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The Legal Geographies of Water Claims: Seawater Desalination in Mining Regions in Chile

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Received: 18 December 2018; Accepted: 23 April 2019; Published: 27 April 2019

Abstract: The use of desalination has been increasing in recent years. Although this is not a new technology, its use often proceeds within ill-defined and ambiguous legal, institutional, economic and political frameworks. This article addresses these considerations for the case of Chile, and offers an evaluation of legal ambiguities regarding differences between desalinated water and other freshwater sources and associated consequences. This discussion reviews court records and legal documents of two companies operating desalination plants, both of which have simultaneous rights granted for underground water exploitation: the water supply company in the Antofagasta Region and Candelaria mining company in the Atacama Region. The analysis shows that issues of ambiguity and gaps in the legal system have been exploited in ways that allow these entities to continue the use and consumption of mountain water. They do so by producing desalinated water, and by entering into water transfer and diversion contracts with the mining sector. These findings highlight the importance of undefined socio-legal terrain in terms of shifting hydro-geographies of mining territories, contributing conceptually to critical geographies of desalination, delineating the importance of legal geographies important for water governance, as well as empirically documenting the significance of this case to consider shifts for the mining sector and water technologies and uses in contemporary Chile.

Keywords: water; desalination; legal geography; mining; Chile

1. Introduction: Legal Geographies in New Water Technologies

> "Desalination has been identified as a secure source of water, which guarantees supply stability, avoiding the variability that natural resources present and the shortage in the basins of the northside of the country. For that reason, desalinated water is going to be used in those regions (. . .)".
>
> —Chilean National Strategy of Water Resources [1] (p. 35)

The use of desalination is often proposed as a solution for alleviating drinking water shortages associated with climate change, demographic growth, and attendant water scarcities [2,3]. These socio-environmental needs, coupled with a reduction of the economic cost (technological advances), are supporting the incremental expansion of desalination in many regions of the globe—in the early 1990s, less than 2500 plants were operating and currently there are more than 15,000 [4]. However, despite the promises associated with desalination, critical scholars are observing important socio-environmental drawbacks, such as brine disposal in the marine environment (hypersaline concentrate) and CO_2 emissions associated with the energy consumption required for processing, as well as pumping water

from sea level to high elevations [5,6]. Regarding social impacts, studies are showing inequities related to use and management of desalinated water e.g., often linked with price increases, and uneven water allocation, as well as changes in daily water practices [7,8].

Subsequent work moved beyond examining the effects of desalination, focusing more broadly on hydro-politics. For instance, contributions have highlighted how the technology is proposed for solving transboundary contestations and reducing interdependencies and asymmetrical relations between neighboring countries (e.g., Israel-Jordan, Singapore-Malaysia and United States of America-Mexico in the Colorado River) [9–11]. Such analyses have been critical to highlight environmental and spatial-political contestations associated with desalination promises, showing ways that water technologies play an agential role in shifting nature-society relations. Examples have highlighted such shifts in relation to the privatization of desalination (plants and ocean water), water commodification, and shifting configurations of water governance [2,3,12–14]. Within this body of work, it has been argued that desalination technologies have essentially reversed water flows (traditionally gravity sends water from mountain regions down to coastal areas and urban centers—a pathway that is inverted with desalination). As such, desalination technologies are shifting the socio, environmental, political and economic relations of water [15]. While these insights have been important, the coupling of desalination technologies and shifting water flows with legal spheres has received only cursory treatment, mainly from the perspective of property rights [11]. This article aims to expand the understanding of these linkages—offering a legal geographic analysis to broaden and deepen insights into how desalination is shifting hydro-geographies, water uses, and mining operations in contemporary Chile.

Anticipating the argument that water governance can be shaped by technology, as well as by legal frameworks and knowledges, the concept of the waterscape offers a useful starting point (Budds and Hinojosa [16]). These authors engage the waterscape concept to expand the boundaries of traditional spatial scales and the water's materiality (beyond the watershed), focusing attention on how water is co-produced by social power relations, expressed through e.g., infrastructure, institutions, rights, discourses, legal arenas and technologies. Closely tied with the notion of waterscapes is the broader hydro-social perspective–which involves understanding water flows as being co-produced by socio-economic power relations and technology/ water infrastructure [17]. This framework has become a necessary reference for commentators aiming to describe the relationship between water and society as mutually constitutive [18]. Among other linked contributions, political ecologists have worked to research, explicate, and analyze the ways in which customary patterns, forms of resistance, local knowledge and power imbalances are shaping water cycles [18]. Building upon this framework, legal geographers have analyzed water laws to better understand socio-environmental and socio-economic injustices produced through diverse legal discourses and the multiple overlapping legal frameworks that affect hydro-social systems (covering gaps, ambiguities and the pluralistic character of law) [19–23]. Moreover, critical legal geographers have recently argued that our current legal instruments are often not well adapted to shifting and emergent nature-society dynamics, e.g., artificial water and water requirements for non-humans (animal and plants) [20,24,25]. This work offers an analysis of power imbalances by considering the imposition of legal meanings and discourses over humans and non-humans [22,26,27]. Indeed, access to legal knowledge is often a tool, and one that only certain entities might have access, at the service of spatial-political interventions. The advantages of analyzing legal geographies and nature-society dynamics have been illustrated through the study of natural resources, such as oil, gas and water [19,20,27–29]. Such work has shed light on the multiscalar legal and political geographies, evidencing its effects on environmental governance and ecosystems.

Where does desalination fit in these debates? Despite the rapidly increasing development of desalination in recent years, this is not a new technology. March [30] has traced this technology back in time to sailing vessels employing solar distillation for long expeditions. Later, in 1791, he discusses that Thomas Jefferson reported advances in producing fresh water, and in 1872 there is documentation of the first solar distillation plant installed in Latin America, Chile. This expanding technology, however, is emerging as ever more important in the water landscape of different regions

of the globe. Important for our purposes, it is also being implemented in contexts where the legal, institutional, economic and political frameworks are ambiguous or even wholly undefined. Legal scholars, as well as critical geographers, have stressed such ambiguities, including those pertaining to water rights over the seas (if desalinated water is no longer seawater, does it cease to be public property?) and diverse water management strategies, e.g., privatization of desalination facilities and the water produced [2,10,11,31,32].

Our analysis offers insights as to how these ambiguities are being exploited in ways that allow for companies (those that produce desalinated water) to continue the use of mountain water. They do so through complex articulation with water markets in Chile [33], in ways that serve to shape new water geographies and associated socio-environmental concerns. Related to our intervention here, Rojas and Delpiano [34] (p. 123) have argued that in the Chilean case "there is an area or legal space of desalination, that has been replaced by sectorial regulations, which is generating a patchwork, rather than a legal order". For our purposes, it is important that legal loopholes exist notably for companies operating desalination plants, while having simultaneous and parallel water rights/uses granted for surface water and/or groundwater exploitation.

To advance discussions regarding specific political-legal formations that sustain desalination, and how these socio-legal couplings are reconfiguring hydro-geographies in Chile, we explore these concerns in two dimensions that have not yet been considered by desalination-legal studies: (1) how desalination intersects with existing water rights/uses, and (2) how desalinated water is considered to be equivalent and therefore a substitute for freshwater sources due to its particular characteristics (produced at any quantity and quality). Insights from legal documents and two legal cases are used: Sanitation Service Superintendent v. Council for Transparency 9347–2011; Aguas Antofagasta v. Council for Transparency 9368–2011 (they are companion cases and were litigated together); and, Environmental Superintendent v. Candelaria mining company 140–2016. The case study is important because Chile is likely to become the first country in which desalinated water use will be mandatory for the mining industry—in cases where the fresh water consumption exceeds a rate of 150 liters per second. At the present, the water consumption for the mining sector is composed of direct seawater/desalination; recirculated water, and; surface water and groundwater—either through water rights permits or purchases from third parties (i.e., municipalities, irrigators, water supply companies) [35].

