social sciences to privilege the role of humans in our accounting of historical events. "One always knows in advance who the protagonists are," he protests, as he peruses histories of dam making in Egypt during this period. "Human beings are the agents around whose actions and intentions the story is written" (Mitchell 2002, 29). Yet, as Mitchell attends more closely to the histories of hydraulic engineering, he demonstrates how expertise was subject to the "ambivalent relations" between mosquitoes, wars, epidemics, famines, and fertilizers. The expertise of dam building was produced on-site, as engineers confronted and sought to mediate different human and nonhuman forces.[14]

By suggesting that chemicals, mosquitos, and crops were historical actors, Mitchell follows scholars in STS who have urged that we disassemble constitutive distinctions between humans and nonhumans, nature and culture, subject and object in theorizing social and political life.[15] As was evident in the water audit, the distinctions between subjects and objects are historically situated, interested ways of ordering the world. They give special status and form to human agency. The failure of the water audit made evident how human bodies, water, pipes, and water meters are not already constituted subjects or objects. As water is made to flow in pipes to hydrate human lives that produce the technologies of distributing and measuring water, an attention to the iterative process reveals how infrastructures, natures, and humans are actively co-constituted through emergent relations *with* each other.

Following a series of large infrastructural breakdowns, new materialist scholarship has suggested we think more modestly about the powers that humans have in controlling and managing the worlds that we make. Indeed, even as humans play a vital role in structuring infrastructures, infrastructures are processes that are constantly productive of relations that exceed human control. As such, they challenge humanist framings of agency and compel us to think more humbly about the power of human agency to manage the tremendous force of the infrastructures we create.[16]

For example, in her account of the massive electricity blackout on the east coast of the United States in 2003, Bennett refuses to hold any single law, corporation, or regulatory authority responsible for the event. Instead, she suggests that the kind of agency that her theorization of the blackout makes visible "is not the strong kind of agency traditionally attributed exclusively to humans. . . . The contention, rather, is that if one looks closely enough, the productive power behind effects is always a collectivity" (Bennett 2005, 463). For Bennett, the blackout that affected more than fifty million people did not just occur because of the corporate modes of running electricity infrastructures at near capacity, the special interested laws of the state, or even just a software glitch. It occurred also because reactive power, a kind of electricity, was also made "to travel too far" by an emergent political regime whose human protagonists working in energy companies were overly preoccupied with cost and capacity efficiencies (Bennett 2005, 454). To understand the blackout, Bennett suggests, we also have to acknowledge the agency not of individuals, but of assemblages; an agency that emerges from human- nonhuman relations.

In drawing attention to the ways that electricity acts despite and with human designs for its control, Bennett's work demonstrates how we inhabit a world that, while already terraformed by humans (Masco 2014), is not one that is easily controlled by modern political institutions. While urban planners, government officials, and engineers have long designed infrastructures to be centrally controlled by bureaucratic institutions (Scott 1998), Bennett's work suggests that modern technopolitical forms are nevertheless compromised by the intransigence of their accreted material politics, and the excesses that form them (see also Collier 2011).

As new materialists have drawn attention to the vital powers of nonhumans in the production of catastrophic events, their work has been criticized by postcolonial scholars who worry that questions of political and social difference might be overlooked as we identify nonhumans as political actors.[17]

Critical humanists worry that assigning agency to electrons, water, or pipes risks eviscerating the "special responsibility" that humans have in governing resources and arbitrating over critical questions of distribution in everyday life (Appadurai 2015).[18] Thus if "a materialist analysis of politics is one which must attend to the resistance of matter to political control" (Barry 2001, 26), critical humanists are concerned that these attentions deflect from an attention to political practices of social differentiation at best, or explain away social difference as caused by nonhuman matter at worst.

An attention the power of Mumbai's hydraulic infrastructures does not entail a form of material determinism that critical theorists are rightfully cautious of. In focusing on the actions of the city's leaking water pipes, I do not suggest that their materialities are the cause of social difference (or leakage) in the city, nor do I ascribe "naturalness" to their political form. Instead, I wish to understand why engineers are unable to account for leaks, and how in the absence of this measure they act and authorize water flows in the city.

In Mumbai, engineers seek to manage and control the city's water infrastructure and to make water known and flow in predictable ways. Nevertheless, they are unable to constitute and measure water as a stable object that flows through the city's water infrastructure. Its surreptitious and unnoticed flows—into the earth or the bodies of differentiated residents—make it difficult to control through audit technologies. I do not wish to suggest that engineers are unaccountable for the city's water infrastructure, or that they are able to escape the political consequences of the inequitable distribution regime they manage. They design the city's water infrastructure to deliver less water to residents of the settlements (chapter 1). These residents of the city would frequently hold its urban administration and its political apparatus responsible for the difficulties they had accessing water in everyday life. As Kregg Hetherington points out, "responsibility is less a characteristic of people than a form of description that one offers of the relationships between different actors in an event whose causal sequences are not merely mechanical" (2013, 71). Engineers consider themselves, and are considered by publics, to be responsible for water distribution issues in the city.

