Assembling the water factory: seawater desalination and the techno-politics of water privatisation in the San Diego–Tijuana metropolitan region

[Accepted for publication in *Geoforum* 27/04/2018]

Joe Williams
Department of Geography, Durham University
Joseph.g.williams@durham.ac.uk

Abstract

This paper is about the peculiar particularities of the dual trends towards urban water privatization and commodification. It uses as its analytical entry point the extraordinary emergence of large-scale seawater desalination, delivered through public-private partnerships, as an alternative municipal water supply for the San Diego–Tijuana metropolitan region. The paper engages and extends Karen Bakker's work on water as an 'uncooperative commodity'. Interrogating the neoliberalization of water through desalination, it is argued, requires reference to the socio-technical relations drawn together under the 'desalination assemblage'. Such water treatment technologies –and the social relations that flow through them– are, in other words, efficacious in the market-disciplining of water. The paper presents an understanding of privatization and commodification as diffuse, and as unfolding through multiple and contradictory materially heterogeneous relationships. Drawing on both urban political ecology (UPE) and assemblage thinking, the paper calls for a more constructive dialogue between different concepts of socio-material relationality. The empirical case studies of two large seawater desalination plants (one in Southern California, one in Baja California) and the re-configuring relations of public/private water governance associated with these projects, provides a pertinent imperative for greater attention to be paid to contingency and heterogeneity in our understanding of the ecology of capitalism.

Keywords: assemblage, urban political ecology, infrastructure, neoliberalism, water, desalination

Commodifying the Pacific Ocean

In December 2015, San Diego County, California, underwent a dramatic metabolic transition in its hydro-social cycle. After nearly two decades of planning and development, the rather arduously named *Claude 'Bud' Lewis Carlsbad Desalination Plant* began producing purified seawater for the county's growing urban economy and its 3.3 million residents. Currently the largest desalting facility in the Western Hemisphere, the Carlsbad plant has the capacity to meet 10% of San Diego's potable water demand. In a region that has historically maintained public control of water services, this billion-dollar project, as well as being an important element of San Diego's strategy to localise and diversify its water supply portfolio (SDCWA 2016), also represents a significant re-configuration of the social and political relations of water. The result of a public-private partnership between a Connecticut-based venture capitalist firm, Poseidon Resources (the project developer) and the San Diego County Water Authority (hereafter, SDCWA), the county's water wholesaler, the Carlsbad water factory produces a commodity, H_2O, from seawater, which is sold to San Diego's water users at more than double the price of established water supplies. Just along the coast, about 30 kilometres south of the U.S.–Mexico border at Rosarito Beach, the world's first 'binational' seawater desalination project – which will be double the size of Carlsbad– is currently under development. When complete, it will supply purified seawater to Mexican *and* U.S. water districts in the Colorado River basin. Again, this project will be delivered through an unprecedented partnership between the State of Baja and a company called NSC Agua (the project developer). The commodity produced at the Rosarito water factory will be sold, firstly, to Tijuana's public service department (Comisión Estatal de Servicios Públicos de Tijuana), and secondly, to U.S. off-takers by an intermediary water trading company, either by pipeline transfer (as 'wet water') or through the transfer of water entitlements on the Colorado River ('dry water').

This paper considers the peculiar particularities of the dual trends towards water commodification and privatisation (Bakker 2005; Castro 2013; Page 2005; Swyngedouw 2005). Through an analysis of the extraordinary technical, discursive and political work of assembling desalination plants as viable decentralised water sources, I argue for an understanding of these meta-political and economic trajectories as complex, diffuse, contingent, and as socially and materially heterogeneous. The principle empirical aim of this paper is to demonstrate how processes like privatisation, which are often considered to be directed, logical and coherent, always unfold through the re-forging of highly complex and contradictory, socio-material relationships. Furthermore, I attempt to uncover how the 'generative principles' of the real subsumption of nature by capital (Smith 1984), intersect with existing assembled actors and factors, including geophysical processes, alternative forms of accumulation, techno-legal configurations and governing institutions. This explicit engagement with heterogeneity –or the unpacking of the material embeddedness of political economy– is intended to build on and extend Karen Bakker's seminal work on water as an 'uncooperative' commodity (Bakker 2003). In particular, the key purpose here is to demonstrate how the enrolment of particular technologies and materialities by various interests, and the resultant techno-political configurations drawn together in the desalination assemblage, are efficacious in the market-disciplining of water.

In mobilising the case of privatisation by desalination in Southern California and Baja California, this paper places two literatures, which so often lie as incongruous bedfellows, into dialogue. The first –the political ecology approach– understands the privatisation and neoliberalisation of nature as part of broad political economic movements emerging from the dialectical contradictions of capital. The second –the assemblage approach– elucidates contradiction and contestation by extrapolating focused analysis of particular socio-materialities –say, of a specific technology. The central divergence between these two approaches, I argue, is their handling of the politics of relationality. Where the former begins with a whole (capitalism) and teases apart the relationships through which the whole is constituted, the latter attempts to assume no whole, but

builds up a picture of heterogeneous relations from principal materialities, be they people, animals or things. With some exceptions, attempts to integrate these two approaches in geographical research, particularly through empirical analysis, have often struggled theoretically. Yet, as Ranganathan (2015) has argued, there is great conceptual and political potential in greater cross-fertilisation between political ecology and assemblage thinking. Through an analysis of the technological and material configurations of desalination, and their efficacy in reconfiguring the social relationships of water, this paper represents an attempt to bridge this gap. In a word, I aim to demonstrate how mundane materialities really matter in political economy and political ecology research.

Both infrastructure projects analysed in the paper, although differing in many ways, have entailed significant reconfigurations between public and private governance of water. The particular materialities of the desalination assemblage are paramount in these changing configurations. For instance, both projects were conceived as public ventures. In both cases, however, the projects were appropriated by private companies that were able to insert themselves as developers by purchasing or leasing the prime land adjacent to coastal thermoelectric power stations, which guaranteed the economic and permitting benefits of co-location. In this sense, the formulation of neoliberalisation as a conjunct, albeit piecemeal, process between the state and private capital towards market governance (Heynen and Robbins 2005; McCarthy and Prudham 2004) is challenged, and instead presented as more diffuse and contested. The manner in which desalination has been assembled in these two cases, it is argued, has been efficacious in the privatisation and commodification of water, both by opening up new opportunities for the insertion of private capital, and, because of the high price of desalted water, contributing towards pricing conditions necessary for the development of market institutions.