Both projects analyzed in this paper, although differing in many ways (Aguas Antofagasta is the water supply company and Candelaria is a mining company), have some key similarities. For instance, both are not only located in mining territories, but also have water contracts with the mining sector. Water claims against both companies were raised by local organizations (social and public sector), but then, for different reasons, these legal processes were continued by organizations operating at national scales (NGOs and public sector). More importantly, legal discourses in both cases have been constructed in terms of justification for ongoing consumption of mountain aquifers. The analysis is not presented as a comparative study, but is intended to explain the political characteristics of both contexts in order to explore the complex and shifting socio-legal terrain and its interactions with the hydro-geographies of mining, while highlighting water access and quality in different parts of the country.

The outline of the article is as follows: The next section discusses how critical desalination studies can be enriched by engaging with legal geography literature, in order to illuminate gaps and ambiguities of the legal systems and broader legal-political frameworks that might have important implications for nature-society relations. After presenting the methodology, we examine the mining-water nexus in Chile, with special attention to the case study of two desalination plants operating in the Atacama and Antofagasta Regions. The following section explores the gaps of the water legal framework in Chile, both in terms of the desalination permitting process and when desalination intersects with the current water legal system (surface water and groundwater). The paper then turns to discussions of the understanding of new technologies in the legal water system. In the final remarks it is argued

that new water technologies are still inserted into a legal system that has failed to recognized how desalination can shape and be shaped by socio-natural dynamics. In particular, failure to distinguish desalinated water from other freshwater sources results in gaps and loopholes which are currently being exploited by the mining industry.

2. Socio-Legal Terrain in the Advance of Desalination

Desalination, as serving wider political agendas (e.g., by its coupling with economic development and socio-natural pressures) has recently been attracting research interest by critical scholars in geography and allied disciplines [2,10–12,14]. Such analyses served to highlight that desalination is proposed as a 'fix' for solving contestations that are threatening water governance (environmental and spatial-political) over different scalar relations (regional/national and transnational) [2,10–12,14]. By tracing these hydro-social relations, some scholars have also observed that political interactions over water have been reinforced by mutual collaborations through financial agreements, but also by leaving behind contestations and dependency on water transfers [9,10,14]. However, changes in power distribution are observed as shaping water governance and the privatization of oceans [9,10,14].

In these analyses, some scholars have reflected on the intersection of desalination's characteristics with legal and economic frameworks. One of the predominant assumptions is that certain pillars sustaining desalination (legal, environmental and economic, etc.), have contentious characteristics [2,12]. For example in Spain, where desalination was proposed as a 'fix' for urban socio-natural conflicts, it has been argued that desalination is unifying multiple and, sometimes, opposite interests, while at the same time highlighting major concerns, such as: the hegemonic role influencing developmental logics (tourism and agriculture), notions pertaining to legal rights over the seas (the free character of pumping seawater) and the multi-scalar strategies for financing desalination [2,12]. Some of these characteristics were early referred by Meerganz von Medeazza [31] as socially-induced factors, different from direct (i.e., brine and energy), but equally powerful in terms of their unplanned impacts from desalination. This means that in addition to the immediate impacts from the technology's uses, there are other implications derived from the ways that society made use of the technology and the water produced [31].

As a result of the combination of undefined 'techno-legal' frameworks and 'techno-political' characteristics (colocation with infrastructures that increase desalination profit), Williams [11] identifies opportunities for private capital to (re)configure the sphere of water governance. The author demonstrates that legalities are intersecting with desalination in three areas: (1) industrial land zoning and land rights, in terms of suitable locations for desalination and rights to extract water, (2) permitting processes for desalination infrastructure, and (3) new Public-Private Partnership laws for public utilities management. This approach is built on the idea that social relations are flowing through technological solutions, which ambiguous conditions (legal-political) have enabled, in order to transform water into a 'new' cooperative commodity [11].

A legal perspective pushes for consideration beyond conventional preoccupations of political ecologists (power, politics, inequities, ways of knowing and scale). These concerns are important, yet the analysis of power imbalances facilitated and created by legal-political maneuvers offers a new perspective for the understanding of socio-environmental-economic injustices. As Andrews and McCarthy [27] (p. 9) have argued "a political ecology that seeks to examine the full range of contestation over human–environment relationships may, in some contexts, need to devote more attention to the formal political and policy arena and specifically legal geographies". Indeed, legal geography offers to political ecology an important understanding of natural-social boundaries as defined by legal institutions and practices [20,36]. While legal knowledge ruling desalination has been covered mainly from water rights over the seas, notably, what appears to be less developed are the gaps and ambiguities of this legal system in accounting for and distinguishing desalination from other water types/sources. This is particularly important in cases where uses of desalination are intersecting with other water supply sources (mountain water, sewage water and recycled water), and where there

is no effort to distinguish water coming from different sources. As we explore in Chile, these legal loopholes, provide opportunities for ongoing exploitation and reconfigured hydro-geographies of the mining industry.

As such, we engage insights from Budds and Hinojosa [16] (p. 129) particularly emphasis whereby "supply-led technical solutions, proposed and constructed for mining, can significantly modify hydrological regimes and patterns and rules of access". We contend that changes in hydro-social cycles stem from, what we call, the legal coupling. We define this as the insertion of one legal framework into another in order to fill gaps (e.g., loopholes and unclear concepts) for the facilitation of legal-spatial outcomes. This is only one of many ways in which legal and regulatory structures can be changed, deployed and reinforced. Our work suggests that, in desalination, this is enabled by its intersection with broader water legal systems. We understand 'water legal system' as comprising Water Code and Sanitation Law. In doing so, the paper not only adds new dimensions to the discussions of desalination's legal features, but also, to the longstanding debate on 'modern water', wherein water is reduced to its chemical composition H_2O and the social contexts are abstracted [37].

Legal institutions and practices can reveal new definitions of water and, more broadly, approaches to water governance [38]. As such, "With water management being a globally contentious issue, understanding the various interpretations of water underpinning policy could facilitate a critical examination of the assumptions held by policy makers and the likely material outcomes for diverse stakeholders within and across jurisdictions" [38] (p. 170). Here, our emphasis is that legal interpretations of artificial water might expand the understanding of current socio-environmental outcomes. Defining desalinated water, from the perspectives of the public trust doctrine legal principle, and international legislation aiming to protect marine environmental impacts, became a key issue with legal scholars [32,39–41]. Examples of international norms are the United Nations Convention on the Law of the Sea (UNCLOS) and soft laws (the Montreal Guidelines, Agenda 21 and the Washington Declaration). By looking beyond how law responds to technologies in international/national commons, and instead to how socio-legal discourses can make, un-make and re-make spatial forms with corresponding legal spaces and vice-versa [26,36], the study aims to shed light on the complex socio-spatial order, of formal and informal legal instruments, as a product of social power arrangements [26,42–44]. In this sense, we situate our study in legal geography, where urban political ecology has been useful as a means to understand that water policies, environmental needs and social organizations are combining, which represents a (re)politicization of urban waterscapes that creates uneven socio-ecological conditions [12,45].