What is less clear is how engineers are able to act and manage a leaking system that is always on the verge of being beyond their control. Recognizing that their power, measure, and knowledge are compromised in this vibrant system, Bennett's theorization of distributive agency helps us understand why engineers—the measurers of all things—do not spend much time measuring water consumption or leakage in the city. Instead, they govern leakage by crafting heterogeneous and improvised sociotechnical practices.[19] Their work acknowledges the vitality and vibrancy of human and nonhuman actors and the difficulties they have in managing them. Their work also demonstrates how material technologies are neither autonomous of human-centric notions of agency nor encompassed by it.[20] Engineers do not rule *over* the city's water system. In their quotidian efforts to control leakages, engineers "manage" water leakages as compromised and compromising experts. They manage leakages much as Karmarkar did his roof—by moving out of the way, or by making discrete and situated compromises with water's fickle flows.

Managing Leakage

As they work to address the thousands of leaks that fill their schedules every day, engineers in the city's ward offices are only too aware that governing water is difficult precisely because of the deeply ambivalent, unknown, and fungible relations between what is apparent and what is real, between what is physical and what is social. As a result, they are not too concerned about measuring leakage. Instead, they are very busy fixing leaks to keep the water system working.

Take, for instance, K-East ward, one of twenty-four wards in Mumbai. The ward has a population of more than 800,000 residents and is twenty-eight square kilometers in area. In the process of studying the ward for their privatization initiative, Castalia, the management consultants, collated the number of leakages that people *complained* about. Nearly three thousand leakages were reported throughout the ward in one year alone; more than six hundred were classified as "major joint leaks and bursts." This is to say that more than eight leakages were reported every day in K-East ward alone. This figure did not include leaks from customer service lines that also resulted in complaints. Because city engineers respond to these leakages less urgently than bursts on larger and more significant trunk mains, smaller connection leakages actually cause a greater loss of water from the system than bigger bursts (Kingdom, Liemberger, and Marin 2006).

Confronted with thousands of leaks per year, engineers speak of their department as functioning by "fire-fighting" and attending only to the problems that—for social, political, and material reasons—are impossible to ignore. Nevertheless, they are challenged in their effort to do so. Engineers frequently report that their work of leakage reduction is compromised by a lack of qualified engineers in the department. The city administration's hiring freeze—a consequence of state policy intended to shrink the size of the

TABLE 1. Complaints received, attended, and completed in K-East ward, 2004–2005

Month	Connection leakage	Major joint leaks and bursts	Contamination	Short supply
April	253	48	16	123
May	260	54	10	132
June	235	69	9	121
July	243	62	10	141
August	247	47	12	124
September	248	62	12	127
October	288	44	9	123
November	277	56	9	131
December	271	58	9	117
January	283	61	14	137
February	295	63	19	123
March	283	57	15	142

Source: Leak burst data, K-East WDIP, Municipal Corporation of Greater Mumbai.

public sector—has meant that several engineers' posts have remained vacant for years (*Mumbai Mirror*, October 5, 2007; Bjorkman 2015). In K-East ward alone, with a population of over eight hundred thousand residents, only six engineers are available to manage the entire ward's water supply, including fixing its three thousand leakages. Engineers, therefore, can only attend to the major problems. The rest of the water just leaks away.

With their hands already occupied with known leakages, engineers do not spend much time looking for unknown leakages, not least because of the material and technological barriers to finding leaks. As pipes rust, break, or rupture underground, many leakages go unnoticed and unreported. Because the city is largely built on wetlands, much water leaking from the underground mains flows away without giving notice. Sometimes, these leaks produce spectacular effects. Left unattended for years, they eat away at the earth and eventually cause random and chaotic sinkholes in the city, a phenomenon that only too vividly reminds the city's residents that the firmness of the city's ground is contingent on the subterranean flows of water within and beyond the pipes of the city. Take, for instance, this news article from 2008, which describes the way that a sinkhole swallowed cars in the city:

> The Saat Rasta crater incident that has served as an eye-opener for the civic authorities—and a nightmare for citizens—may be just the beginning of problems in store for Mumbaikars. That's because the entire island city rests on a hollow surface due to multiple pipeline leakages underneath which are steadily causing soil erosion. This is paving the way for more horror holes, which if not plugged in immediately, will give room for similar incidents to reoccur.
>
> Madhukar Kamble, BMC hydraulic engineer, said, "We adopt a technique to detect the leakages underground. But due to the cluster of utilities, magnetic waves often fail to identify the exact leakage spots." He also revealed that failure of magnetic detection is also largely due to the noise levels in the city. For effective implementation, one requires silence to capture the sound waves. In Mumbai, this is possible only at night. However, at night due to the absence of water flowing through the lines, it becomes next to impossible to find faults in them. (Mhaske 2008)