The data presented in this paper was collected during the course of field research in 2014 and 2015, involving 36 expert interviews, extensive documentary analysis, and archival research, conducted at San Diego State University, the San Diego History Centre, the San Diego Public Library and the National Archives in Washington DC. The paper proceeds in four parts. I begin by outlining the

theoretical rationale in more detail, before considering the materialities of water as forming barriers to accumulation and outlining the particularities of desalting technologies as 'market disciplining' this uncooperative commodity. The empirical sections of the paper then interrogate the ways in which desalination infrastructures are re-configuring the social relations of water in Southern California and Baja California. The analysis of the two desalting plants is not presented as a comparative study, but is intended rather to mobilise the explanatory potential of distinct –yet overlapping– governance contexts.

Infrastructural assemblages

The extraordinary emergence of water desalination in just a few short decades from fringe water source to a global industry, increasingly the focus of techno-managerial solutions to urban water stress, has lately attracted critical attention in urban studies. By essentially reversing the hydrological cycle, causing water to flow from the sea to the land, the inclusion of desalted seawater in the supply of a neighbourhood, city, region or country reconfigures the social, political and economic relations of water (Feitelson and Rosenthal 2012). Critical perspectives on these large emerging infrastructures have conceptualised desalination as: 1) a technological fix to water scarcity (Fragkou and McEvoy 2016, March et al. 2014, McEvoy 2014); 2) a spatial-political fix for increasingly contested terrestrial water supplies (Swyngedouw 2013, Swyngedouw and Williams 2016, Wilder et al 2016); and 3) as an accumulation strategy for the global water industry (Loftus and March 2016). This paper, while broadly part of this literature on the transformation of the hydrosocial cycle through desalination, is distinct in that it attempts to bridge the conceptual gap between detailed analysis of materiality and general trends in water governance.

The increasing involvement of private capital in governing water, and urban water in particular, should first and foremost be understood in relation to broader processes of the internalisation of nature by capital. "Capitalism," as Moore (2015, 2) argues, "is not an economic system; it is not a social system; it is *a way of organizing nature*." Moreover, commodification of water

and the privatisation of water bodies and water services over the last 30-40 years is intimately connected to the neoliberalisation of nature –or the nature of neoliberalism (McCarthy and Prudham 2004), as what Castree (2008) calls the current 'shell' of the capitalist mode of production. Indeed, the transformation of the social relations of water consistent with the market logics of privatisation, (de/re)regulation, commercialisation and corporatisation are key hallmarks of the neoliberal era. Neoliberalism is then, at its heart, an environmental project, and one in which the objectives of economic liberalisation are advanced through the reshaping of socio-ecological relationality (Heynen et al 2007, Heynen and Robbins 2005, Himley 2008, Mansfield 2007). As Bakker (2013) notes, the broad processes that we understand as the neoliberalisation of nature have involved a double movement of, firstly, the increasing private ownership and management of nature and resources, and secondly, the use of market logics and market proxies in the governance of nature. Attention has been drawn to the extension of capitalist relations into nature via, for example, payment for ecosystem services, carbon trading, mineral extraction in indigenous lands, land grabbing, and the privatisation of urban infrastructural services.

Yet, studies that rely too heavily on purely Marxian notions of the (under)production of nature, without engaging posthuman or more dispersed notions of materiality have a "tendency to move too rapidly from the concrete to the universal, so that diverse materialities become conflated into the unitary category 'nature'" (Bakker and Bridge 2006, 11). Assemblage thinking is therefore advanced as a useful set of conceptual tools and terminology to work through some of the theoretical challenges unresolved in Marxist thought. The concept of the 'desalination assemblage' is used throughout. This is intended to connote two key notions of the assemblage literature. The first is that of emergence. Although Featherstone (2011) points out a tension in some assemblage thinking between conceptualising assemblages as relational processes or as constituted 'things,' there is nevertheless general emphasis on flux, contingency and dynamism, and to uncovering the multiple movements that together constitute an effect. The process of assembling, rather than the assemblage as resultant formation, is therefore prioritised conceptually. Assemblage thinking is, more than

anything, interested in uncovering the "hard work required to draw heterogeneous elements together, forge connections between them and sustain these connections in the face of tension," and in analysing "how the elements of an assemblage might –or might not– be made to cohere" (Li 2007, 264). Following on from this, Colin McFarlane, along with others, has argued that the contributions of the assemblage literature, be they conceptual, descriptive or methodological, imply a normative commitment to explore how these social-material networks are produced, to whose potential benefit, and to how they might be imagined differently (McFarlane 2011a; Anderson and McFarlane 2011). This is the 'history-potential relation' that describes both the 'depth' of assemblages –how the historically and geographically contingent processes of assemblage formation produce particular trajectories– *and* the potentialities of new configurations to emerge from the old (McFarlane 2011b). In this respect, Ranganathan (2015; 1302) contends in her analysis of storm drains in Bangalore, "assemblage thought is not opposed to structural political economy; it is simply an alternative reading of it."

The second broad theme concerns distributed agency. The assemblage interpretation is not that of the strong theory of nonhuman agency espoused in ANT (Callon 1986; Latour 1993; Law and Mol 1995) and some of the New Materialism literature (Bennett and Joyce 2010). Whereas the ANT approach attributes agential capacity to particular actants or actors, the assemblage conceptualisation contends that an action or movement is never the outcome of a single actor. Rather, effect emerges through the intersection of human and material elements. In a word, there is no causality without relationality. Thus, relations between parts of an assemblage are *contingently obligatory* in that they are not given or predetermined, but arise through coevolution (DeLanda 2006). To Bennett (2010, 31/34), a "theory of distributive agency…does not posit a subject as the root cause of an effect." Instead, there are "always a swarm of vitalities at play." According to this concept, therefore, an assemblage "owes its agentic capacity to the vitality of the materials that constitute it." Human agency is not only distributed in the tools and technologies that are intended to produce certain effects, but also in the disruptive capacity of seemingly excluded elements (Bennett 2005). Agency is hereby seen

as *distributed* and *composite*. The assumption of society's heterogeneity is the foundation from which assemblage thinking proceeds –i.e. that the 'social' is non-homogenous. Assemblage thinking is useful because it "offers the possibility of grasping how something as heterogeneous as nation states, for instance, or regional political formations, hold together *without* actually ceasing to be heterogeneous" (Allen 2011, 154). The political importance of nonhuman agency is, nevertheless, often overstated. Moreover, doing so raises very difficult questions about intentionality and accountability, which are sometimes inadequately addressed or overlooked in the assemblage literature. Notwithstanding the important contributions to post-human politics made by Bennett and others, I therefore prefer to talk in terms of material efficacy, rather than agency.