Focusing on water governance, legal geographer scholars have shown how local communities are challenging national legalities through communal norms of water management and local knowledge [21,23,43]. This is identified as producing plural hydro-social territories [21]. Recently, a less anthropogenic form of water governance is captured by reviewing court cases and the rights of nature 'rivers' to legal defense in court (rights recognized in many Constitutions e.g., Ecuador, Bolivia and Mexico City) [25]. Water requirements for non-humans (animal and plants) have also been proposed through a revision of watershed-scale drought plans, wherein ecological impacts were disclosed as primarily acknowledging impacts to fish [24]. Within this body of work, legal discourses have been highlighted by their particular power in the production of spaces: "The legal process demarcates the boundaries of water politics because the law determines who holds legitimate power to organize, distribute, and manage a region's physical water resources" [19] (p. 615). This means that legal discourses have additional power because the state has participated in their validation and, in its protection, has the force of law behind it [20,26]. Interestingly though, while these studies are quick to point out that these interactions are useful in gaining a better understanding of socio-environmental injustices, desalination technologies have scarcely been mentioned in water-society relations. This paper bridges legal geography with critical geography on desalination technologies. In doing so, it is suggested that it is firstly crucial to understand the existing water legal framework; to do so we use the case of Chile. In the next section we present the methodology used and describe the case study.

3. Methods

3.1. Data Sources and Collection

The research presented here is based on court records, bills and legal documents connected with two different companies operating desalination plants: Aguas Antofagasta S.A., which is the water supply company in the Antofagasta Region and Candelaria mining company in the Atacama Region. The status of the two plants is summarized in Table 1. These methods are complementing and expanding political ecology's methodological toolkit (often composed by field-based research) [27]. Therefore, as was argued by Andrews and McCarthy [27] (p. 9) this allows us "(...) to better understand the legal and political dynamics central to the case that may not be addressed by political ecology's conventional suite of methods". The analysis is not presented as a comparative study, but is intended rather to explain the constrained spaces in the institutional and legal framework of two similar contexts dependent on the mining industry.

Table 1. Companies operating desalination plants under study.

Companies / Desalination Plants		Approved Since	Capacity L/s	Investment (Millions USD)	Final User [1]
Aguas Antofagasta	Desal Tocopilla	2016	200	26	Potable water
	La Chimba	2001/2014 [2]	850	10	Potable water
	Sur Antofagasta	2012	1.000	120	Potable water
	Agua de Mar Antofagasta	2001	602	30	Potable water
Candelaria Mining	Candelaria	2011	300	270	Mining

[1] According to the environmental permit. [2] The plant has been functioning since 2003, but was expanded in 2014.

The data was collected from decisions gathered from the Appeal Court of Santiago (Sanitation Service Superintendence v. Council for Transparency 9347–2011; Aguas Antofagasta v. Council for Transparency 9368–2011) and the Environmental Tribunal (Environmental Superintendence v. Candelaria mining company 140–2016). Since the Law 20417/2010 was enacted, the Environmental Tribunal supplements the new Chilean environmental institutions with the authority to evaluate infractions of the environmental law. These documents are publicly available on each institution's website. Legal documents and bills were collected from websites of the National Congress Library -*Biblioteca del Congreso Nacional de Chile*- and National Congress. Data was triangulated with relevant information available in secondary sources, such as grey literature and newspaper articles covering the court cases.

All Court decisions include the following information: (a) identification of litigating parties (e.g., address and profession) and location of the conflict, (b) type of legal action and details of plaintiff and defendant arguments, (c) detailed description of arguments that, in the court's consideration, served as a basis for the decision, (d) legal references that support the decision, and (e) court decision and date of judgment. The emphasis on this method is oriented to get an interpretation of how law is experienced or 'lived' or, equally, 'law in action', which involves valuing diverse legal discourses of what is needed to achieve socio-natural and socio-economic justices [19]. Therefore, as Jepson [19] argues, the benefits are not only a better understanding of the law, but also the discourses applied to law to naturalize social power.

3.2. Data Analysis

To unpack legal records a coding framework was developed, which captures the following themes: actors involved, water legal system (desalination, surface and underground water), water consumption (underground and desalinated), water physical characteristics (underground and desalinated), and, final water users (underground and desalinated). The assignation of passages of text to one or multiple themes, allow for us to compare all of the different perspectives and opinions about a common theme. Through a consideration of space as a critical element, next to social perceptions of law, we are aiming to dive into the legal geographies [36,44] of new technologies.

This coding scheme allows us to conduct an analysis on the legal discourses about: (a) how desalination intersects the currently existing water legal framework, and (b) how desalinated water reaches parity with the characteristics (quantity and quality) of other water supply sources, making it available as a substitute for fresh water. This analysis enables the identification of gaps and failures in the water legal system, in cases where companies have multiple water sources granted by the state, and nexus with new water claims, which are involving desalination technologies. The next section provides a brief overview of the context of the mining-water nexus in Chile and dives into the context of both case studies. This is done in order to show the permanent interaction of the mining sector and water in Chile.

4. The Mining-Water Nexus in Chile: Water and More Water 'Desalination' for the Mining Sector

Potable water supply companies and mining industries being under the same ownership is not a new story in the mining-water nexus in Chile. During 1878, Tomas North 'the saltpeter king' owned major mining sites and the potable water company in the Iquique Region [46]. Later on (1904), the British investment was expanded to 'The Antofagasta and Bolivia Rail Way Company' and acquired the water supply company in Antofagasta. Back then water was already such a contested resource (between industries and human uses), that even the price of the water personally consumed by miners was deducted from their salaries [46].

The first solar distillation plant for mining uses—Las Salinas mine site (1872)—was also serving as a water provider for their employees. Later, other mining companies started utilizing seawater in their operations: Compañía Minera Tocopilla in 1987 and desalination plant 'Michilla' from Antofagasta Minerals in 1991 [47]. Since 2009, water used in copper mining has been increasingly obtained from ocean water [48]. Here, the geographical characteristic (high altitudes where mining sites are located) and distance from the coast are directly influencing the cost of desalinated water, therefore, while removing salt from seawater represents 51% (average 1.9 US$/m^3) of the total cost, the energy consumed by the pumping system represents 49% (2.6 US$/m^3) [35]. A different cost is associated with the desalination plant capital investment and volume of water treated (see Table 1). By numbers, while the cost of desalinated water represents 5.1 US$/m^3, freshwater is 1.6 US$/m^3 [49]. As a consequence, strategies for reducing pumping cost/energy have been explored. For example, the SWAP model (trading water sources)—which in essence means desalinated water for coastal cities and mountain water for mining—is proposed in many public documents, such as 'Water management and mining in Chile 2007' by the Chilean Copper Commission-COCHILCO, 'From copper to innovation: a technology roadmap 2015–2035' by Fundacion Chile, and even in declarations from public authorities (mining ministry) [50]. In other words, the cost of desalination is not connected with desalinated water users, but instead with geography and distance to the coast –close to the coast would be around 1 US$/m^3 and in high terrain this increases to between 8 US$/m^3 and 10 US$/m^3 [49]. The total water consumption in the mining sector is distributed in 4 areas, which in 2017 represented: concentrator plant (67%), hydrometallurgy (14%), smelting and refinery (4%) and others (e.g., services and mine site) (15%) [48].