"Horror holes" are caused by the large leakages in their city's underground water mains. The news article also points to the difficulty in detecting leaks given the material situation of the city's water infrastructure. For instance, a common method for detecting leaks involves using sonic equipment, which, placed over pipes or valves, can isolate and register the peculiar sound made by a leaky pipe. But here, too, engineers dismissed their efficacy in the peculiar "context" of Mumbai. Sonar (and magnetic) technologies only work when there is little background noise, when no one is using the road. Yet water largely flows in Mumbai's network during the day, at which time the streets are filled with the sounds of cars and traffic, of commuters and the city. Engineers complain that the city produces too much noise, rendering sonar technologies ineffective. Sonic technologies are harder to use at night because water does not flow through the pipes at night.[21] Other cities detect leakages using pressure monitors, by monitoring for sudden drops in pressure. However, pressure monitors are compromised by the intermittent system, because the water pressure in the pipes is always changing. As valves are constantly opening and closing, the changing pressures stress the instruments and cause them to break down. Even when instruments work, engineers complain that they are unable to tell whether the drop in pressure is due to leakage or because of valves turning upstream or downstream of the monitors in the varying, dynamic system.

Subterranean Hydraulics

Haresh, the engineer, had spoken of the technical constraints of water. When you are dealing with water, he had said, you are dealing with an approximation. Indeed, as I came to learn more and more about the water service system in Mumbai, I realized that the city's water infrastructure delivers and produces not known quantities of water but approximations. In Mumbai, the materiality of water and its infrastructures entailed these approximations. Because water infrastructure needed to be used and maintained at the same time, fixing the hydraulic system takes extraordinary work that can be quite disruptive to those dependent on its daily operation. This is not just true of postcolonial cities like Mumbai. Take a recent article about leakage repair works in New York:

> All tunnels leak, but this one is a sieve. For most of the last two decades, the Rondout-West Branch tunnel—45 miles long, 13.5 feet wide, up to 1,200 feet below ground and responsible for ferrying half of New York City's water supply from reservoirs in the Catskill Mountains—has been leaking some 20 million gallons a day. [To fix the tunnel,] the city has enlisted six deep-sea divers who are living for more than a month in a sealed 24-foot tubular pressurized tank complete with showers, a television and a Nerf basketball hoop, breathing air that is 97.5 percent helium and 2.5 percent oxygen, so their high-pitched squeals are all but unintelligible. They leave the tank only to transfer to a diving bell that is lowered 70 stories into the earth, where they work 12-hour shifts, with each man taking a four-hour turn hacking away at concrete to expose the valve. (Belson 2008)

In this spectacular story of workers who live in a submarine inside New York City's water tunnels, note the ambiguous and extreme conditions in which their work of leakage repair is situated. First, estimates of water leakage from this single tunnel are significant (around twenty million gallons daily). These are only approximations, entailed by the way in which unknowns are constitutive of the urban water system. Second, the article shows how leakage detection is extremely difficult work, not only because the pipes are deep underground but also because the city's residents continue to require their use even as they are being maintained. Workers needed to work in the tunnel even as water was flowing. New York, therefore, decided to fix leakages by placing divers in submarines in their water tunnel.

In some ways it is easier to fix water mains in a submarine, breathing helium, than it is to fix three thousand small, leaking service lines. Such work is not only time-consuming but also requires engineers to know the network intimately well—to understand where leakages are, employing little if any technology. As such, regardless of their seniority, Mumbai's engineers have only a partial, experiential knowledge of the distribution system and rely on field engineers to reveal its local state. I talked about the water system one day with Mr. Surve, one of the department's most senior engineers, referred to by his juniors as one of the five rajas of the city's water supply. However, when we met, I learned that even this king seemed to have only a partial grasp of the distribution system.

Always genial and friendly on the phone, it was only after months of persistence that Surve could make time to meet with me. When I arrived at his office, he was reviewing some works proposals and requested a few minutes to finish up. I utilized my time by taking in Surve's surroundings. As one of the city's rajas, he had a large office. I recognized, by now, the government-supplied, glass-topped desk (reserved for senior officers) at which he sat. The glass encased a long phone list with the cell phone numbers of all others in the department—a list essential to engineers, who delegated their responsibilities through phone calls. On the table behind him, a bundle of papers was wrapped in government-issued red cloth paper. The wall to my left displayed a large, electric model of the water network.

Working between the phone list, government documents, and a network map, Surve started by telling me Mumbai's water story. This story, which I had by now heard several times before, began with the catchment of Mumbai's water several miles away. To help me understand, he tellingly did not refer to the map on the wall but drew me one of his very own—enlarging and extending it as the story went on. The map, which he drew with some ease, was filled with pipe diameters and place names, pumps and filtration plants (see figure 14). People, even the engineers, were almost entirely absent from the account. This was a story of careful management and effective control—of directing water from dammed rivers to the water treatment plant, a massive feat of technopolitical achievement by any standard.