Notably, despite the traction of assemblage thinking in contemporary urban theory, its concepts have been applied almost exclusively to the analysis of small socio-technical assemblages, and not to large infrastructural networks. This is a curious gap, given the clear overlaps between the assemblage concept and infrastructure studies. Infrastructures transcend and link together spaces of production, distribution and consumption; they connect the raindrop to the kitchen tap, the aquifer to the garden hose, the coal mine to the light switch, and the photon in a ray of sunlight to the kettle. Infrastructures are, in a sense, relationship creators; they are efficacious in the forming and reforming of social and material interconnectivities. It is now well understood that infrastructures act as mediators, being both shaped by and creating geographies and territories (Barry 2013, Bouzarovski et al 2015, Moss 2014), in the configuration and consolidation of state power (Bouzarovski and Bassin 2011), the transformation and urbanisation of nature (Kaika and Swyngedouw 2000), in the metabolising of resource flows (Monstadt 2009), and in forming relationships between people and between people and the environment (Amin 2014, Kaika 2015). The intentionalities embedded in infrastructure, ossified in material form, influence and shape human action (Bouzarovski 2010).

As heterogeneous socio-material assemblages, spaces where different elements, technologies, flows, cultures, capital and social intentionalities are drawn together in a process of mutual constitution and reconfiguration, urban infrastructures are at once palimpsests of old and new

forms of urbanism, and technologies of transformation (Graham and McFarlane 2015). Understood also as "site[s] of multiple, overlapping, or nested forms of sovereignty, where domestic or transnational jurisdictions collide" (Easterling 2014, 15), the governance of environmental and social transitions is inherently a process with infrastructure at its heart. Given the centrality of these technologies to urban transitions, infrastructures are also necessarily integral to discussions on the future trajectories, forms and politics of cities (Coutard and Guy 2007, Goldman 2011, Hodson and Marvin 2009).

Market-disciplining an 'uncooperative' commodity

Barriers to accumulation

Water presents a particularly intriguing entry point for analysis, in part because, as Loftus (2009, 956) has observed, "capital has actually found it remarkably difficult to profit from water privatisation." Consideration of the particular material characteristics of water, which render it in many respects unsuitable as a vehicle for surplus value and accumulation, is central to this debate. The market has, in a word, historically struggled to discipline water (Bakker 2003, Bear and Bull 2011, Castro 2013, Page 2005, Swyngedouw 2005). Particularly useful in grappling with the political economy of water is Karen Bakker's notion of the 'uncooperative commodity.' She writes;

> *"Understanding why water is such an 'uncooperative' commodity, persistently characterized by externalities and hence market failure, requires reference to its biophysical characteristics; in other words, to its 'materiality'… The use of the term 'materiality' implies an acknowledgement of the corporeality of our economies, of their embedding in natural processes. The term 'materiality' also refers to an understanding of nature as a subject of political economic processes, whose specific biophysical characteristics shape the social relations of production, simultaneously enabling and constraining its own production."* (Bakker 2003, 31-32)

At the heart of this concept of the materiality of water, and its political significance, is the notion of barriers to accumulation. These can roughly be divided into three characteristics of water: density, volume and fluidity. Water is heavy and difficult to transport. Sites of collection, storage, treatment and consumption, are therefore, geographically constrained and contingent. This limits opportunities for trading on an open market. Water must also be mobilised in large volumes, and crucially, at relatively low cost in order to sustain sanitary cities, industrial production and agriculture. Herein lies a deep tension between water as the general preconditions of production and reproduction, and water as the object of production and bearer of surplus value. Water is a flow resource, transient, technologically challenging to store and transport. Externalities, such as pollution, are rapidly diffused and difficult to contain. As water flows, it passes through multiple functions and forms of ownership, not all of which are easily commensurable under the capitalist rubric. Any attempt to commodify water, then, can only establish the social relations of capitalism in a particular phase of the hydrological cycle –hence, the 'commodity phase' of water (Page 2005).

Together, these material characteristics present a number of significant obstacles for capital. First, the necessity for large infrastructures and long-term fixed capital investment is contrary to capital's imperative for accelerating circulation and turn over (Harvey 2006). This also leads to the formation of natural monopolies, which reduce opportunities for competition. Second, capital's usual strategy for achieving growth through increasing either price or supply is often not viable in the case of water, where the political and ecological imperatives are generally towards limiting use and maintaining price (Swyngedouw 2005). Third, many areas are simply not profitable to provide with water services, particularly outside affluent urban centres. This has resulted, in places where privatisation has been poorly governed, to the cherry-picking of profitable areas and resulting uneven geographical distribution. Finally, there is limited scope for 'adding value' to water in the production process. Water is, after all, either safe or dangerous. At least in North America and Europe, water is also almost always delivered through centralised conduits. It would be neither feasible nor ethical, therefore, to deliver varying qualities of water to different customers, based on price differences.

Although interesting work has been conducted on, for instance, the use of water meters to introduce market logics to the water sector (Loftus 2007), insufficient attention has been paid to the technologies mobilised in the market-disciplining of water.

Technologies of market-disciplining

With the possible exception of bottled water, which intersects the cultural and economic relations of water in the most curious ways (Jaffee and Newman 2013; Wilk 2006), the desalination of seawater in many respects represents the purest form of water commodification. Terrestrial water supplies exist in an almost constant state of flux: both physical flux, in that they flow and combine with other material and technical forms, are dependent on unpredictable climate and rainfall patterns, and are challenging to capture, store and transport; and socio-political flux, in that they pass through multiple overlapping and complex forms of ownership and use, and are increasingly contested. Gorostiza and Sauri (2017) mobilise assemblage thinking to interrogate how riparian waters embody historic socio-material relations through watershed pollution, with particular political implications. This paper, by contrast, suggests that the desalination assemblage functions to remove water supply from these complex histories.

In North America's desert southwest, where water has traditionally been governed through large and inert government institutions, potable water has generally formed, in Marx's words, the *preconditions of production*, rather than commodity or object of accumulation. In the desalting factory, this relationship is turned on its head: water becomes the focus of accumulation and the bearer of surplus value. In other words, desalination has become a technology of water commodification. The seawater desalination plant is a factory in every sense of the word. Ocean water enters the desalination factory as raw material, where it is combined with the means of production, which are the fixed capital associated with various purification processes and electrical energy from the grid, and labour to produce a commodity. This commodity embodies surplus value produced by the labour of operating the desalting process and the dead labour ossified in the fixed capital of the

factory. In a high-technology process such as reverse osmosis, the fixed capital component is significant, representing 45% of the cost of water produced at Carlsbad, compared to 28% for electricity and 27% for operations and maintenance (including labour). Desalting factories are modular. They can be built to manufacture any given quantity of water, regardless of environmental factors like rainfall or stream flow. Indeed, the only capacity-limiting factors are energy supply, market for the commodity (which is related to the price of desalted water), and seawater intake and outfall permitting.