The importance of mining in the Chilean economy has been raised through statements such as 'the Chilean Miracle' and 'the Chilean Wage' [51]. In 2016, mining contributed at the national level with 11.2% to the GDP—while the average over the las 10 years has been 14.9% [52]. At the regional level, in the same year, it represented 47% for Antofagasta and 28% for the Atacama Region. In the

Regional Strategies from both, Antofagasta (ERD 2009–2020) and Atacama (ERD 2007–2017), water scarcity is recognized, next to the importance of the mining sector and the encouragement of using desalinated water in place of freshwater.

In addition to water scarcity, and the law aiming to make mandatory the use of desalination for mining purposes, local communities are currently demanding desalination projects as partial compensation or as part of corporate social responsibility efforts e.g., Salamanca community with the Pelambres mining company [53]. The company (owned by Antofagasta plc. group) is planning to build a desalination plant to supply water for both mining and human consumption in the Salamanca community, Coquimbo Region. As we can see, this is the same configuration (mining companies adjusting their interest to potable water service) that arose years earlier when Saltpeter was extracted, and is the same that Aguas Antofagasta experienced, which in 2002 was part of the same Antofagasta plc. In 2015 the water supply company was sold to Colombian investment group EPM (*Empresas Publicas de Medellin*).

4.1. Aguas Antofagasta: Water Supply Company in the Antofagasta Region

Aguas Antofagasta (hereafter A.A.) is the water supplier company (responsible for everything from providing potable water through sanitation services) in the Antofagasta Region. The company acquired the water concession in 2003 through a 30-year contract from ex ESSAN S.A. (state-led company) –under which management, operation and investment are in the private arena. Aside from natural water sources, the company operates desalination plants. Mountain water is captured from the intersection of the Loa and San Pedro Rivers. According to DGA [54], the volume of water authorized for mountain water extractions for this company are: Lequena (550 L/s), Toconce (470 L/s) and Quinchamale (300 L/s). The Loa River's waters have been recognized by the WHO (World Health Organization) for having high concentration of arsenic, and because of this desalination is presented as an alternative for human consumption [8]. Although, since 1978 this situation has improved with water treatment plants [46].

According to the Environmental Impact System Evaluation-SEIA [55] the company has four desalination plants approved for providing potable water, although one of them, Aguas de Mar Antofagasta, is not yet functioning (Table 1). The A.A. website provides information about which communities are receiving desalinated water (Antofagasta, Taltal and Mejillones) and which ones are receiving mountain water, mainly from the Loa River (Antofagasta, Mejillones, Calama and Tocopilla) (see Figure 1). As was identified by Fragkou [8] (p. 77) "(this) is creating three qualitatively different parallel metabolisms of tap water within the same region (. . .) one part of the city is supplied with freshwater, another with desalinated water, and a third part with a mixture of these two".

In 2003, A.A. signed a commercial agreement with the mining company Doña Inés de Collahuasi (located in the Tarapacá Region-Northern from Antofagasta), which included water transfers from the Lequena sector -covering 500 L/s (see Figure 1). In December 2011, the project started its Environmental Impact Assessment (EIA) in order to get approvals for water transfers. This has led to social mobilizations (combining NGOs and local government representatives) claiming that those waters rights' uses were granted for providing potable water—ecological impacts and water as a common resource were highlighted as well [56]. Indeed, the deputy for the region, has stated: "In the region, and province, there is water scarcity, water sources are exhausted, therefore I think that it is absolutely inadequate, inconvenient and risky to trade potable water with a mining company" [57] (p. 1).

Despite water transfers to Collahuasi being canceled, similar freshwater contracts are benefiting several other mining companies, again, in circumstances where those waters where adjudicated to provide potable water services [56]—mining sites involved in those contracts are depicted in Figure 1. Two of the companies involved in the water contracts were under the same ownership as A.A.—until 2015 they belonged to the Antofagasta plc. group (El Tesoro and Esperanza) [56]. This means that the increasing water availability through desalination is strategically coupling with the mining industry, through allowing the continuity and allocation of freshwater for mining uses. As we show through

our case study, water supply companies are legally authorized to sell untreated water to private sectors, with the only requirement being to guarantee water provision for human consumption in the concession area —these contracts are endorsed by the Sanitation Service Law. Alongside this, desalinated water is allocated for human uses, while freshwater is freed for continued consumption for mining purposes.

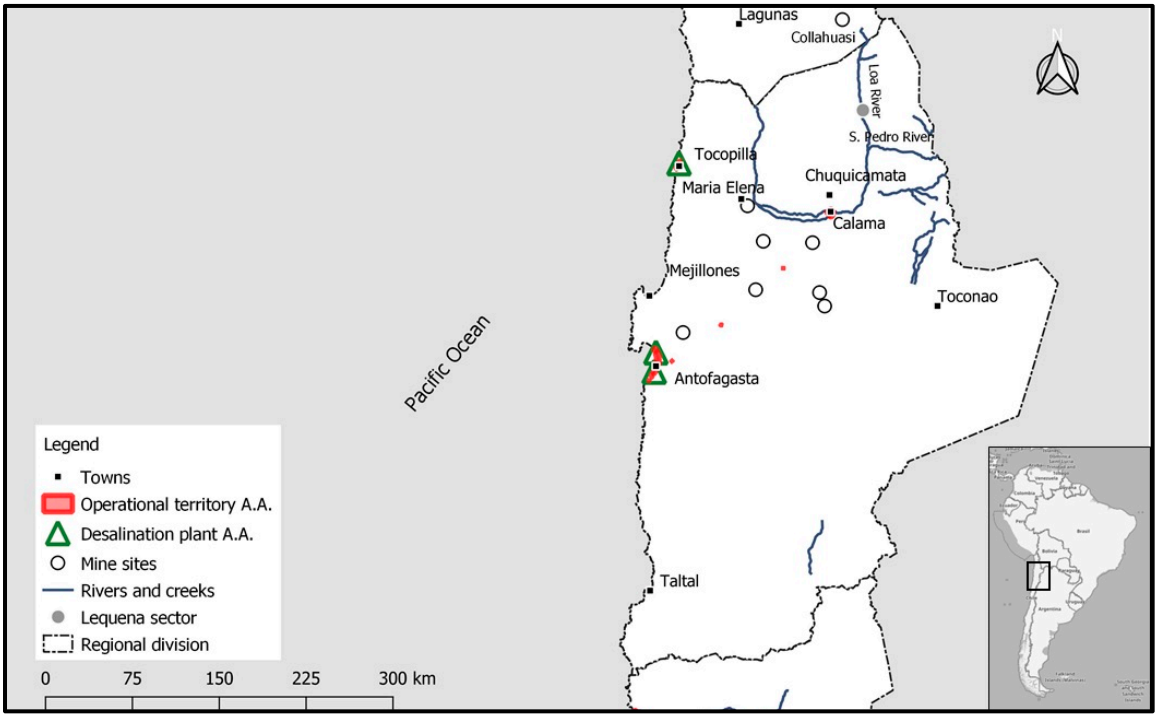

Figure 1. Aguas Antofagasta and mining companies involved in water contracts.

The water market in the region was identified by A.A. as composed of different actors, "on the one hand, mining companies, which are operating both as water consumers and suppliers through desalinated water or seawater without treatment and, on the other hand, water rights' holders, either by selling water rights or supplying freshwater to mining through water contracts. Finally, companies which operate sanitary services, such as Aguas Antofagasta, are participating either by selling freshwater from continental water sources, desalinated water or waste water" [58] (p. 6). Thus, the role of the mining industry is pivotal in framing different water uses and access in the region. Here, the state also plays an important role in deregulating markets, or even opening new venues, e.g., through water swaps.

