

RESILIENT PUBLIC SPACES TO FACE THE ENACTMENT OF LAW 21.364 ON THE NATIONAL DISASTER PREVENTION AND RESPONSE SYSTEM.¹

THE CASE OF THE "LA REINA ALTA" SECTOR IN THE SANTIAGO FOOTHILLS, CHILE

ESPACIOS PÚBLICOS RESILIENTES FRENTE A LA PROMULGACIÓN DE LA LEY 21.364 DEL
SISTEMA NACIONAL DE PREVENCIÓN Y RESPUESTA ANTE DESASTRES. EL CASO DEL
SECTOR "LA REINA ALTA" EN EL PIEDEMONTE DE SANTIAGO, CHILE

JORGE INZULZA-CONTARDO ²
MIRARI RAMÍREZ-FUENZALIDA ³

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- ² Doctor en Planificación y Paisaje
Director Departamento de Urbanismo, Facultad de Arquitectura y Urbanismo. Editor Revista de Urbanismo
Universidad de Chile, Santiago, Chile
<https://orcid.org/0000-0003-4578-4550>
jinzulza@uchilefau.cl
- ³ Magíster en Urbanismo
Arquitecta de la SUBDERE, unidad Región Metropolitana
Unidad Regional Subsecretaría de Desarrollo Regional y Administrativo (SUBDERE)
<https://orcid.org/0009-0008-0498-4090>
mirari.ramirez@ug.uchile.cl

La accesibilidad a espacios públicos seguros ha tomado cada vez más interés en el contexto urbano, sobre todo en aquellos países que comparten el Anillo de Fuego del Pacífico. Lugares capaces de albergar requerimientos de prevención y respuesta ante desastres. Por su parte, la entrada en vigencia de la Ley N° 21.364 en Chile, que establece el Sistema Nacional de Prevención y Respuesta ante Desastres, abre la discusión sobre las posibles formas de implementar -en la escala comunal- los mecanismos que permiten operativizar la prevención y respuesta ante desastres en los territorios habitados vinculados de alguna manera a la comunidad involucrada. Los municipios deben hacerse cargo de la actualización de los Planes de Emergencia Comunal y los Planes para la Reducción del Riesgo de Desastres. Sin embargo, aún no existe claridad sobre la aplicabilidad de estos instrumentos. La investigación tiene por objetivo definir grados de vulnerabilidad para el sector de La Reina Alta, en Santiago, Chile respecto a los riesgos asociados a la presencia de la Falla San Ramón y a las quebradas cordilleranas, para priorizar la necesidad de inversión pública de escala comunal. Por medio de una metodología exploratoria mixta se hace un levantamiento cartográfico de La Reina Alta que incluye indicadores de riesgo asociados a la Falla San Ramón y a las quebradas cordilleranas, déficit de accesibilidad a parques y plazas públicas, y ubicación respecto de las áreas de riesgo. Los resultados muestran que es posible apoyar la formulación de proyectos municipales de habilitación de espacios públicos con criterios resilientes que aborden, tanto la infraestructura aplicable para mejorar estándares, como la institucionalidad, el capital social, y la educación a la comunidad con entrega de información respecto de los tipos de riesgo que enfrenta su territorio.

Palabras clave: espacio público, resiliencia, Ley N° 21.364, falla San Ramón, vulnerabilidad, La Reina.

Accessibility to safe public spaces capable of complying with disaster prevention and response requirements has become increasingly important in the urban context, especially in countries that share the Pacific Ring of Fire. The enactment of Law N° 21.364 that creates the National Disaster Prevention and Response System opens the discussion on the possible ways of implementing communal mechanisms that allow disaster prevention and response to be operationalized in inhabited areas involving the community. The municipalities must oversee updates to the Communal Emergency Plans and the Disaster Risk Reduction Plans. However, there is still no clarity on how applicable these instruments are. This research aims to define degrees of vulnerability for the La Reina Alta sector, in Santiago, Chile, that are related to the risks associated with the San Ramón Fault and its mountain ravines, to prioritize the need for public investment at the communal level. A cartographic analysis of La Reina Alta uses a mixed exploratory methodology, including risk indicators associated with the San Ramón Fault and the mountain ravines, the lack of accessibility to parks and public squares, and their location regarding risk areas. The results show that it is possible to support the formulation of municipal projects to develop public spaces with resilient criteria that address both the applicable infrastructure to improve standards, as well as institutionality, social capital, and community education, providing key information regarding the types of risk that their area faces.

Keywords: public space, resilience, Law N° 21.364, San Ramón Fault, vulnerability, La Reina.