INSERT IMAGE 1 ABOUT HERE

There are several stages to the production of H_2O by reverse osmosis desalination. Before reaching the RO stage, intake water goes through a two-part pre-treatment process, of filtration and membrane microfiltration, to remove suspended solids (Vedevyasan 2007). After pre-treatment, the water enters the RO process, where feedwater is forced at high pressure (around 800psi) into tubular pressure vessels housing spiral-wound thin film composite membranes (Greenlee et al. 2009)(Image 1). These membranes remove salt and virtually all other dissolved elements. The resulting product is pure H_2O, lacking in virtually any other chemical constituent. Water in this state, if distributed, would leach minerals from any metal it came into contact with. Post-treatment is therefore required to avoid pipe corrosion (Lahav and Birnhack 2007). Product water is, therefore, put through a process of re-mineralisation, pH adjustment, disinfection and fluoridation. This final stage can be tailored to accommodate the specifications of the water purchaser, for instance, if the off-taker requires particular chemical characteristics, or would like the RO water to mimic the taste of the other water supplies in the region:

"Desal is a world commodity. It's not exotic, it's been tested. The people who'll build this plant are going to be one of three or four world-class companies…and they've done this in Australia, the Middle

East, Israel… Desal is really a designer water, and it's a factory product. I can tell NSC Agua I need water that looks like this, these constituents, and they manufacture it." (General Manager of a water district, 09/09/2014)

Seawater desalination is the only water supply that can be produced in a pre-agreed quantity and with specified physical characteristics. It is the manufactured product of an industrial process, object of private ownership like any other commodity, rather than a flow resource subject to multiple forms of ownership and cultural association. It is ocean water metabolised, socialised, re-made in the image of capital, and sold as a commodity, H_2O –or, 'designer water'.

Plugging in the desalting factory

The particular techno-political configurations of large seawater desalting factories, because they are plugged into existing infrastructural systems, present many opportunities for new actors to insert themselves into the processes of water governance, and for new social relations to coalesce around the desalination assemblage. In both the Carlsbad and Rosarito cases, the issue of plant siting has been of particular importance. Along the heavily urbanised Southern Californian and Baja Californian coast, where real estate is at a premium, there are limited locations suitable for such facilities. Furthermore, the specific physical, infrastructural and legal characteristics of a potential site are critical in determining the viability of projects and relative cost of water produced. In the late 1990s and early 2000s when large-scale RO began to take off in North America, co-locating desalination facilities with existing coastal thermoelectric power plants became the preferred model for developers. In a state that has historically relied on large base-load coastal power plants, "piggybacking on existing infrastructure," as one expert put it, "made absolute sense" (Industry expert, 16/10/2014). Co-locating with thermoelectric plants allows desalination projects to take advantage of benefits from: 1) reduced capital and operating costs by using existing intake and outfall infrastructure; 2) reduced environmental impact of seawater intake and outfall; and 3) political and legal streamlining from existing industrial land zoning (Kamal 2005; Pankratz 2004; Voutchkov 2004). The co-location model

created a particular and peculiar set of political and material conditions for the deployment of desalting technologies. In the cases of Carlsbad and Rosarito, it also presented a unique opportunity for private capital to insert itself into a sector dominated by public utilities. Both were conceived as public projects and the initial plans in both cases were for delivery through public finance under public ownership. In both cases, however, the projects were appropriated by private companies, who took control of development by securing the prime land adjacent to power plants.

Co-location as speculative strategy in Carlsbad

The site of the Carlsbad plant next to the gas and oil-fuelled Encina Power Station had been identified by the San Diego County Water Authority since the early 1990s as a favourable location for a large-scale desalting facility, along with two other sites adjacent to power infrastructure: the (now decommissioned) South Bay power plant in the south of the county and the (now also decommissioned) San Onofre Nuclear Generating Station in the north (SDCWA annual reports 1990-2016). Both locations were, for different reasons, thought to be infeasible, leaving Carlsbad as *the* prime location for a desalination plant in San Diego County. The SDCWA were developing plans for a 189 mega litre per day plant co-located with Encina. The proposal reached the permitting stage when the Water Authority submitted an Environmental Impact Report (EIR) for the project. The initial plan was for the SDCWA, in collaboration with the City of Carlsbad (who had also looked at developing the project independently), to develop, finance and own the facility. Development, however, progressed slowly through the 1990s.

Poseidon came to California in 1999. A Connecticut-based venture capital firm specialising in delivering RO water treatment projects, the company's first large desalination project was the ill-fated Tampa Bay plant in Florida, twinned with the TECO Big Bend power station. Poseidon's involvement in the troubled history of the Tampa Bay project, which led to the bankruptcy of three of the companies involved, beleaguered by poor financing, incompetent contractors and inappropriate technical design, came to an end in 2002 when they were bought out by the Tampa Bay Water district

(Cooley and Gleick 2013). During this time, Poseidon had begun looking for investment opportunities on the West Coast. Their business plan was simple: secure prime real estate adjacent to coastal power plants (Poseidon Water 2016). At one point, Poseidon was attempting to lock up land at approximately ten sites along the Californian coast. In the end, they managed to secure leases to two sites: one in Carlsbad, San Diego, and the other in Huntington Beach, Orange County. Poseidon even holds a 2005 patent on the co-location design of RO seawater desalination with once-through cooling systems. By securing a long term lease on the land adjacent to the Encina Power Station, Poseidon ensured that, because of the benefits of co-location, it could produce desalted water at a lower cost than any other potential project in the region (senior manager, 24/10/2014). This effectively removed the desalination 'solution' from public hands.

Co-location as speculative strategy in Rosarito

Having been effectively shut out of the Carlsbad project by Poseidon, the SDCWA increased its efforts towards alternative desalting schemes. In 2005 the Water Authority published a feasibility study for a binational project. The report considered a number of potential locations and highlighted a site next to the Presidente Juarez gas-powered thermoelectric plant operated by Comisión Federal de Elecricidad (CFE –the Federal Electricity Commission) in Rosarito Beach as particularly promising (SDCWA 2005). The Rosarito site, where there had been a small RO desalination plant owned by CFE in the 1980s and where various subsurface and surface seawater intake technologies had been tested at the time, was also well studied. Interest in the Rosarito project increased rapidly and, led by the SDCWA, a total of eight public water agencies from both sides of the border embarked on an extensive feasibility and development study (SDCWA 2010). Two mechanisms for water delivery to the Unites States were considered: 'wet water' option, delivered by pipeline; and 'paper water', which would involve a transfer of a portion of Mexico's rights to Colorado River water to U.S. agencies. For US agencies, the Rosarito project represented a viable way to ease contested Colorado supply. Indeed, Las Vegas Valley and Southern Nevada agencies had been considering the possibility of financing

coastal desalination in return for increased Colorado allocation for some time (Shrestha et al. 2011). On the Mexican side, the Baja State Government had attempted a number of times to develop desalination capacity to increase supply reliability. In Tijuana particularly, which relies almost entirely on limited Colorado supply imported from the Mexicali Valley, per capita water consumption is 30% lower than the Mexican national average and there is widespread belief that inadequate and insecure water supply is retarding the city's growth (Fullerton et al 2007; Meehan 2013). The potential for a binational desalting project was also recognised by both federal governments in a series of agreements coordinated by the International Boundary and Water Commission to increase cooperation on water issues (IBWC 2012).