The demand of public access to the contracts that A.A. signed with mining companies (data of water volumes and water sources), triggered the two companion legal cases under study. Main arguments used by A.A. for the denial of sharing those contracts were: (1) the right to develop private contracts with untreated water (according to the Sanitation Services Law), (2) the poor quality of freshwater (as compared to desalinated), which allows it to have contracts for private water provisions, and (3) the non-jurisdiction of the Sanitation Service Superintendence (hereafter SISS) in private contracts. These documents offer insights into the ambiguities of desalination and the different arguments used to maintain underground water rights' uses, highlighting the water legal framework's failure in accounting for this new technology.

In the final resolution, the Appeal Court determined that the content of these water contracts must be made open to the public [59]. This decision, as was mentioned by CIPER [60] (p. 1) is a "milestone in terms of transparency ... opens the door for the requirement of access to any document from private companies operating in a regulated sector by the state. In other words, it expands the

public boundary and citizen oversight". While this process is a successful story, the ambiguities of desalination remain a blurry arena in terms of its intersection with freshwater sources. The case of A.A., having simultaneous freshwater right uses and desalinated water permits, can provide insights into new techno-legal formations sustaining desalination and how this technology is shaping water governance in mining territories. Similar formations are experienced when mining companies have both water supply sources, as is the case of Candelaria.

4.2. Candelaria Mining in the Atacama Region

Candelaria is a Canadian mining company operating in the Atacama Region since 1995. The project is located about 20 km south of Copiapó city and comprises an open pit and underground mine extracting copper ore. The company also operates a desalination plant, which obtained its Environmental Qualification Resolution (RCA) in 2011 [61] (see Figure 2). In addition to this water source, Candelaria has been granted multiple underground water rights, both in Tierra Amarilla and Copiapó [62]. According to the Environmental Superintendent, the limit authorized for freshwater extractions is 300 L/s [63].

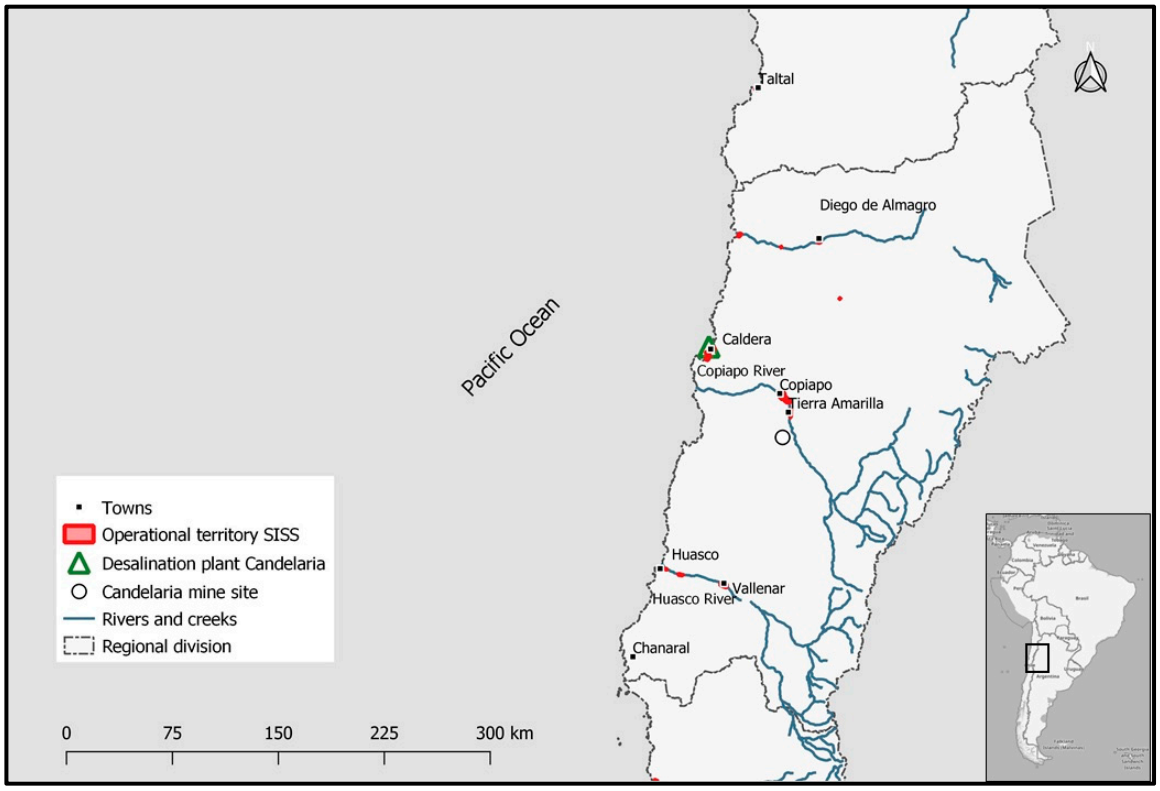

Figure 2. Desalination plant operated by Candelaria.

The Copiapó River watershed has been recognized for having, in general, a good quality—although the mining industry have influenced it with the presence of copper, iron and chromium [64]. The Copiapó and Huasco rivers are the main sources of potable water in the region and both are experiencing water deficits, affecting four communities out of the nine in the region (Copiapó, Tierra Amarilla, Caldera and Chañaral) [65]. In this vein, desalination represents a well-accepted alternative for the reduction of freshwater consumption.

Yet, in January 2014, the Environmental Tribunal received a complaint from the Municipality of Tierra Amarilla, against Candelaria, over environmental damage. Few days later, this complaint was retracted by the same lawyers acting on behalf of the Municipality. According to city councilors, the reason for this was the signing of a multimillion-dollar agreement, between the company and

the Municipality [66]. Despite this agreement, the Environmental Superintendent continued with a sanction process against Candelaria. One of the core arguments in this sanction was the company's non-reduction of natural freshwater consumption [63]. By numbers, over a span of 32 months, Candelaria was selling water to other mining companies (Minosal and CMP), while in 16 of those months water was sold at a rate of more than 50% of Candelaria's freshwater extraction volume -this includes 2013–2014 years, when the desalination plant was operational. Additionally, during the same time frame (years 2013–2014) their freshwater consumption limit was exceeded several times, by 18 L/s to 45 L/s [63].

The ruling references the different water strategies adopted by Candelaria—desalinated, recycled water and sewage water (purchase from the potable water supply company-Aguas Chañar S.A.) [67]. However, the court emphasizes that the company, in the EIA permit approval, acquired the formal commitment of diminishing water extractions (in the Copiapó River watershed) proportional to newly incorporated water sources [67]. The court also referred to Candelaria's water trading: "water deliveries to third parties, without considering its source, have evidenced that, during the months that water deliveries were produced, Candelaria mining had more water available than was needed for its process" [63] (p. 81). In other words, desalination is increasing water sources available for mining use, rather than reducing freshwater consumptions.

The court's final decision was to fine Candelaria with approximately US$ 4,254,473.613, confirming the excessive use and non-reduction of freshwater consumption—considering the alternative water sources integrated in their mining operation [67]. However, similar to the previous case (Aguas Antofagasta), the court does not further elaborate on the gaps and ambiguities of the current water legal systems in accounting for new water technologies and how legal frameworks might be used to continue with freshwater consumptions. The next section explores the legal loopholes that are allowing the pursuit of legal-coupling (desalination with broader water legal systems) in order to sustain their freshwater consumption and uses in Chile.