The map, however, became considerably more complex and hard to quantify when he began to extend it into the secondary network, in which water subsequently flowed from the treatment plant to twenty-seven service reservoirs. Up until that point, water is generally counted, and metered. By the time Surve began speaking of the tertiary network that draws water from

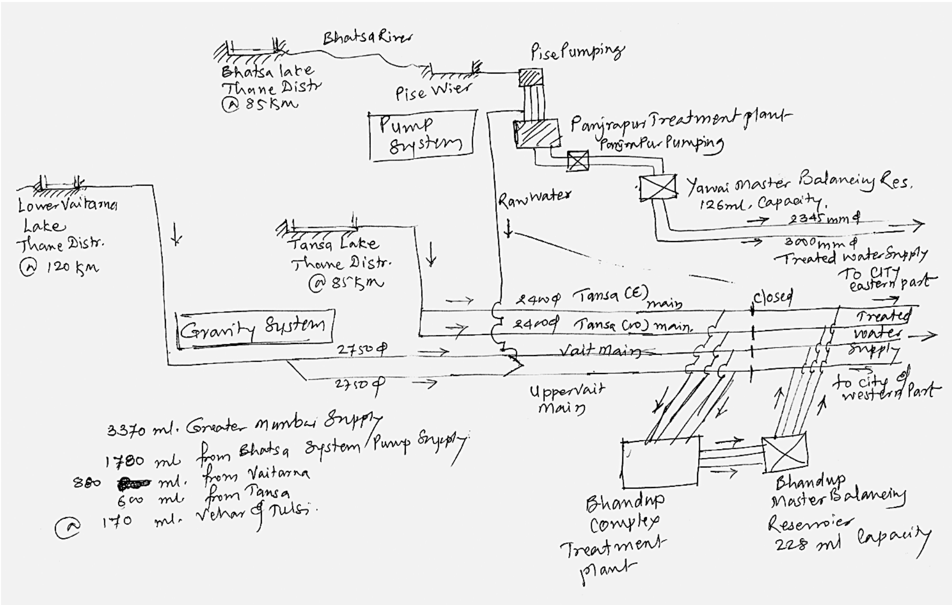

FIGURE 14. Surve's diagram of the water network.

reservoirs to the service mains, his map-making skills and knowledge of the system had reached their limit. It is these unmapped networks that are the subject of both leakage work and reform efforts.

Proponents of twenty-four-hour supply argue that tertiary networks should be continuously charged with water. But this proposition is the source of much anxiety for engineers like Surve who realize how little is known about leakages in the tertiary network. A system of 24/7 water supply would require a state of knowledge, a level of control, that he simply could not access. "We just don't know the alignment of lines in the city," he said. I asked if they had maps.

> Yes, but how far and how deep from the road [the pipes are], no one knows. There is no exact GIS to tell us this. Then, we have been searching for equipment to tell us where the leaks are. There is no equipment anywhere in the world that can tell us this. Mumbai sits on reclaimed land. . . . Therefore, the [leaking] water just goes away, it does not come to the surface. . . . There are pressure monitors. . . . But for these questions the person in the field is the best judge.

With most of the tertiary network underground, engineers have trouble locating exactly where its many parts are, much less what condition they are in. The maps they had were clearly not up to the task, and are sparingly used. The maps they do have do not contain elevation information—a critical detail necessary for water supply.

As a result, engineers draw on the experience and knowledge of their colleagues in the field for any major or minor works. Ward engineers are in a constant search to locate pipes and their leaks beneath the structures of the city. They need to know where the pipes can be found—how far from the sidewalk, how deep in the ground, whether water will climb hills and how it can do so. As Surve suggests, they are the city's pressure monitors and geographic information systems. In a city of consistent breakdowns and hydraulic difficulties, engineers must consistently gauge and judge individual problems and fashion solutions to each of them. Sometimes, retired engineers have been summoned back to work just so that they can point to where the pipes lie beneath the ground (see also Coelho 2006).

Repair

Fixing leaks is hard, necessary, time-consuming work. With most of the city's network underground, water leaking from a pipe presents both material and social challenges. Engineers use their management skills not so much as authoritarian rulers but as compromised experts, subjectified by the situations of the politics, labor, and materials of the city's water infrastructure. To ensure that the system continues to function, they need to negotiate with not only the city's pipes but also its water, residents, municipal employees, and a range of social actors that are connected to the city's pipes in a variety of ways. Thus, far from being a mechanical process, leakage repair makes visible the sociological and technical work that engineers are required to perform as they deploy their ingenuity and improvisational skill to manage the problem (Latour 1996, 33).