I. INTRODUCTION

Accessibility to safe public spaces has increasingly become of interest in the urban context, especially in those countries that share the Pacific Ring of Fire⁴; places capable of hosting disaster prevention and response requirements (Antinao *et al.*, 2003). In addition, the possibility of having resilient spaces with adequate infrastructure allows the inhabitants not only to take shelter but also to inform themselves in the event of a catastrophe. In this way, public space can become essential in local-level planning, as a scenario where the recognition, congregation, and organization of the community involved can be carried out (Berroeta *et al.*, 2016).

For the Chilean case, the enactment of Law N°21.364 of 2021 (Ministry of the Interior and Public Security [MISP], 2021) established the National Disaster Prevention and Response System. This modifies how the State handles disaster risk management, creating the National Disaster Prevention and Response Service (hereinafter, SENAPRED), which replaces the National Emergency Office of the Ministry of the Interior (ONEMI). Chile's public and private entities are organized at different scales. They address the national, regional, provincial, and communal levels, including local governments, which play a greater role at the latter level through the priority allocation of budgets to finance the development of disaster risk management instruments (Pontigo & Inzulza, 2023). However, so far it is not clear how this action could be operationalized spatially in the area under municipal control, which opens the discussion and allows proposing ways to approach it, especially in public spaces intended for people to shelter, where today it is possible to focus resources through public investment (Berroeta *et al.*, 2016).

This research is based upon a case study under the implementation of Law N°21.364 in the inhabited area of Santiago Andean foothills, analyzing access to parks and squares (CNDU & INE, 2019b; CNDU & INE, 2019a) to provide protection conditions to safeguard the lives of those living there (Romero & Vásquez, 2005). The research aims to define degrees of vulnerability for the specific "La Reina Alta" sector located in the commune of La Reina, in the eastern part of the Metropolitan Region. It is one of the areas subject to the geological risks associated with the San Ramón Fault (hereinafter SRF), which extends

along the area (Inzulza-Contardo *et al.*, 2021), with its crisscrossing ravines (Easton *et al.*, 2018).

The article is divided into four parts. First, an applied theoretical framework is provided regarding the importance of resilient public spaces and their implementation by municipal management under Law N°21.364. Then, the mixed exploratory methodology is outlined, with a cartographic survey that considers risk indicators associated with the presence of the SRF and the cordilleran ravines, the lack of accessibility to parks and public squares, and the location considering the risk areas. Subsequently, the results show the possibility of formulating municipal projects to provide resilient public spaces in La Reina Alta, considering a collaborative definition of resilient public space. Finally, conclusions are provided on the importance of addressing resilience in a way that goes beyond improving infrastructure standards, including institutional, social capital, and education, providing information.

II. THEORETICAL FRAMEWORK

Resilient public spaces for disaster risk prevention

Risk is understood as a constant in Chile, so it is necessary to assume and incorporate it into the city design process to build resilient cities. For its part, urban resilience is defined as the ability of an urban system to absorb and recover quickly after an event by maintaining continuity in its services (United Nations-Habitat [UN-HABITAT], 2016). Within this system, there is an agreement that mentions that the public space is part of the built system (Allan *et al.*, 2013) capable of reducing and mitigating risks, which can contribute to a city's recovery process (Soto & Escobar, 2020). However, this requires the definition of strategies, especially at a local level (UN-HABITAT, 2016), which can be articulated within the three pillars of urban resilience: structural, institutional, and social capital (Baeriswyl, 2014). Regarding the structural part, the urban design of public spaces and how it seeks to reduce vulnerability of the urban territory is crucial. This includes acknowledging risk areas, implementing mitigation measures, and using the scope of the IPT to coordinate land uses and permitted activities, considering the threat level presented by each sector.

⁴ The "Pacific Ring of Fire" is a subduction zone located on the coasts of the Pacific Ocean. It is characterized by some of the most important and active seismic and volcanic regions in the world. It comprises the mountainous area of western Argentina, Chile, Peru, Colombia, Panama, Costa Rica, Nicaragua, El Salvador, Honduras, Guatemala, Mexico, the United States, Canada, the Aleutian Islands, Russia, Japan, Taiwan, the Philippines, Indonesia, Malaysia, East Timor, Brunei, Singapore, Papua New Guinea, the Solomon Islands, Tonga, Samoa, Tuvalu, and New Zealand.



Figure 1. Disaster risk management instruments in the new institutional framework. Source: Asociación Chilena de Municipalidades [ACHM] (2022).

Another important point is the need for an evacuation network that is properly signposted and capable of guiding the population to safe sectors.

As for institutionality, the State's presence in the area is the key actor in managing prevention measures for inhabitants and places where they congregate. In particular, care should be taken about how resources and coordination are distributed at different scales at different stages of the disaster management cycle. Similarly, incorporating and classifying spaces intended for protection, especially in the public space, as anchor places to organize preventive and reactive tasks is essential (French *et al.*, 2019). This allows implementing education and information programs for the community, coordinating early warning systems, upholding public order, attending to the affected communities, and conducting the reconstruction processes (Baeriswyl, 2014).