5. Water Legal Framework in Chile

> "Our legal framework has a lack of regulation (*desalination*), today we use maritime concessions, but they have a different purpose (. . .) Water scarcity and climate change will place Chile at a crossroads."
>
> —Alfonso De Urresti, Senator [68] (p. 1) (italics add by author)

Desalination projects are not new in Chile. However, with new water policies and legal frameworks aiming to confront water scarcity, this technology is likely to increase in the country. By the year 2015, Chile had 20 desalination plants already operating (11 in the mining sector, 8 for potable water and 1 for industrial use) and there are at least other 12 plants planned [35,69]. Nevertheless, to date, these projects have no clear or prescribed permitting process for desalination infrastructure [34,68,70]. Some gaps in the new water framework are identified by the Organization for Economic Cooperation and Development (OECD) [71] as: a) no current land-use planning strategy in relation to the coastline, and b) lack of regulation and institutions to oversee the management and use of the water produced through desalination technologies, etc. As this paper contends, additional gaps appear by paying attention to the intersection of desalination with the current water legal system. Firstly, it is not clear how desalination releases previously granted water rights/uses (surface water and groundwater), nor the final use that would be destined for those waters (e.g., ecosystem, human consumption, industries), and secondly, it is ambiguous how desalination water flows would be accounted for [72,73]. A core question here is: does desalinated water become groundwater, when its uses involve, for example, filling aquifers or reservoirs? [34] (p. 125).

Ongoing legislative changes, in countries such as Spain, are trying to cover some of these gaps by declaring desalinated water as a public property (since 2005), while in the US Supreme Court it is considered under the 'public goods inalienability' principle [74]. Nevertheless, for critical geographers

what remains in question is the management and use of desalination plants and the water produced. This practice has been open to contracts or licenses and, more recently, to forms of Public-Private Partnership e.g., in California and Singapore [10,11].

In Chile, legislative ambiguities and gaps have been somewhat addressed through broad legislation. For example, the right to use seawater has been coupled with maritime concessions — The Maritime Concessions Law DLF 340/1960 and the regulation 002/2005— which were created for non-consumptives uses of seawater (e.g., aquiculture), but not for consumptive uses (either of the natural seawater or the derived desalinated water) [34,72]. In other words, desalination projects are coupling their approvals with procedures stablished for seawater uses that were not framed in terms of technological uses and, more specially, for water extractions. Complementary regulation, although not strictly connected with desalination, is also used as a guideline for these projects e.g., coastline use and zoning (Inter-communal Regulatory Plan for coastline) and environmental permits (EIA) [72].

In the attempt to fix these gaps multiple draft bills are being debated at the Chilean Congress. Besides the draft bill that proposes to regulate desalinated water uses for mining projects [75] there are another two main proposals for this technology: (1) granting to the State the authorization for the construction and management of desalination plants [76] and, (2) regulating seawater uses for desalination [72]. From these documents, and the current legal system, key issues are inferred in desalination from the legal community (e.g., senators, deputies and lawyers). Here we identified three central contradictions.

5.1. Ownership

If desalinated water is no longer seawater, does it cease to be public property? The process of producing artificial water assumed as an extension of maritime concessions, has come with gaps and ambiguities, and one of them refers to ownership [72]. Referring to this, the senator Galilea mentions: "desalinated water through an industrial process isn't natural water, it is the outcome of an industrial process, and therefore telling a company, which is investing, that this is a national good of public interest, is a conceptual mistake" [68] (p. 1).

Further discussions over ownership are referring to water management. This means that even if it is agreed that seawater is in the public domain [34], due to its management, it is becoming amenable to private ownership (e.g., public-private partnerships) [72]. As Swyngedouw and Williams [12] have argued, the free pumping of seawater has already opened debates in terms of legal rights over the seas, and with privatization of the oceans this discussion is likely to increase.

5.2. Desalination Uses and Water Flows

"There is no public definition in terms of guidance and priorities for sea water uses (...)" [72] (p. 7). This declaration, made by a group of Senators, seeks to avoid the replication of current mistakes in the surface water and groundwater regimes, and instead prioritize water for human consumption and aquifer replenishment [72]. Furthermore, this new approach is also highlighting the need for a direct correlation between the purpose that was intended in the desalinated water concession, and the actual final use of that water [72]. This is important in cases where desalination is approved for mining or energy services but, at the same time, is delivered/diverted for communities' uses (see for example Compania Minera del Pacifico selling water to Caserones).

In addition to desalination uses, new concerns are raised over water flows: "To date there is a lack of regulation for water flows extraction and characteristics for specific uses" [34] (p. 120). In some cases, this is read as an economic imbalance between seawater users and surface water and groundwater users [34]. A different reading is expressed by Senator Muñoz, "if there is seawater in excess (that's why we emphasize establishing quantity and purpose), it may happen that free access to water results in that water being sold back to the state for human consumption (...)" [68] (p. 1).

5.3. Desalination and Granted Water Rights' Uses

Desalination is often bound to the idea of restricting legal water rights' uses and releasing water for human consumption and the ecosystem [72]. Nevertheless, the draft bill that regulates desalinated water for mining uses has ambiguities on how it would reach that goal [73]. The legal framework does not specify how desalinated water might be separated from the current water permits granted for surface water and groundwater uses [73]. Additional concerns refer to how desalination would release water right's uses and the final use that would be given to those waters [73]. In summary, there is no clear legal guidance in terms of distinguishing freshwater from desalinated water in scenarios where companies are simultaneously using both water sources. The draft bill reforming the Water Code attempts to address some of these issues by establishing that water for human consumption will have priority over other water right' uses (see draft bill 7543–12). Beyond these existing assessments, we identified in our case studies new ambiguities emerging in terms of how desalination reaches parity with other water supply sources.

In the following section, we show that legal gaps in the intersection of desalination with freshwater sources, have been addressed by a legal-coupling with the Water Code and Sanitation Services Law—with the main purpose of enabling the maintenance of groundwater consumption in support of the mining sector. Given that there is a move to make desalination mandatory, our case studies might offer insights about the role of desalination in mining territories.

6. Discussions in the Understanding of Desalinated Water in the Context of Water Law and Mining Regions in Chile

When desalination legalities started being discussed in the legal community, ambiguities and gaps were raised, mainly, in notions pertaining to its permitting process and the free access to seawater. These debates later evolved to value how desalination intersects with the current water legal system, for example, by considering water flows, water allocations (filling aquifers) and how alters previously granted water uses. In this section, we show that some of the loopholes of desalination have been somewhat addressed by wide water legal frameworks, such as the Water Code and Sanitation Services Law (both legacies of the Pinochet regime).

Here we will disclose that this legal-coupling is enabling the maintenance of consumption of groundwater in support of the mining sector. These issues are identified not only in the mining sector (Candelaria), but also in desalination for potable water services (Aguas Antofagasta). The case studies are revealing two gaps: (1) how desalination alters existing water rights, and (2) how desalination matches up against the purity and quantity of other freshwater sources. Implications of these ambiguities demonstrate the importance of legal and institutional frameworks for how desalination works, or fails to work, under its sustainable promise.