Like the political anthropologist, the engineer is only too aware of the ways in which his efforts to maintain the city's infrastructure is deeply situated in ambivalent social-technical environments of uncertainty, ignorance, and improvisation. For instance, one afternoon I accompanied Patankar—a water engineer who worked in a different city ward—on his "field" visits. Identified by his colleagues, seniors, and subjects as a diligent public servant, Patankar oversaw the maintenance of mains and service connections in the ward. Trained at an engineering college in a nearby city, Patankar had lived and worked in the same ward for the past twenty years. As such, he was familiar with its diverse neighborhoods and their hydraulic politics. He exercised extraordinary energy in managing and mediating knowledge of the ward's water network and took a great deal of care in deciding which leakages to attend to and which others to ignore.

As I rode on the back of his motorcycle through city traffic from the site of one water problem to another, I was struck by the way in which Patankar approached each problem with experience, an eye for improvisation, and a social intuition that he could have only learned on the job. We rode across the ward to investigate a leaky main. I had been to the line previously, just a couple of weeks prior, when city workers were patching it up. A few nights before, the pipe had burst again, and residents of the neighboring ward had not received water for two days. Patankar told me that he had been working long hours just to locate the origin of the leak. The city's infrastructure was not cooperating with his efforts. The pipe lay nearly ten meters under the surface of the street, and Patankar had told me that whenever his team tried to uncover the pipe, the sodden, marshy soil would collapse over it again. As we disembarked from the bike and walked toward the troublesome pipe, we crossed over a bridge. I noticed a different pipe running alongside the bridge, with many smaller connections protruding from it. One small connection was leaking with high pressure into the *nalla* (canal/drain) below. Patankar did not even give this pipe a second glance. With his time and expertise already stretched, he walked toward the twenty-four-inch water main, where the bigger problem lay.

We arrived at the site to find water department employees and heavy machinery already at work. A shop had once stood where the maintenance team was now unearthing the large pipe. As we paused for a moment to observe their efforts, a couple of people came up to talk to us. "Will you cut our water again?" one of them asked, referring to a two-day cut that had occurred when the pipe was previously repaired. Not suggesting that water would be cut, nor telling them it would not, Patankar assured the residents that they would be notified if this was to be the case. A second person was not as pleased. He objected to the works project and aggressively complained about how a shop had stood there for two years before it was demolished due to maintenance works. Patankar smiled and responded by asking of the absent shopkeeper: "Who told him to build a shop on a water line? Did the pipe come first or the shop?" The petitioner, somewhat silenced by the question, observed: "The pipe, of course."

As we spoke, the maintenance team was trying to find a valve that could shut off the water to the burst pipe so that they could better inspect it. Patankar walked across another bridge and, noting a thick metal sheet that lay by the side of the road, asked his four men to move it to one side. As they grunted and heaved the sheet aside, they found an opening in the ground. There, about ten feet deep, lay a layer of water, below which a manhole cover might have been visible. Patankar asked whether it might be possible for the maintenance crew to go into the manhole, and find the valve. The crew members, each of whom had firm opinions about the matter, were understandably not enthusiastic. They suggested lowering a camera to find the valve. Patankar agreed, and wondered whether this could be accomplished during supply hours, when water was flowing through the line. The junior staff disagreed. Instead, they concluded that they would come back with a camera the next day. Realizing that the issue would require another day to be resolved, Patankar said a few words to the supervisor before we left the site to attend to another problem.

This everyday work of fixing water connections drew my attention to the contingency, improvisation, and social/material mediation Patankar and other engineers frequently employed to maintain the water network in working condition. To govern water pipes effectively required not only a (very contested) *metis* for repair and recovery (Latour 1996; Scott 1998) but also an understanding of how to handle the uncertainties and difficulties affiliated with the city's water infrastructure. As Patankar and his workers struggled to locate the leak, they were required to deal with both restive political subjects and the challenges presented by the water network—the opacity of water and earth, as well as the pipe network's corrosions, containments, and concealments.

In the absence of flexible protocols that could apprehend and direct how this leak could be known and plugged, state authority was not just improvised but was also diffuse and actively negotiated between the experts, laborers, and objects of Mumbai's water infrastructure. It was not just Patankar, the senior engineer, who was an expert of the system but also his less formally trained workers. Fixing the unknown leak on the pipe, therefore, required not only the cooperation of the earth not to collapse onto the pipe every time it was revealed. It also required the cooperation of city workers who, while charged with maintenance works, had their own ideas about how this maintenance could be done. In order to maintain and govern the city's water network effectively, Patankar needed to know certain key facts about the line (where the leak was, how it might be found and patched) as well as how this infrastructure was situated in regimes of labor, nature, materiality, and the law. To fix the pipe, Patankar required an acute sociotechnical knowledge that was attentive to contingency, obduracy, and the ignorances of people and things.