Regarding social capital, the idea is reinforced that the community's collective action before, during, and after a disaster allows for a resilient response. In this sphere, public space becomes relevant, especially in post-disaster stages, when a series of actions related to reconstruction are required. These tend to activate communities' perceptions of urban space while conditioning new appropriation practices (Berroeta *et al.*, 2016). The public space is therefore transformed into a stage where the recognition, congregation, and organization of the community involved can take place.

Similarly, it is important to promote community participation in disaster risk reduction activities, which implement strategies and encourage concerted actions, attributing roles and responsibilities, delegating tasks, and managing volunteers for the different phases of the risk cycle (United Nations International Strategy for Disaster Reduction [ISDR], 2017). For risk management education and providing relevant information to the community, the starting point for promoting a resilient culture is publicizing the threats and factors affecting the territories' vulnerability.

The implementation of Law N°21.364 in municipal management

Law No. 21,364 incorporates into its proposed new system a set of public and private entities with competencies in the different phases of the disaster risk cycle: mitigation, preparedness, response, and recovery. These entities are organized at the communal, provincial, regional, and national levels and seek to provide suitable disaster risk management. This process is understood as a continuous social, professional, technical, and scientific process where policies, plans and programs, regulations, instruments, standards, permanent measures, and actions for updating knowledge and disaster risk reduction are formulated, executed, and monitored to avoid the generation of new disaster risks, reduce existing risks, and manage residual risk (MISP, 2021).

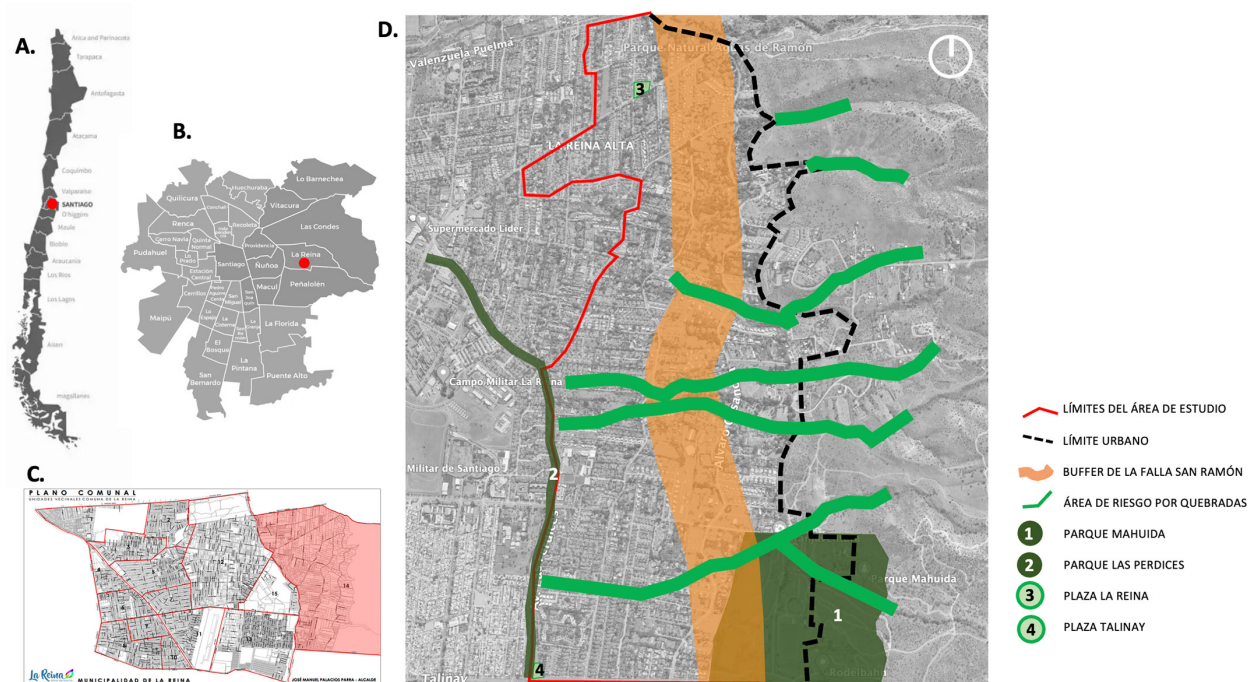


Figure 2. A. Location of the Metropolitan Region of Santiago in the country context; B. Location of the Commune of La Reina on the regional scale; C. Boundaries of the Neighborhood Unit N°14 “La Reina Alta” in the communal context and D. Layout of parks and public squares, associated with the San Ramón Fault and cordilleran ravines in La Reina Alta. No scale. Source: Preparation by the authors, based on Google images of the Municipality of La Reina and Landsat/Copernicus Google Earth Pro image, 2022; Curihuinca (2021); Ministry of Housing and Urban Development [MINVU] (1994)

For risk management instruments (Figure 1), the Communal level committee is responsible for reaching the necessary agreement to approve, by mayoral decree, the Communal Disaster Risk Reduction Plan and the Communal Emergency Plan, which are prepared in each municipality's Disaster Risk Management Unit. These documents must consider threat and risk maps. To finance these instruments, municipalities can participate in the Disaster Risk Management Program, part of the SENAPRED budget and regulated in Article 41 of Law No. 21,364.