As interest from the Colorado River agencies peaked, a small company was formed in Tijuana, called Norte-Sur Agua (North-South Water). Its ambitious mission was to deliver the world's first binational seawater desalination facility. Having studied the 2005 and 2010 reports, NS Agua recognised that the most favourable site on the entire coastline for a large facility was next to the CFE power plant in Rosarito (senior manager, 25/09/2014). Their main limiting factor was lack of capital. NS Agua therefore began searching for partners and opened negotiations with a publically traded (Nasdaq-listed) desalination company based in the Cayman Islands called Consolidated Water. In May 2010 Consolidated Water acquired a 50% share in NS Agua, which then became *NSC Agua* (Norte-Sur-Consolidated). This share has now risen to 99.9% of the company.

"[NS Agua] were looking to develop this project, which wasn't really their idea; the idea was from this binational study. It looked like a good idea; it was well studied by people on both sides of the border. NS Agua said 'This is a good plan. All these public sector dudes are just talking and talking and talking.'"
(Executive of a desalination company, 18/09/2014)

With the injection of capital and technical expertise, NSC Agua was able to progress more rapidly. In 2013 the company purchased the 20 hectares of land adjacent to the CFE thermoelectric plant –the same parcel of land that had been identified by the 2005 and 2010 binational studies as the best

location for a large desalination plant on the entire San Diego–Baja California coastline (Consolidated Water annual reports 2000-2015). NSC Agua also began purchase negotiations with two public utilities, one on each side of the border: Tijuana's public services department (CESPT), and the Otay Water District, which services the rapidly growing border region of Otay in the very south of San Diego County.

Here again, just as had happened a decade earlier in Carlsbad, a private company was able to appropriate a major government project (in this case, a project involving agencies of two national governments) simply by securing the land rights that guaranteed technological (and therefore cost) advantage. In this way, the very particular technical, political and legal configurations of the desalination assemblage are serving to circumvent the material and historical barriers to water privatisation in the West, and now offer private capital opportunities to insert itself into the water production business. Although there is nothing about the reverse osmosis desalination process that makes it suitable for water privatisation *a priori*, the unique infrastructural, institutional and political relationships that have formed around it are certainly efficacious in the market disciplining of the uncooperative commodity.

New water, new rules

The desalting factory is a factory where the total commodity output has a guaranteed purchaser for many years, even before its construction has begun (Wolfs and Woodroffe 2002). This has led to the development of 'take or pay' contracts, which have become the standard model for desalination public-private partnerships, where a municipality or water agency commits to paying for a given amount of water a year (Ghaffour et al. 2013). Consider for example the large desalters built in Australia around 2008-11, which have barely been used, but for which the cities of Brisbane, Sydney, Melbourne and Perth are still paying (Keremane et al 2013). The Carlsbad and Rosarito desalting projects are based on 30 and 50 year water purchase agreements respectively. Moreover, because these projects set new precedents in terms of size and scope for the USA and Mexico, neither

California nor Baja California had clear or prescribed permitting processes for desalination infrastructures. This legislative muddiness has since been somewhat addressed in California by new legislation (SWRCB 2012, 2015), and in Baja California by a new Public-Private Partnership law passed in 2014 (discussed below). Nevertheless, both projects are treading new ground in terms of political, institutional and legal process. This, I argue, combined with the techno-political particularities of the desalination assemblage described above, has created a unique set of conditions for the reconfiguration of public-private relationships in the sphere of water governance.

From private to public–private: financing Carlsbad

When, in the late 1990s and early 2000s, Poseidon were speculatively securing prime real estate for co-located desalting factories along the Californian coast, their vision in Carlsbad was for a fully privatised facility, from which they could sell water to local cities and water districts. In 2008, before the County Water Authority joined the project, Poseidon had a total of nine water agencies and districts willing to purchase water. The City of Carlsbad itself had hoped to take 40% of the plant's output (Voutchkov 2005). Poseidon managed to raise $167 million in private equity through the New York–based investment firm, Stonepeak Infrastructure Partners. This amount was, however, insufficient to cover the full cost of the plant, which, despite initial lower estimates, has cost nearly a billion dollars to deliver. Poseidon then began to look for opportunities to deliver the plant through a public-private partnership, and entered into negotiations with the SDCWA to become the sole off-taker. This led to an agreed Term Sheet in 2010 and the final Water Purchase Agreement in 2012.

Put simply, the Carlsbad project could not have been successful without collaboration between Poseidon and the SDCWA. On the one hand, Poseidon had control over the land adjacent to the Encina Power Station, had secured some private equity, and had already begun the permitting process and lobbying for political support. On the other hand, the SDCWA, as one of the largest urban water agencies in the country, had the capacity to secure finance and the ability to guarantee long-term purchase of water through a public-private partnership. In 2012, Poseidon and SDCWA submitted

a joint application to the California Pollution Control Financing Authority (CPCFA), which issues tax exempt bond financing for waste, recycling or water projects that in some way contribute to pollution control. The purpose of the bond programme is to "stimulate environmental clean-up, economic development and job growth throughout the state of California" (CPCFA 2013, 1). Less than a month after Poseidon and SDCWA signed the Water Purchase Agreement, the CPCFA issued $734 million in low interest tax exempt bonds for the project. The bond issue, which allocates $530,345,000 for the plant and $203,215,000 for the pipeline and associated works, was the second largest in the CPCFA's 40 year history (CPCFA 2012). Critics of the project, particularly the Californian and San Diegan environmental communities, have argued that not only does the Carlsbad desalination plant not fulfil the CPCFA's criteria for addressing pollution, but that publically subsidised finance should not be directed to venture capitalist firms such as Poseidon.

Re-insertion of the state: PPPs in Baja California

NSC Agua had assumed, because they controlled the prime land that guaranteed a cost advantage over any other desalting facility in the region, that they would be able to privately develop, finance and operate the plant, from which they could then sell water. The company had planned to purchase a portion of the heated water discharged from the power plant from CFE. A peculiarity of Mexican law means that a water body that has been polluted becomes the responsibility (and therefore property) of the polluter. Given that heated water is legally recognised as polluted, NSC Agua had thought to use this law to claim ownership of the heated seawater purchased from the power plant, and therefore to sell purified seawater as a private commodity.