6.1. Desalination in Aguas Antofagasta: Changing Perspectives on Freshwater

Potable water uses of desalination, in addition to environmental permits, must function according to the Sanitation Services Law (1989) and the water quality regulation act (NCH 409/1.OS. 2005). This framework guarantees adequate sanitary services and recognizes desalination as part of them, "sea water will be admissible as a water supply source, through desalination" [77] (Article 15). Nevertheless, as we show, their primary focus on the high quality of desalinated water is affecting the perceptions of freshwater supply sources—at least from desalination plant operators. In other words, while this framework recognizes that desalination can be used to supply these services and must meet the strict potable water quality regulations, we contend, it is failing in: (1) prioritizing water supply sources, and (2) releasing water rights. Thus, desalination is allocated for potable water uses and freshwater consumption is maintained in support of mining industries.

6.1.1. Desalination and Water Supply Priorities

The laws' unique attention to water quality is exploited (by both the water supply company and the water state agency-SISS) to justify freshwater transactions with the mining sector, under the assumption that: freshwater has poorer quality in comparison with desalinated water [59]. Indeed, the artificial character of desalinated water, in terms of it being able to be produced at any quantity and quality—'designer water' [11] (p. 35)—is changing the perspective and priority uses of freshwater. The outcome has been to prioritize desalination for human consumption. The representative from OLCA (the Latin American Environmental Conflicts Observatory) observing this 'game changer' perspective of desalination, mentions: "50% of potable water in Antofagasta is provided by desalination, because in that region, and in particular in that city, mining is the main economic driver, and so they preferred to give fresh water to mining companies rather than to the population" [78]. In her recent study of social impacts of desalination, at the household level in the Antofagasta Region, Fragkou [8] has found that freshwater is perceived as having a higher quality by comparison with desalinated water. This means that between desalination operators and water consumers there are different perceptions of desalinated water quality.

With this in mind, in addition to what many legal scholars have found as a consequence of focusing solely on the regulation of the high quality of desalinated water e.g., ignoring environmental implications (such as cross-border pollution) [34,41], the A.A. case shows how the economic power involved in desalinated water management can prioritize uses of freshwater/desalinated water. As such, legal ambiguities in desalination are being maneuvered to determine water flows of desalinated water, as well as freshwater. In this sense, the use of the Sanitation Service law raises the issue of how water laws can handle the ambiguities of desalination.

6.1.2. Desalination and Water Rights

The legality of maintaining water rights uses for different purposes than potability treatment is rooted in the law that regulates tariffs in the water sector (DFL 70/1988). This law states [79] (Article 24) "if the provider (*public service company*) wants to supply non-mandatory services, it may freely determine payments or compensations with the interested parties" (italics by the author). As we can see, this prescription has failed to anticipate how desalination may increase water supply flows, how to tally them and how to prioritize final water users. Additional water volumes have resulted in A.A. now having 49 non-regulated customers, mainly mining companies [80]. Both A.A. and SISS refer to non-regulated costumers as private businesses, not regulated by the Superintendence of Sanitation Services-SISS, and therefore out of its control and jurisdiction [58].

The permissive right to provide non-mandatory services is used for facilitating economic development through the water network [59]. Their argument is that selling freshwater to mining companies is not regulated by the sanitation legal framework; instead, transactions are operating within the private space boundary. The price at which the freshwater is sold to mining companies varies in relation to water flows, distance, etc. For example, for 342,144 m^3/year (contract between A.A. and Cerro Dominador) the annual price is US$ 272,950.18 and for 1,399,680 m^3/year (contract between A.A. and Sierra Miranda) the annual price is US$ 3,343,402 (for a complete analysis of water contracts see González [81]). What is evident from these water transactions is that desalination operators can account for volumes of water rights granted (freshwater) as distinct from desalinated water flows, which is useful in terms of increasing, and accumulating, water sources and water private provision contracts. Major implications of these contracts are changes in urban water cycles -consuming desalinated water instead freshwater- and increases in water markets [8,33].

Additionally, the importance of connecting these services (non-regulated and regulated) relies on the price paid by the final customer [59]. Yet, as a community member has argued, there is a major issue "(. . .) those waters, were originally for Antofagasta and now, since they are desalinating, Aguas Antofagasta wants to sell them" [82] (p. 376). This suggests that what is at stake is the practice of the economic 'coupling' (keeping Usher's term) [10]–the mining sector sharing the infrastructure built for

sanitary services–with its further effects in determining not only water tariffs, but also water access and, more broadly, water flows.

Responses from the Council for Transparency privileged the public access to private water contracts (which might involve either freshwater or desalinated water), and this approach was confirmed by the Appeal Court of Santiago. The court made a landmark decision: the right to public information prevails over economic interest, especially when it affects sanitation services [59]. While legal authorities agreed that new water contracts could be forced to be open to the public arena, there was little consideration of how artificial water through desalination is enabling the emergence of new water contracts and water accumulation, and how it has been accounted for and prioritized in relation to freshwater. As Larson [41] argues, one of the greatest challenges of environmental law is to respond to emerging technologies. In line with this thinking, this case shows that, not only are environmental laws becoming outdated in relation to more recent technologies, but also water laws.

6.2. Desalination in Candelaria: Tailoring the Legalities of Water Flows

Strategies for reducing freshwater consumption, by Candelaria mining, include: recycled, sewage water and desalination. By numbers, the total water consumption for the 2014 year was 30,095 L/s [63]. Of that number, desalination represented 3837 L/s; sewage water 1272 L/s; freshwater 115 L/s, and; recirculated water 5195 L/s. In terms of calculating the limits of freshwater consumption, it is accounted as equivalent sewage water and desalinated water. Between 2013–2014 the freshwater limit was exceeded in 9 of the 12 months [63]. Thus, water solutions mobilised do not involve reductions of water exploitation, but sustain the mining extractive sector. Enabling this result, we contend, is the still unclear water legal system. The characteristics of the water model are broadly explained by Bauer [83] and Budds [84] in terms of economic and market features (e.g., property rights, minimum state intervention and the freedom to trade water rights). However, the contemporary practices of desalination are revealing new failures of this system. The paradox is that, while the Water Code explicitly excludes seawater, it is evident that desalinated water is altering major hydraulic infrastructures (such as reservoirs and water pipelines) [34]. As we will show, water reductions are usually read in connection with the EIA, however, ambiguities in the legal system are exploited in terms of 'tailoring' freshwater consumption. These strategies are covering: (1) how to account desalinated water flows, and (2) how desalination releases water rights.

6.2.1. Desalination and Water Flows

When Candelaria expanded its operation in 1997, the limit authorized for freshwater extraction was 300 L/s. In 2011, the same water exploitation (300 L/s) was approved for its desalination capacity, with a possibility of expansion (500 L/s) [67]. The EIA granted to Candelaria mining states "to the extent that Candelaria incorporates desalinated water, there is to be a proportional reduction in water extraction (. . .) Mountain water will still be used in case of emergencies (natural events) and operational contingencies" [67] (p. 83). Although the rule may seem straightforward, in practice desalination flows can be tricky to define. This brings up the issue of how desalination flows are intersecting and should be counted in relation to freshwater flows: annual average or monthly maximum flow [67]. These temporal scales meant that they can 'play' with monthly ratios of consumption between water supply sources.

These legal gaps have been addressed by the Water Code. This is inferred from Candelaria's statement when, accounting for water flows, argues: "this is related with groundwater rights grants in aquifers, wherein consumption levels are granted by annual volumes" [67] (p. 77). By this method annual tallies are allowing the mining company to 'play' with monthly ratios of consumption between water sources, and thus justify the partial reduction of freshwater consumption during certain periods of time.

According to the Environmental Superintendent a non-reduction of freshwater consumption occurred between the years 2000 and 2014—its desalination plant has been functioning since 2013 [67].