Disaster Risk Management Plans at all levels should work in a coordinated manner. Those with a national scope will prevail over regional and, the latter, over communal ones. In addition, they must consider the local reality and the special characteristics of each area in question (MISP, 2021). In particular, the Communal Disaster Risk Reduction Plan considers the National Strategic Plan for Disaster Risk Reduction guidelines and all the necessary actions to reduce vulnerabilities in its area. It must also consider the risk and threat maps, which relate directly to the communal territory's Community Development

Plan (PLADECO, in Spanish) and Planning Instruments (IPT, in Spanish).

III. CASE STUDY

The “La Reina Alta” sector, chosen as the case study, is part of Neighborhood Unit N°14 “Reina Alta” and has the following boundaries. To the North with the communal boundary of La Reina, Valenzuela Puelma Street; to the East, the urban limit; to the South, the communal boundary on Talinay Street (its continuation to the east, to the urban limit, along Rodelbahn Road is considered); and to the west, the main intersections located outside the areas directly affected by the risks studied (Figure 2). This western edge, from north to south, is the streets of Valenzuela Puelma interior, Helsby, Onofre Jarpa, Escultora Rebeca Matte, Escritor Benjamín Subercaseux, Carlos Silva Vildósola, María Monvel, and Avenida Las Perdices.

La Reina Alta is subject to risks associated with the San Ramon Fault (Easton *et al.*, 2022) and, from north to



Figure 3. Parque Las Perdices. Source: Photographic archive M. Ramirez, 2024



Figure 4. La Reina (left image) and Talinay (right image) Squares. Source: Photographic archive M. Ramirez, (2024).

south, the María Monvel, Las Cabras, Paidahue, Carpay, Verde, and Parque Larraín ravines (Municipality of La Reina, 2010; MINVU, 1994). Considering communal and local scales, a list of public spaces was made for municipal upkeep and control in the study area. The first relates to the parks that inhabitants of the commune in question and neighboring communes generally use. The second is linked to the squares, as spaces on a more limited scale, such as the neighborhood.

It is possible to identify two parks: Mahuida and Las Perdices. The Mahuida park is located within the risk area of the Parque Larraín ravine (MINVU, 1994) on the south-eastern boundary of the study area. The park's western sector is located within the San Ramón Fault buffer zone

(Curihuinca, 2021); as such, it cannot be considered a safe zone. On the other hand, Las Perdices Park (Figure 3), a linear park, runs through a large part of the study area from south to north, on the western side, outside the San Ramón Fault buffer, and in an area without risk associated with the ravines, so it is suitable for the study.

There are only two squares, La Reina and Talinay (Figure 4). La Reina Square is used regularly by the neighbors. It is located in the northern sector of the study area. It works as an integrated and consolidated space with suitable equipment. Talinay Square, located on the south-western boundary of the study area, is small and triangular. However, it acts as a space to wait for public transport.