This unusual techno-legal transformation of property rights has, however, recently become extraneous to the development in Rosarito. In 2014 the State of Baja enacted a law requiring that all private infrastructure projects must be delivered through new Public-Private Contract of Association schemes, or APPs (Congreso del Estado de Baja California 2014). This law effectively re-wrote the rules about private sector infrastructure investment in Baja California. Under the APP model, every new

project idea must be submitted to the state government for review, and is then released by the state to the private sector for bids. Multiple companies may put forward bids to deliver a project, from which the State of Baja chooses the most suitable developer. This put NSC Agua's position as project developer in doubt for a time, but after a successful bid the company was awarded the contract by the State of Baja in June 2016.

During the same period, the project underwent a further phase of re-structuring. These changes were prompted because the Rosarito plant is actually being designed to produce more water than the original two off-takers were willing to buy. From a total annual production capacity of 125,000 mega litres, NSC Agua had at first planned to sell 25,000 to the Otay Water District through a cross-border pipeline, and 100,000 to the CESPT (Tijuana's public service department) through the State of Baja. The CESPT, however, decided that it required only 62,500 ML to supplement Tijuana's water supply, leaving 37,500 ML a year without a guaranteed purchaser (consultant, 25/06/2015). The State of Baja therefore engaged another company, a Los Angeles-based firm called Baja Norte Water Resources LLC (hereafter BNWR), to work with NSC Agua to find US buyers for the remaining water. Established in 2009 for the specific purpose of furthering binational water trading agreements between the United States and Mexico, BNWR, although headquartered in the US, claims to represent Mexican interests. BNWR has advised the State of Baja on a number of binational water issues on the Colorado River.

BNWR proposed an alternative deal structure, to which the State of Baja agreed in 2015 (Smith 2016). The new agreement is outlined as follows. The State of Baja purchases the entire 125,000 ML/year output from the desalination consortium –which will be NSC Agua, because it won the competitive bid to be project developer. It then directs 62,500 ML to CESPT for Tijuana's supply. The remaining 62,500 ML is sold to the Mexican-based affiliated entity of BNWR called Baja Infrastructure Resources (BIR). Water then flows across the border from BIR to BNWR, who establish purchase contracts with various US water end-users. The Otay Water District will almost certainly become an end-user, probably taking delivery of 'wet water' through a cross-border pipeline. In addition, the

Metropolitan Water District of Southern California has already expressed an interest in establishing a 'paper transfer' of desalinated water with BNWR, along with water wholesalers in Nevada and Arizona. Such contracts may possibly utilise Mexico's storage right in Lake Mead, established in Minutes 318 and 319, provided the storage agreement can be extended. Payment for water then flows back across the border to the State of Baja and the desalination consortium through a North-South Trust structure, which will be administered by a respected public institution –possibly the International Boundary and Water Commission.

The significance of this agreement, which remains effective for a period of 50 years, despite the APP contract for the desalination plant lasting only 25 years, is greater than simply the sale of desalted seawater from Rosarito. Certainly, in negotiating this deal BNWR has ensured that all of the water from Rosarito sold in the United States flows through an institutional and economic structure with itself at the centre. But moreover, the company's broader intention here is for this model to become the blueprint for future binational water trade agreements in the West. In effect, BNWR has used the Rosarito desalination development, the particular material and political assemblages of its deployment, and the uncertainty associated with a project without precedent, to insert itself into the very structure of water trading between two countries. Here again, the peculiar particularities of the desalination assemblage, and the material and political relationships that are drawn together, have been directed towards the creation of new opportunities for private capital to insert itself into the waterscape of the arid West, this time, across an international border.

Conclusion

The extension of the social relations of capital –specifically in neoliberal form– into areas, places and socio-materialities that have previously been characterised by incomplete or non-capitalist relations is receiving keen attention in Geography and related disciplines. Ethical concerns raised by issues including the imposition of intellectual property rights to genetic code, the appropriation of land and resources by global capital, and the marketization of ecosystem services, have placed N/nature at the

centre of debates over social and environmental justice. The privatisation of water and water services, because water has so far has not easily been brought in line with market logics, has received considerable critical attention, particularly from geographers. In Europe and North America particularly, the state hydraulic paradigm, where water is supplied in large quantities at low cost by the state as the general preconditions of production and reproduction, has been remarkably successful in fostering economic growth –notwithstanding, of course, its failures in other respects. Indeed, attempts to privatise water have been geographically piecemeal, largely limited to profitable urban areas, and of questionable success.

This is certainly true in Southern California, where water has historically been governed by large public institutions, circulated through centralised capital-intense mega infrastructures, and subject to complex forms of ownership. Emerging paradigms throughout the desert West towards diversified and localised water management, then, present certain opportunities for the insertion of private capital into the waterscape and for the re-formulation of water as an accumulation strategy and vehicle of surplus value. Despite the barriers to accumulation in the water sector, the dual trends towards water privatisation and commodification have continued over the last 20-30 years. Yet, insufficient attention has been paid to the technological and political tactics through which this is being achieved. Moreover, questions around how particular socio-material relationalities brought together in such a way as to discipline water to the logics of the market, have been insufficiently addressed.

The central theoretical argument running throughout this paper has been that processes like commodification and privatisation always unfold through the assembling and re-assembling of heterogeneous elements and relations. In the case of water commodification, multiple technologies, material elements, and socio-political relations are enrolled in complex, and often contradictory, forms. Structural trends in political economy and ecology must be understood, therefore, in relation to the complex assemblages out of which they unfold. The emergence of seawater desalination on the coast of California and Baja California provides a pertinent illustration of the importance of studying

and conceptualising the geographically and historically specific ways in which complex and contingent socio-material forms are configured, and how these facilitate and disrupt processes of privatisation and commodification. Under the desalination assemblage, the neoliberalisation of water unfolds through mundane processes like land ownership transfer, infrastructural interfacing and technological co-location. Even the very process of passing seawater through semi-permeable membranes and the physical and chemical processes this entails become politically significant. This historical perspective on the assembling, disassembling and reassembling of socio-material relations through desalination, the paper has argued, is an important terrain for constructive dialogue between different relational theories. The emergence of the desalination assemblage, therefore, has entailed a significant reconfiguration of public–private relationships in the governance of water. In a word, even considering its multiple contradictions, desalination has become a market-disciplining technology, efficacious in the commercialisation of an 'uncooperative' commodity.

Bibliography

Allen, J., 2011. Powerful assemblages? Area 43, 154–157. doi:10.1111/j.1475-4762.2011.01005.x

Amin, A., 2014. Lively Infrastructure. Theory Culture Society 31, 137–161. doi:10.1177/0263276414548490

Anderson, B., McFarlane, C., 2011. Assemblage and geography. Area 43, 124–127.

Bakker, K., 2003. An Uncooperative Commodity: Privatizing Water in England and Wales. Oxford University Press, Oxford.