Discreet States

Leakages not only emerge from the corroding materialities of the city's infrastructure. Facing demands for water from residents that they are either legally or structurally unable to serve because of exclusive city water rules, engineers and other city authorities also participate in the production of leakage (euphemistically called *social leakage*) when they permit otherwise ineligible residents to connect to the water system. As engineers tacitly sanction different kinds of connections for these groups, these leakages are not documented, nor are they visible to their superiors in the head office.

By enabling water connections while keeping the higher-ups in the city administration ignorant of these informal connections, ward engineers allow for otherwise ineligible residents to receive state services, even as they reproduce their authority as experts of Mumbai's water system. Let me illustrate this point with an example. One day, I arrived at the field engineer's office to find the city councilor there with a party worker. Patankar (the engineer) was courteous and receptive, as always. As I tried to gather what was going on, I slowly realized it was a negotiation over an illegal connection. Months before, certain tenements had been in the news for threatening the sanctity of a site of cultural importance, and the court had ordered that the tenements' water connections be cut. Patankar was compelled to follow the court's order and cut their water supply. Now, a party functionary who worked in the area had come to him for permission to reconnect the lines. Patankar responded by neither approving nor refusing his request. "What did I tell you then?" he said. "I said I have to cut the connection. After I cut it, you can do what you want."

With this single directive, Patankar fulfilled his duty as a public officer twice over. He carried out the court's order, cutting the connection, while allowing its contradiction, water supply, to continue via other means. His instruction relinquished some of his knowledge and control over the ward's water pipes to the realm of ignorance and to the party workers, plumbers, and residents responsible. This was not an exceptional incident. Engineers like Patankar were often guiding councilors and plumbers through and around its rules, marshaling the powers of ignorance and ignoring the rules when they proved too exclusive. Such practices of ignorance—"do what you want (don't tell me)"—relieved the pressure on city engineers to deliver water and pointed to important ways in which ignorance, indifference, and enforcement were arbitrarily mobilized to produce state authority in the city.[22] By allowing councilors, their party workers, and plumbers to make connections without the written approval of the water department, these practices of ignorance allowed settlers to access public services while maintaining the political authority of the city councilors whose support the engineers required.

I was not able to follow up with this party worker to learn whether he ever made the connection, and I am not sure that Patankar followed up, either. If the party worker did reconnect the water line, the water supply would return to his voting clients' homes as "leakage." This leakage and the ignorance about this leakage, produce gaps in the control of the public system—gaps that both allow people to live in the city (despite the law) and yet place them beyond the accounting regimes of the state. Unauthorized connections are often buried underground, beneath the gaze of the state, and are undocumented and uncounted by the state's knowledge regimes (bills, meters, etc.). They are difficult to expose by those who do not know about them. They are as difficult to detect and fix as discreet physical leaks in the city. As area engineers of the water department participate in the production of leakage, both engineers in the head offices of the water department and the World Bank consultants are unable to parse out how much water is leaking to unauthorized groups or even where these connections exist. Through their everyday work, area engineers in Mumbai make the city's distribution system flow by mobilizing relations of knowledge and ignorance, and leakage and repair. As they improvise solutions to keep water flowing to differentiated groups, their compromised activities make them vitally necessary to the everyday work of water supply.

In the course of doing fieldwork, I was struck by the influence councilors had over engineers and workers in the water supply department. In a telling arrangement, field engineers are not arranged in the ward by the geography of water infrastructure zones. Instead, each engineer is deputed to attend to the needs of specific city councilors. As such, they are often called upon to exercise discretionary power to attend to their requests. When councilors came into their offices, engineers would quickly smile, get up from their seat, and offer them tea and biscuits. They would listen attentively and agree to solve many problems. Almost daily, councilors had requests of the engineers—to send more water to their ward, waive unpaid bills, or arrange new connections for those who were or were not otherwise eligible for water services.

Such quotidian interactions reveal critical shifts in the relationship between the technocratic and democratic state. In Mumbai, particularly as it pertains to water supply, municipal councilors also rule its water system.[23]

As artisans of Mumbai's water system, city engineers are not very happy with its popularized state. They are rueful experts, frequently grumbling about "interference" by councilors, and are nostalgic for times when their power was not as compromised. City engineers like Gupte resent the constant and consistent intervention of councilors who always have special and specific requests for identified constituencies (see also Coelho 2006). "People use water to do politics," Gupte said. "To win in elections, they use the department as an instrument. . . . Without water they cannot win." Gupte described water as "an extremely sensitive issue" and, as such, politicians continuously insisted and demanded their constituency get more water. "But the politicians have no foresight," he said. "They don't want to understand the system, its problems. . . . They only want more water for their ward."

Engineers complain when water—a technical issue for them—becomes encompassed by the world of politics. Nevertheless, because they are dependent on councilors to approve their works contracts and careers and also because councilors can quickly mobilize protesting publics that can embarrass engineers, engineers work to satisfy councilors' requests, marshaling the powers of procedure, technics, and ignorance to do so.