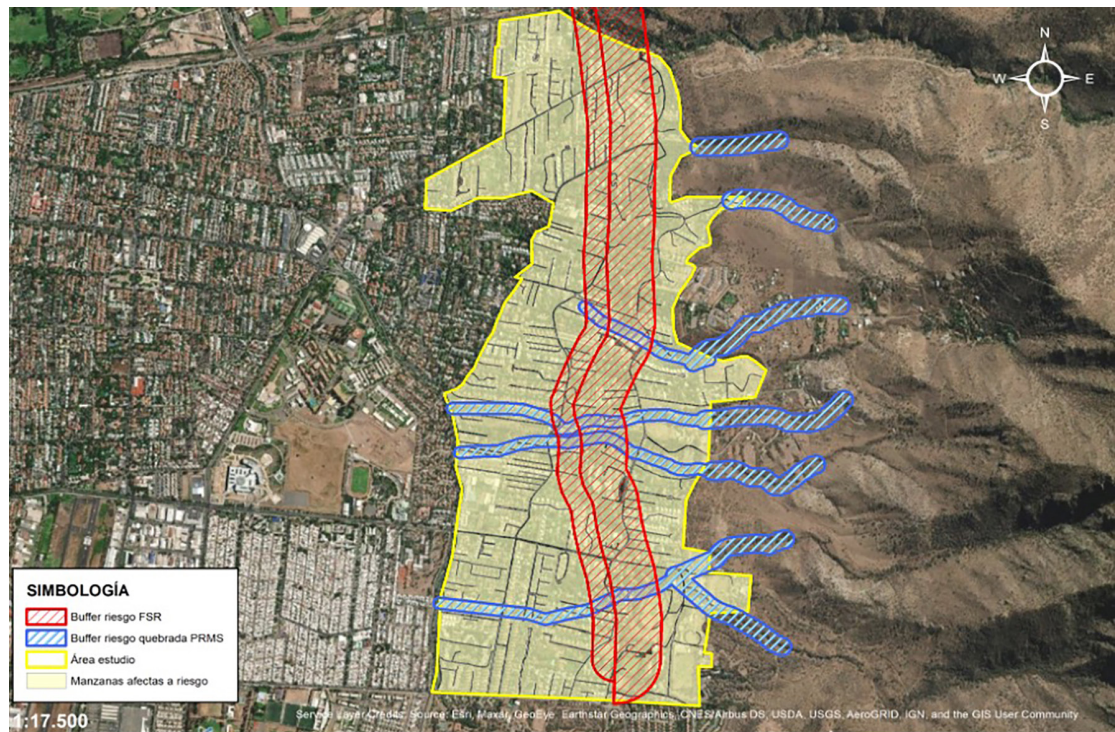


Figure 5. Risk areas within the La Reina Alta study area. Scale 1:17,500. Source: Ramírez (2024) based on INE (2017); Curihuinca (2021); MINVU (1994)

IV. METHODOLOGY

The research approach is mixed exploratory, including qualitative and quantitative methods, which are applied in the case study (Hernández et al., 2014), the Reina Alta sector, in the commune of La Reina, affected by the San Ramón Fault and cordillera ravines. The work was carried out in two periods: from March to May and from September to October 2023.

On the one hand, the preparation of graphic and cartographic material was consulted regarding the risk associated with the presence of the SRF and the cordillera ravines, the deficit of accessibility to parks and public squares, and the location of the analyzed blocks compared to the defined risk areas in La Reina Alta. The indicators used are data obtained from Curihuinca (2021), Santiago Metropolitan Regulatory Plan [PRMS, in Spanish] (MINVU, 1994), the standards of the Urban Development Indicators and Standards System, proposed by the Urban Development Council [CNDU, in Spanish] and the National Institute of Statistics [INE, in Spanish] (CNDU & INE, 2019b; CNDU & INE, 2019a), and resilience indicators of UN-HABITAT (2016).

The review of secondary theoretical framework sources allowed developing the collaborative concept of resilient public space, which is discussed in the section after the results.

In addition, a vulnerability ranking was generated for the study area's 19 blocks. This considers the variables of overcrowding, dependence, quality of buildings, building data, population density, accessibility to parks, and accessibility to public squares.

V. RESULTS

Risk associated with the presence of the San Ramón Fault and the cordillera ravines

Within the study area, the seismic risk associated with the San Ramón Fault (Easton *et al.*, 2022) and the risk of landslides and flooding from the cordillera María Monvel, Las Cabras, Paidahue, Carpay, Verde, and Parque Larraín ravines, from north to south (Figure 5), are plotted in the restriction and protection plan of the 2001 La Reina Communal Regulatory Plan (Article 8.2.1.1. Flooding. MINVU, 1994).

	Surface area occupied by lots (ha)	N° of inhabitants
Commune Total	1,334.99	92,678
Blocks subject to risk	249.14	6,868
Total risk areas	154.45	4,260
Areas at risk from SRF + ravines	41.33	1,139
Risk areas from ravines	31.11	938
Risk areas from SRF	78.91	2,175

Table 1. Surface area (ha) and number of inhabitants exposed to risk from the SRF, cordilleran ravines, and overlapping risks. Source: Preparation by the authors based on ArcGIS GIS; Ramírez (2024)