Bakker, K., 2005. Neoliberalizing nature? Market environmentalism in water supply in England and Wales. Annals of the Association of American Geographers 95, 542–565.

Bakker, K., 2013. Privatizing Water: Governance Failure and the World's Urban Water Crisis. Cornell University Press.

Bakker, K., Bridge, G., 2006. Material worlds? Resource geographies and the "matter of nature." Progress in Human Geography 30, 5–27.

Barry, A., 2013. Material Politics: Disputes Along the Pipeline. Wiley-Blackwell, Chichester.

Bear, C., Bull, J., 2011. Guest Editorial. Environ Plan A 43, 2261–2266. doi:10.1068/a44498

Bennett, J., 2005. The agency of assemblages and the North American blackout. Public Culture 17, 445–465.

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

Bennett, T., Joyce, P. (Eds.), 2010. Material Powers: Cultural Studies, History and the Material Turn. Routledge, Oxford.

Bouzarovski, S., 2010. Post-socialist energy reforms in critical perspective: Entangled boundaries, scales and trajectories of change. European Urban and Regional Studies 17, 167–182.

Bouzarovski, S., Bassin, M., 2011. Energy and identity: Imagining Russia as a hydrocarbon superpower. Annals of the Association of American Geographers 101, 783–794.

Bouzarovski, S., Bradshaw, M., Wochnik, A., 2015. Making territory through infrastructure: The governance of natural gas transit in Europe. Geoforum 64, 217–228. doi:10.1016/j.geoforum.2015.06.022

Callon, M., 1986. Some Elements of a Sociology of Translation: Domestication of the Scallops and the Fishermen of St. Brieuc Bay, in: Law, J. (Ed.), Power, Action and Belief: A New Sociology of Knowledge. Routledge and Kegan Paul, London.

Castree, N., 2008. Neoliberalising nature: the logics of deregulation and reregulation. Environment and Planning A 40, 131–152. doi:10.1068/a3999

Castro, J.E., 2013. Water is not (yet) a commodity: Commodification and rationalization revisited. Human Figurations 2.

Congreso del Estado de Baja California, 2014. Ley de asociaciones publico privadas para el Estado de Baja California, Publicada enel Periodico Oficial 42.

Consolidated Water, 2000-2015. Annual reports. Consolidated Water, Gran Cayman.

Cooley, H., Gleick, P., 2013. Desalination: Let the Buyer Beware [WWW Document]. The Huffington Post. URL http://www.huffingtonpost.com/peter-h-gleick/desalination-let-the-buye_b_2199814.html (accessed 6.6.16).

Coutard, O., Guy, S., 2007. STS and the City: Politics and Practices of Hope. Science, Technology & Human Values 32, 713–734.

CPCFA, 2012. Series 2012 Plant Bonds and Series 2012 Pipeline Bonds [WWW Document]. URL http://www.sdcwa.org/sites/default/files/files/finance-investor/carlsbad-desal-project-limited-offering-memorandum.pdf (accessed 9.7.16).

CPCFA, 2013. Tax-exempt bond program, 2012 annual report. California Pollution Control Financing Authority, Sacramento.

DeLanda, M., 2006. A New Philosophy of Society: Assemblage Theory and Social Complexity. Continuum, London.

Easterling, K., 2014. Extrastatecraft: The Power of Infrastructure Space. Verso, London.

Featherstone, D., 2011. On assemblage and articulation. Area 43, 139–142.

Fragkou, M.C., McEvoy, J., 2016. Trust matters: Why augmenting water supplies via desalination may not overcome perceptual water scarcity. Desalination 397, 1–8. doi:10.1016/j.desal.2016.06.007

Fullerton, T.M., Tinajero, R., Cota, J.E.M., 2007. An Empirical Analysis of Tijuana Water Consumption. Atl Econ J 35, 357–369. doi:10.1007/s11293-007-9074-x

Ghaffour, N., Missimer, T.M., Amy, G.L., 2013. Technical review and evaluation of the economics of water desalination: Current and future challenges for better water supply sustainability. Desalination 309, 197–207. doi:10.1016/j.desal.2012.10.015

Goldman, M., 2011. Speculative Urbanism and the Making of the Next World City. International Journal of Urban and Regional Research 35, 555–581. doi:10.1111/j.1468-2427.2010.01001.x

Gorostiza, S., Sauri, D., 2017. Dangerous assemblages: Salts, trihalomethanes and endocrine disruptors in the water palimpsest of the Llobregat River, Catalonia. Geoforum, 81, 153-162

Graham, S., McFarlane, C. (Eds.), 2015. Infrastructural Lives: Urban Infrastructure in Context. Earthscan, London.

Greenlee, L.F., Lawler, D.F., Freeman, B.D., Marrot, B., Moulin, P., 2009. Reverse osmosis desalination: Water sources, technology, and today's challenges. Water Research 43, 2317–2348. doi:10.1016/j.watres.2009.03.010

Harvey, D., 2006. The Limits to Capital. Verso, London.

Heynen, N., McCarthy, J., Prudham, S., Robbins, P. (Eds.), 2007. Neoliberal Environments: False Promises and Unnatural Consequences. Routledge, London.

Heynen, N., Robbins, P., 2005. The neoliberalization of nature: Governance, privatization, enclosure and valuation. Capitalism Nature Socialism 16, 5–8. doi:10.1080/1045575052000335339

Himley, M., 2008. Geographies of Environmental Governance: The Nexus of Nature and Neoliberalism. Geography Compass 2, 433–451. doi:10.1111/j.1749-8198.2008.00094.x

Hodson, M., Marvin, S., 2009. Cities mediating technological transitions: understanding visions, intermediation and consequences. Technology Analysis & Strategic Management 21, 515–534.

IBWC, 2012. Minute No. 319. International Boundary and Water Commission.

Jaffee, D., Newman, S., 2013. A More Perfect Commodity: Bottled Water, Global Accumulation, and Local Contestation. Rural Sociol 78, 1–28. doi:10.1111/j.1549-0831.2012.00095.x

Kaika, M., 2015. The uncanny materialities of the everyday: Domesticated nature as the invisible "other," in: Graham, S., McFarlane, C. (Eds.), Infrastructural Lives: Urban Infrastructure in Context. Earthscan, London.

Kaika, M., Swyngedouw, E., 2000. Fetishizing the modern city: the phantasmagoria of urban technological networks. International journal of urban and regional research 24, 120–138.

Kamal, I., 2005. Integration of seawater desalination with power generation. Desalination 180, 217–229.

Keremane, G.B., McKay, J.M., Ettehad, E., Wu, Z., 2013. The Evolution of Business Models for Non-Major Desalination Plants in Australia -- Issues for Governance (SSRN Scholarly Paper No. ID 2476255). Social Science Research Network, Rochester, NY.