In this governmental institution there is a different understanding for counting water volumes: "it is not about increasing water sources, but reducing water extractions to the extent that they incorporate different water sources" [67] (p. 99). As such, they've accounted desalinated water by monthly volumes. While the court decision implies reduction of freshwater consumption, as we see, to date there are no clear guidelines in terms of how to account new water flows, nor specificity about final use that would be given to the released water and water rights granted.

6.2.2. Desalination and Water Rights

The Copiapó River watershed is well-known for being a zone of prohibition for new water exploitations. In fact, since 1993, there is legal resolution indicating that water sources in that watershed must be protected (DGA Resolution 193/1993) [67]. However, this resolution is not as straightforward as it seems at first glance. The legalities of water rights' uses are being exploited to sustain water consumption, and ambiguities of how desalination intersects with this water source doesn't seem to provide guidance on further reductions of freshwater consumption.

The legalities of maintaining water rights uses are claimed by Candelaria through using a legal-coupling with the Water Code: "it is a reality that fresh water extraction (...) has affected water levels (*Copiapó River*), nevertheless, it is a legitimate extraction that corresponds to granted water rights (*Water Code*). In consequence, it is not an illegal act" [67] (p. 91) (italics by the author). Effectively, neither the Water Code nor the desalination legal system have prevented this situation. In 2018, the court ruled that the 'legality' of an act can not be used to justify environmental damage [67]. Candelaria's argument is expanded, even further, by referring to water resource diminution as a result of the water legal framework; characterized by the overexploitation of water rights and weak institutional control [67]. This suggests that what is at stake is not simply the water management under the Water Code, but rather how desalination is intersecting and expanding this framework [33].

As the court ruled in this case, there is no discernable legal category which specifies how desalination intersects with other water sources and the release of water rights granted. As such, the mining company has exploited this loophole for the continuity of their freshwater uses. The ruling goes even further by acknowledging that more anthropogenic intervention is needed, in terms of new public policies and regulations to repair the environmental damage [67]. What is remarkable is that this measure is not counting desalination's uses and its socio-environmental implications in terms of increasing water consumption and accumulation, rather than securing water needs. These responses converge with the Aguas Antofagasta case by the acknowledgment of economic development being facilitated through the water network, as well as on avoiding ambiguities that are allowing the continuation of fresh water extraction in cases where desalination plants are operating.

7. Conclusions

The use of desalination is dramatically increasing worldwide [4]. Nevertheless, its legal and political dimensions have, only recently, begun to be evaluated, and concerns about ownership and management are attracting much interest [2,10,11,31,32]. In particular, while the technology is not new, it articulates uneasily with existing social and political frameworks. This in turn leads to legal loopholes, which are exploited by the ways in which society accesses legal knowledge and makes use of both the technology and the water produced. Legal gaps have been maneuvered through, for example, in both the USA and Singapore with new Public-Private Partnership laws for public utilities management, which in turn are offering opportunities for private capital to (re)configure the sphere of water governance [10,11]. As we see from the Chilean experience, legal loopholes are opening opportunities for the continuity of fresh water consumption to benefit the mining industry. As is shown in this paper, additional dimensions for the discussion of desalination's legal gaps are characterized by: (1) how desalination alters existing and parallel water rights/uses, and (2) how desalination reaches parity with the characteristics (quantity and quality) of other water supply sources. The particular attributes of desalination, being able to produce water at any quantity and quality,

must be taken into account in any critical analysis of the technology [11]. In this way, these cases build on existing critical studies in desalination, which have demonstrated that political formations sustaining the 'desalination factory' [11] (p. 35) are permeating in the logics of economic development and privatization of nature [2,10].

The case of desalination plants operating in mining regions in Chile highlights the fact that desalination (quantity and quality) is changing perspectives on other water supply sources. Legal geography pushes for consideration of how desalination legal frameworks intersect with the extant legal and political system in ways that provide a tool for spatial interventions. In this context, the articulation of this technology with existing water laws and legal practices, what we defined as legal-coupling, enables the continued use and consumption of mountain water in support of mining development. We note that in some cases, companies might have different and parallel water sources for their operations, which are often articulated and contested within the realm of formal law and policy. Broad discussions of Chilean desalination's legal framework show ambiguities not only in terms of the permitting process, but also in how this new water source is going to be accounted for in terms of other water sources' uses. Without a clear legal reference, ambiguities and gaps have since been somewhat addressed through broad legislation: The Maritime Concessions Law, Water Code and Sanitation Services Law. Thus, this analysis also complicates recent efforts and calls for making the use of desalinated water by mining companies mandatory. Here, we see that desalination is not necessarily tied to reductions of freshwater exploitation; ambiguous laws and geography (pumping water to high altitude levels) are exploited for changing water flows.

The paper highlights two main gaps in cases where companies operating desalination plants have simultaneous water rights/uses for underground water exploitation. Firstly, the laws' unique attention to water quality for potability, is being exploited to argued that freshwater doesn't meet the requirements for human consumption, whereas desalination can reach higher quality levels. Here we can see how water has been reduced to its chemical composition H_2O and abstracted from its social context [37]. It is, therefore, a 'game changer' for maintaining the use of freshwater in mining and reserving desalinated water for communities. Secondly, the laws' ambiguity over how to count desalination flows, allows the mining company to report only annual volumes. This means that they can 'play' with monthly ratios of consumption between water supply sources and, therefore, they can consume more freshwater during certain periods of time—having in this sense a partial reduction. In other words, the attention is towards augmenting water supplies. As we see, additional implications of these processes are that desalination plants' owners are able to have contracts as water suppliers for mining companies in the region.

Given that there is a movement to regulate desalination, it is important to investigate the role and issues that this technology is facing, both in terms of legal and geographical contexts. The Chilean case demonstrates the importance of both characteristics in how desalination works, or fails to work, in terms of socio-environmental implications. The paper's findings matter for the growing debates about desalination in both academia and by policy makers. On the policy side, the paper shows how legal discourses of nature are allowing maintenance or changes of spatial configurations and how they are articulated and contested through legal-coupling. Therefore, it highlights the importance of having clear rules about how desalination matches up against the purity and quantity of other fresh water sources and the pitfalls for releasing previously granted water rights/uses, while showing how water uses (desalinated and freshwater) are being prioritized. On the academic side, the paper expands debates on the dimensions of desalination's legal features and its implications for supporting economic development through changes in water consumption. Legal practices and legal knowledge are moving desalination critical analysis, towards the understanding of how natural-social boundaries are defined by legal institutions and practices [20,36]. Indeed, access to legal knowledge is often a tool at the service of spatial-political interventions.

Author Contributions: Conceptualization, C.C. and L.M.H.; methodology, C.C.; investigation and develop of the coding scheme C.C.; C.C. and L.M.H. analyzed the data; writing—original draft preparation, C.C.; writing—review and editing, L.M.H.; figures and tables prepared by C.C.; funding acquisition, C.C.

Funding: This research was funded by CONICYT (National Commission for Scientific and Technological Research) Becas Chile, grant number 74180023.

Acknowledgments: We would like to acknowledge the support we received from our colleagues at the University of British Columbia, who provided insight and expertise that greatly assisted in the development of earlier versions of this paper. We are grateful to the three anonymous reviewers whose comments have served to strengthen this article considerably.

Conflicts of Interest: The authors declare no conflict of interest. The funders had no role in the design of the study; in the collection, analyses, or interpretation of data; in the writing of the manuscript, or in the decision to publish the results.

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