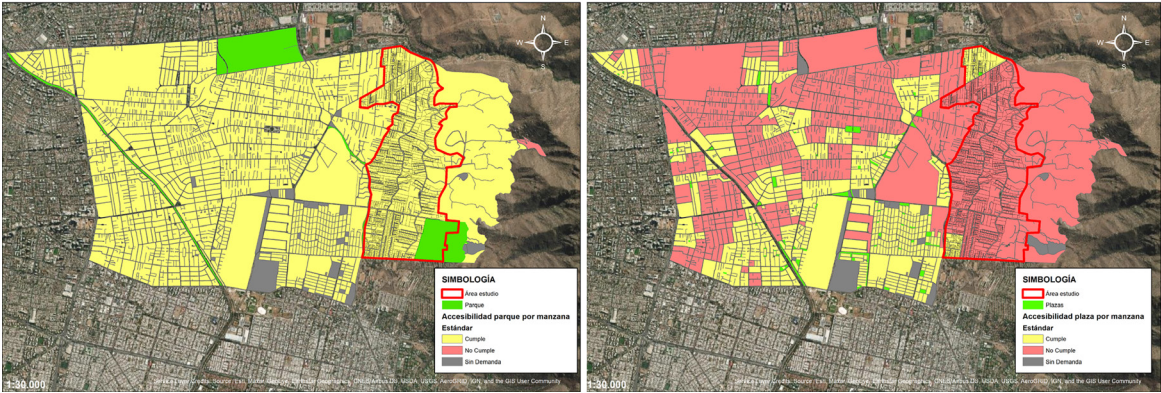


Figure 6. Accessibility to parks (left) and public squares (right). Scale 1:30,000. Source: Preparation by the authors based on ArcGIS GIS; Ramírez (2024)

Regarding the blocks affected by each of these risks or both overlapping risks (Table 1), it can be summarized that about 5% of the total population lives in the risk areas due to the San Ramon Fault and/or the cordilleran ravines, a total of approximately 4,260 inhabitants. 1,270 of the homes were built before 1997 and are located in areas at risk from the SRF and/or the ravines. These housing units do not comply with the NCH 433 Seismic Standard approved in 1996 (National Institute of Standardization [INN], 1996). In addition, 3.31% of the communal total of houses built before 1997, without Seismic Regulations, are located in risk areas, either due to SRF and/or the cordilleran ravines.

Lack of accessibility to public parks and squares

The accessibility to the commune's public parks from the study area blocks was analyzed using the Urban Development Standards and Indicators System (CNDU & INE, 2019b). This system considers a distance of up to

3,000 meters to the nearest Public Park with an area equal to or greater than 20,000 m². This indicator measures the weighted average minimum distance between the geometric center of each populated block and public parks. The distance is measured through the road networks, from the geometric center of each block to the nearest public park. In this way, it is possible to know the availability of potentially resilient communal public spaces, where the municipality could outline projects to host prevention tasks and respond to possible disasters.

For accessibility to public parks, it can be pointed out that the study area's blocks comply with the Urban Development Standards and Indicators System (Figure 6, left image). However, this considers Mahuida Park, which is not a candidate to be qualified as resilient since it is located in the risk area of the Parque Larraín Ravine, on the south-eastern boundary of the study area, and its south-western side is located within the FSR buffer zone. On the other hand, the condominium typology predominates in