Some of the connections that engineers provide on the behalf of councilors are metered, documented, and counted. Some are simply documented but not metered, while others do not even exist on paper. Finally, there are connections that are unknown even to the engineers. Sequestered and buried under the surface of the city, these surreptitious connections—like those that leak into the ground—exceed the engineers' capacities and technologies of detection. Moreover, their detection is also not always in the engineer's interest.

Plumbing the System

To be included in the public system requires some combination of cultural competency, social connections, and varying amounts of cash (see chapter 2). An attention to these arrangements requires a more nuanced understanding of how the public system works in Mumbai. The multiple locations of power and authority in the public system produce many locations at which residents can make claims (or leaks). The success of otherwise unqualified settlers in joining the system depends on their ability to mobilize their relations in the BMC to make water connections, their access to political leaders, and, finally, their ability to grease the engines and palms, with money, of the state. It is a complicated state of affairs that requires plumbers to assist in its navigation.

Maqbool, a plumber by profession, had a delicate sense of the system and how it functioned. As we sat at a roadside chai shop one day, amid traffic and in the setting sun, he explained how many settlers obtained water from the system: "It all depends on the councilor," he said. "Because Shinde [the councilor] fights [with the engineers], the people here get water," Maqbool explained. "He has been a councilor for fifteen years. The engineers fear him and do his work. Nearby, Khan is a new councilor. It's not even been five years. She has no chance [to wield that kind of influence]." Maqbool foregrounds the importance of councilors in his account of how settlers obtain water. Describing the process of making connections, he points to how engineers pay close attention to which councilor's letter of support (an implicit requirement) was attached to applications for new connections to be approved.[24] Chances were further improved if you engaged the services of certain plumbers. Each councilor had his plumbers who put applications to the Municipal Corporation, he told me. These plumbers knew how, where, and to whom money had to be passed, under the gaze (and blessings) of the city councilor.

As Maqbool told me: "They [the plumbers and the councilors] have an understanding, and [the engineers] make sure that with Shinde's blessings, connections are granted. Residents are free to choose another plumber. But they would have to deposit fees in the office for Shinde. Councilors pressure the BMC to ensure they do not give water to anyone without a letter." From the conversation, it was clear that Maqbool was not one of the councilor's preferred plumbers. His description of the public system reveals its very personal nature, one that is tied to, but not determined by, money. In a world of connections, the involvement of the councilor and the necessity of his consent produces an intimate relation between the governing and the governed.

The extremely personal and political negotiations between engineers, residents, and councilors fostering this leakage trouble the normative assumptions of public and private systems. In Mumbai, the poor are seldom just customers, nor are they citizens. They are also "helped' " through relations that sit alongside the practices of citizenship, markets, and the law. In much of the development literature, specifically about India, such "helping" practices are known through the discourses of corruption (J. Davis 2004; Witsoe 2011). Indeed settlers also often talk about these practices as corruption (Gupta 1995). While there is much we need to consider around such practices,[25] here, I want to take Maqbool's provocation seriously—that there is the money, but that it is not the only thing that is going on. In fact, those in more powerful settlements (or more powerful corporations) sometimes do not need to spend their money.[26] In Mumbai, such relations (that at times accompanies the exchange of cash) are a critical way through which settlers overcome structural denials (either by laws or everyday practices) to access the most basic entitlement of life—water. It is these corruptions—these leakages—that make it possible to live.[27]

For those living in settlements, the public system is made through personal-political relations—between residents and councilors, councilors and engineers, and the plumbers who connect them. It is a public system of favors, and one marked with relations of patronage, voting, and money. While settlers are often quite successful in mobilizing water from the public system to their homes, their inclusion in this system reproduces its inequalities and reinscribes the power of its authorities. Recognizing the state of this infrastructure, settlers in Mumbai are constantly trying to find its legitimate patrons, cracks, and fissures so as to survive. With friends and relatives, they petition city councilors and volunteers to write letters on their behalf (see chapter 2). With money, they approach plumbers for new connections to pipes that have more water. With plumbers, they arrive at the water office with a long list of documents, letters, and copies of bills and ration cards. With these relations and contacts, they know the technical geography of the network, frequently drawing pen diagrams for engineers on the backs of envelopes to argue their case. Engineers listen and consider the political geography of the proposed connection on those very same maps. Who is presenting the proposal? Who is around? Who will get less water as a result? In Mumbai, you need to create pressure to make water flow. If residents apply the right kind of pressure—through an eclectic mix of protest marches, phone calls, and petitions in the correct languages of belonging, if they sometimes introduce financial considerations—they get water, often through leaks in the public system.