Lahav, O., Birnhack, L., 2007. Quality criteria for desalinated water following post-treatment. Desalination 207, 286–303. doi:10.1016/j.desal.2006.05.022

Latour, B., 1993. We Have Never Been Modern. Harvester Wheatsheaf, London.

Law, J., Mol, A., 1995. Notes on materiality and sociality. The Sociological Review 43, 274–294.

Li, T.M., 2007. Practices of assemblage and community forest management. Economy and Society 36, 263–293. doi:10.1080/03085140701254308

Loftus, A., 2007. Working the Socio-Natural Relations of the Urban Waterscape in South Africa. International Journal of Urban and Regional Research 31, 41–59. doi:10.1111/j.1468-2427.2007.00708.x

Loftus, A., 2009. Rethinking Political Ecologies of Water. Third World Quarterly 30, 953–968. doi:10.1080/01436590902959198

Loftus, A., March, H., 2016. Financializing Desalination: Rethinking the Returns of Big Infrastructure. International Journal of Urban and Regional Research n/a–n/a. doi:10.1111/1468-2427.12342

Mansfield, B., 2007. Privatization: Property and the Remaking of Nature–Society Relations Introduction to the Special Issue. Antipode 39, 393–405. doi:10.1111/j.1467-8330.2007.00532.x

March, H., Saurí, D., Rico-Amorós, A.M., 2014. The end of scarcity? Water desalination as the new cornucopia for Mediterranean Spain. Journal of Hydrology, 519, Part C, 2642–2651. doi:10.1016/j.jhydrol.2014.04.023

McCarthy, J., Prudham, S., 2004. Neoliberal nature and the nature of neoliberalism. Geoforum, Themed issue on "Neoliberal nature and the nature of neoliberalism" 35, 275–283. doi:10.1016/j.geoforum.2003.07.003

McEvoy, J., 2014. Desalination and water security: the promise and perils of a technological fix to the water crisis in Baja California Sur, Mexico. Water Alternatives 7, 518–541.

McFarlane, C., 2011a. The city as assemblage: dwelling and urban space. Environment and Planning-Part D 29, 649.

McFarlane, C., 2011b. Assemblage and critical urbanism. City 15, 204–224.

Meehan, K., 2013. Disciplining De Facto Development: Water Theft and Hydrosocial Order in Tijuana. Environ Plan D 31, 319–336. doi:10.1068/d20610

Monstadt, J., 2009. Conceptualizing the political ecology of urban infrastructures: Insights from technology and urban studies. Environment and Planning A 41, 1924–1942. doi:doi:10.1068/a4145

Moore, J., 2015. Capitalism in the Web of Life. Verso, London.

Moss, T., 2014. Socio-technical Change and the Politics of Urban Infrastructure: Managing Energy in Berlin between Dictatorship and Democracy. Urban Studies 51, 1432–1448. doi:10.1177/0042098013500086

Page, B., 2005. Paying for water and the geography of commodities. Transactions of the Institute of British Geographers 30, 293–306. doi:10.1111/j.1475-5661.2005.00172.x

Pankratz, T., 2004. Desalination technology trends, Biennial Report on Seawater Desalination.

Poseidon Water, 2016. What We Do [WWW Document]. URL http://www.poseidonwater.com/what-we-do.html (accessed 8.20.16).

Ranganathan, M., 2015. Storm Drains as Assemblages: The Political Ecology of Flood Risk in Post-Colonial Bangalore. Antipode 47, 1300–1320. doi:10.1111/anti.12149

SDCWA, 1946-2016. Annual Reports. San Diego County Water Authority, San Diego.

SDCWA, 2005. Feasibility Study of Seawater Desalination Development Opportunities for the San Diego/Tijuana Region. San Diego County Water Authority, San Diego.

SDCWA, 2010. Rosarito Beach Binational Desalination Plant: Feasibility, Evaluation and Preliminary Design, Phase 1. San Diego County Water Authority, San Diego.

SDCWA (2016) Final 2015 Urban Water Management Plan. June 2016. San Diego County Water Authority: San Diego

Shrestha, E., Ahmad, S., Johnson, W., Shrestha, P., Batista, J.R., 2011. Carbon footprint of water conveyance versus desalination as alternatives to expand water supply. Desalination 280, 33–43.

Smith, N., 1984. Uneven Development: Nature, Capital, and the Production of Space. Basil Blackwell, Oxford.

Smith, R., 2016. Marketing desalinated seawater from Rosarito Beach to US water users. MSSC 2016 Annual Salinity summit. 27-29 January 2016.

SWRCB, 2012. California Ocean Plan. State Water Resources Control Board, Sacramento.

SWRCB, 2015. Desalination facility intakes, brine discharges, and the incorporation of other non-substantive changes. State Water Resources Control Board, Sacramento.

Swyngedouw, E., 2005. Dispossessing H2O: the contested terrain of water privatization. Capitalism Nature Socialism 16, 81–98.

Swyngedouw, E., 2013. Into the Sea: Desalination as Hydro-Social Fix in Spain. Annals of the Association of American Geographers 103, 261–270.

Swyngedouw, E., Williams, J., 2016. From Spain's hydro-deadlock to the desalination fix. Water International 41, 54–73. doi:10.1080/02508060.2016.1107705

Vedavyasan, C.V., 2007. Pretreatment trends — an overview. Desalination, EuroMed 2006Conference on Desalination Strategies in South Mediterranean Countries 203, 296–299. doi:10.1016/j.desal.2006.04.012

Voutchkov, N., 2004. Seawater desalination costs cut through power plant co-location. Filtration & Separation 41, 24–26. doi:10.1016/S0015-1882(04)00317-9

Voutchkov, N., 2005. Tapping into the Ocean | The Solutions Source of the Water & Wastewater Industry [WWW Document]. Water & Wastes Digest. URL http://www.wwdmag.com/desalination/tapping-ocean (accessed 4.26.16).

Wilk, R., 2006. Bottled Water The pure commodity in the age of branding. Journal of Consumer Culture 6, 303–325. doi:10.1177/1469540506068681

Wilder, M.O., Aguilar-Barajas, I., Pineda-Pablos, N., Varady, R.G., Megdal, S.B., McEvoy, J., Merideth, R., Zúñiga-Terán, A.A., Scott, C.A., 2016. Desalination and water security in the US–Mexico border region: assessing the social, environmental and political impacts. Water International 0, 1–20. doi:10.1080/02508060.2016.1166416

Wolfs, M., Woodroffe, S., 2002. Structuring and Financing International BOO/BOT Desalination Projects. The Journal of Structured Finance 7, 19–24.

Image 1: Reverse osmosis units, Carlsbad Desalination Plant, California. Source: the author.