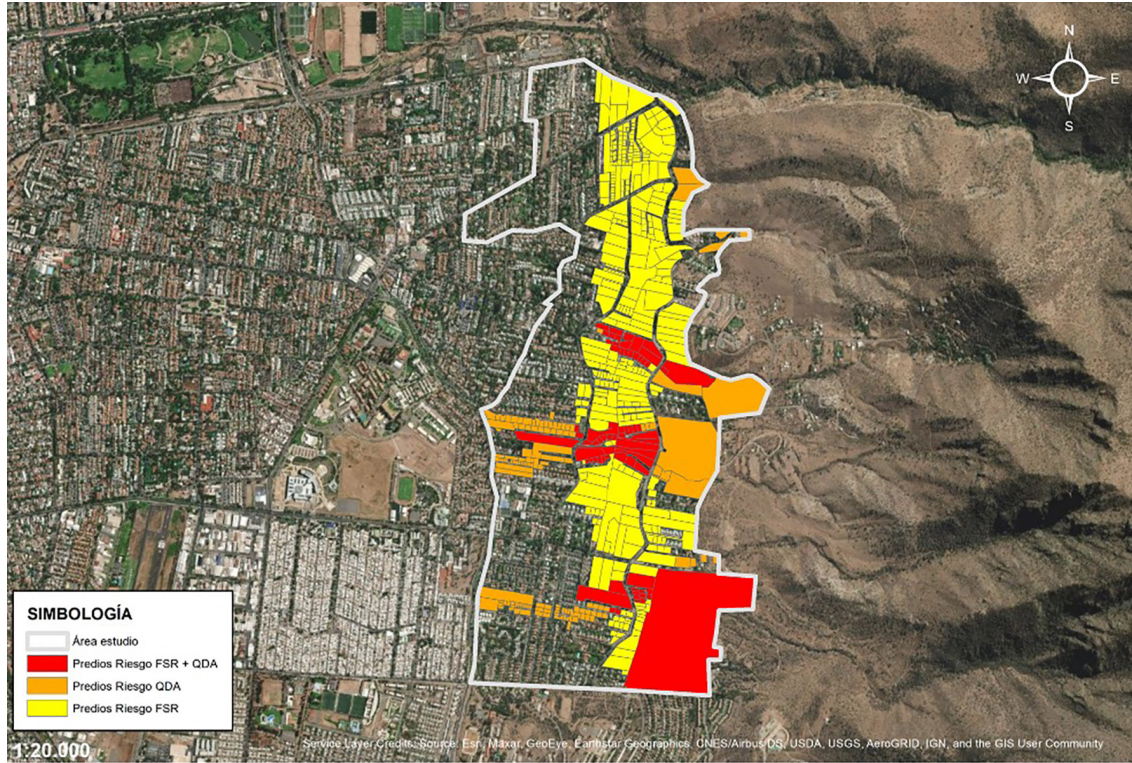


Figure 7. Properties at risk from the SRF and the cordilleran ravines. Scale 1:20,000. Source: Preparation by the authors based on ArcGIS GIS; Ramírez (2024)

the study sector, with a network of passageways and zero green infrastructure or open spaces on a communal scale.

Regarding the accessibility to public squares in the study area, as for public parks, the Urban Development Standards and Indicators System is considered (CNDU & INE, 2019a), but with a distance of up to 400 meters to the nearest Public Square, which has an area between 450 m² and 19,999 m². This allows knowing the load capacity of the urban area's public squares compared to the population. Within the potentially resilient neighborhood public spaces, most of the blocks in the study area do not comply with the SIEDU standard regarding accessibility to public squares (Figure 6, right image), highlighted in red. Only two places were identified in the study area: La Reina and Talinay. The La Reina Square is located in the northern sector of the study area, while Talinay Square is located on the western southern boundary of the study area.

Property location considering the risk areas

The risks linked to the San Ramón Fault and the ravines in the study area were analyzed using the La Reina PRC Restriction and Protection Plan and Article 8.2.1.1. Flooding (MINVU,

1994). This method allows us to identify the blocks affected by the overlapping risks of the San Ramón Fault or the study area's ravines (Figure 7).

The properties affected by both analyzed risks are identified in red; the properties affected by landslides and flooding risks associated with the presence of the cordilleran ravines are marked in orange; and the properties directly affected by seismic risk are displayed in yellow, on being located within the buffer zone of the San Ramón Fault.

Vulnerability ranking of the blocks considering the analyzed factors

According to the analysis in this research, a vulnerability ranking was applied in La Reina Alta, considering a polygon formed by nineteen blocks. This included a layer analysis that considered seven variables (Table 2). For overcrowding, the number of households with more than 2.5 people per bedroom was taken into account, using data from the 2017 CENSUS (INE, 2017); for dependency, the number of people between 0 and 14 and over 65 per dwelling was considered, by census area according to the 2017 CENSUS (INE, 2017); for the quality of buildings, the average of categories (from

Block N°	Overcrowding	Dependence	Building Quality	Building Data	Population Density	Park Accessibility	Square Accessibility	Total
1	1	1	1	1	1	1	1	7
2	1	2	1	1	1	1	1	8
3	1	1	1	1	1	1	3	9
4	1	1	1	1	1	1	3	9
5	1	1	1	1	1	1	3	9
6	1	1	1	1	1	1	3	9
7	1	1	1	1	1	1	3	9
8	1	1	1	1	1	1	3	9
9	1	1	1	1	1	1	3	9
10	1	2	1	1	1	1	3	10
11	1	2	1	1	1	1	3	10
12	1	2	1	1	1	1	3	10
13	2	2	1	1	1	1	3	11
14	2	2	1	1	1	1	3	11
15	2	2	1	1	1	1	3	11
16	2	2	1	1	1	1	3	11
17	2	2	1	1	1	1	3	11
18	2	2	1	1	1	1	3	11
19	2	2	1	1	1	1	3	11

Table 2. Weighting of the variables analyzed by block. Source: Preparation by the authors based on GIS ArcGIS; Ramírez (2024)

1 to 5) per block was considered, according to data from the Internal Revenue Service of Chile (SII); for the data on the buildings, the number of homes before 1997 was considered, per block. It is relevant to mention that the NCH 433 Seismic Standard was approved in 1996.

SII (Chilean Internal Revenue Service) data was used. The total number of inhabitants per hectare per block was considered for the population density variable. Compliance with the accessibility standards of the Urban Development Indicators and Standards System was considered for accessibility to parks and public squares. Finally, to determine the location of the studied blocks concerning the risk areas, the blocks affected by overlapping risks and the direct risk from the SRF and the ravines of the study area were identified (Curihuinca, 2021; MINVU, 1994).

The variables mentioned were later weighted on a scale of 1 to 3, where 1 represents a good standard, i.e., "complies," 2 a regular standard or "partially complies," and 3 a poor standard, which translates as "does not comply." In addition, it was determined that the blocks with a higher number (in this

case, 11) were the most vulnerable since they faced a higher "non-compliance" regarding the analyzed factors.