Conclusion

One afternoon, I took Patankar to lunch so that we could talk a little bit more about the water system and the various causes of leakage. In the quiet, shaded, and air-conditioned environs of the restaurant, Patankar reviewed his methodology. People get angry when they do not get water, he told me.

"It's our job to find and fix the problem." He wondered aloud if the engineers of a private company might be able to do the job more effectively, given their expectations of revenue and the watertight management regimes with which they were more preoccupied. The pursuit of revenue water (or the reduction of nonrevenue water) meant that they were less willing to compromise with the materiality and politics of the system. "Even the chief engineer of the water department, a few years ago, said that he doesn't understand how the system works," Patankar said. "How will these private fellows manage?"

As Patankar described the difficulty that even the most senior and qualified engineers have in comprehending the system, I recalled Haresh's cautions about the difficulties that engineers encounter when measuring water's quantities. Despite efforts to contain, control, and manage water through large infrastructure projects, the differentiated social, material, and political histories that form these infrastructures make it difficult for state officials to know enough about and contain leakages. Engineers were constantly challenged by the relations between errant employees, nonworking meters, corroded pipes, and exclusive water laws. As they negotiated, ignored, or fixed leakages, their improvised practices revealed how the sociotechnical assemblages of water distribution lay just beyond their domains, control, and expertise.

Therefore, when Patankar managed the city's water infrastructure, he did so not by working *on* it but by working *through* it, making discrete improvisations and accommodations so that it could deliver water reliably, while remaining ignorant of the chaos of the system so that he could do his work (Scott 1998). In doing so, he revealed how the expertise of the engineer does not emerge out of his ability to operate and control Mumbai's water infrastructures as objects, tools, or technologies from a distance. Instead, this expertise emerges from very proximate, compromised relations with the materials, persons, and politics of the city's leaky infrastructure—relations that Patankar did not know everything about. The ward's water infrastructure exceeded his control. As attempts to fix leaks are often contested not just by city residents but also by the intransigence of his workers and the muddy, murky subterranean situation of earth, water, and steel, Patankar and other engineers are unable to prevent leakage in the city. They repair leakages just enough so as to maintain sufficient water pressure in the network.

In so doing, Patankar and other engineers reproduce a particular leaky form of the state. As they patch up holes on water lines or disconnect illegal connections, their work is productive of state authority. Nevertheless, as leakages persist, they also diffuse the state's authority. Pipes—as assemblages of valves, steel, laws, persons, and objects—"act" despite and beyond state power. As leakages exceed both the semiotics and politics of subjects and experts in the city, leaking pipes at times enable state formation. At others, they interrupt and lie beside state control, dispersing power and water as they do so.

Indeed, when Haresh reminds us that water has "technical constraints," he is urging us to recognize the ways in which its corporality and its relations to the city's infrastructure reveal not the limits of water but instead the limits of reform efforts in the city. City engineers recognize that their control of Mumbai's water is compromised by the fungibility of materiality and politics. They have more modest demands of its flows. One of Mumbai's most senior engineers described water supply as an "event-driven process." With their control both constituted and compromised by the leaky materialities of the city's water infrastructure, and the exigencies of democratic politics, engineers in Mumbai only try to contain the most egregious (political and material) leakages. They have expressed an inability to make the city's water infrastructure more watertight. Their inability points not only to the limits of human expertise over sociotechnical systems but also the compromised yet significant effects of democratic politics in Mumbai, particularly as they produce and encourage leaky technologies of rule. In this technopolitical environment, leakages are not an exception but a condition of Mumbai's water system; they are often easier to leave alone than to repair, seal, and foreclose.

Nevertheless, even as leakages exceed human efforts to control water flows, they do not have an existence that is independent of human technologies. Like engineers who act through water infrastructures, water only acts through relations with infrastructures as well, including engineers and "mediating technologies" they install on the network—meters, valves, pipes, and so on (see Furlong 2011). As Andrew Barry reminds us, things become political through relations (Barry 2011). Politics, therefore, always emerges as plural, through diverse relations between humans and relations with and between nonhumans. While the properties of water do matter to the events of leakage, these are not independent of human relations and human responsibility.

As such, leaks are more-than-human flows of water in that they are formed with but exceed human intentionality and action (Braun 2005; Braun and Whatmore 2011). This is not to say that leaks are impossible to diagnose and fix with existing technologies. Nor is it to say that settlers who are denied formal water connections celebrate the socially and politically mediated leakages that hydrate their lives. Instead, accreted histories of law, technology, and politics—the intermittent supply, aging pipes, laws proscribing access, fickle meters, engineers allocating water—challenge city engineers to control, count, know, and govern leakage. While leaks establish a particular form of state power, they also render that power "porous" and unstable (S. Benjamin 2005; Fuller and Harriss 2001). They make the state vulnerable not only to calls and demands for neoliberal reform and to the demands of residents denied water. As pipes quietly leak underground for years, they also corrode the very grounds upon which the state and its governmental projects stand.