Regarding the sector analyzed in La Reina Alta, the most vulnerable blocks are those located on the eastern edge of the study area, with a weighting of 11 (Figure 8). The indicators affecting this result most are the lack of accessibility to squares, greater overcrowding, and a higher dependent population. These findings highlight the need to provide more public spaces for neighborhood-scale permanence, which can host activities related to disaster prevention and response. Due to the lack of municipal spaces in the sector, it becomes necessary to adapt municipal spaces that today have other uses or to acquire new land for these purposes.

On the other hand, the need to improve connectivity to the network of existing, potentially resilient, public spaces becomes evident. Due to the sector's predominant housing typology, the area has been structured based on closed passageways and blind streets running east-west (Figure

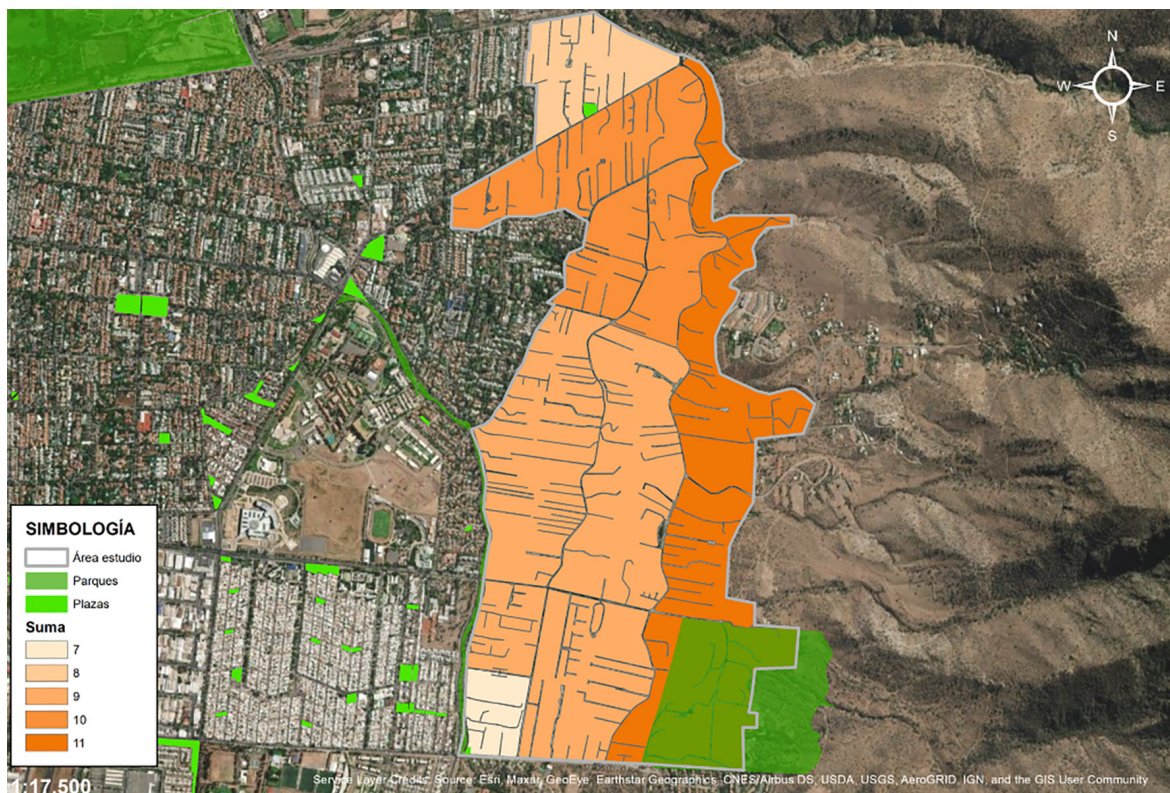


Figure 8. Determination of vulnerability by blocks, according to the factors analyzed in the study area. Scale 1:17,500. Source: Preparation by the authors based on ArcGIS GIS; Ramírez (2024)



Figure 9. A sample of the type of urbanization predominant in the study area. Scale 1:30,000. Source: Preparation by the authors based on images from Landsat/Copernicus Google Earth images and the Street View tool

9). These lead to small-scale North-South roads with little connectivity to the west, where the safe areas for the analyzed risks are located. This would undoubtedly hinder evacuation in case of an emergency.

The least vulnerable block, with a weighting of 7, is located in the southwest corner of the study area, which Talinay Square serves. The other vulnerability factors analyzed also have lower values than the rest of the blocks.

VI. DISCUSSION

The research led to the discussion of crucial aspects behind urban resilience - applied in public spaces for permanence - and that should structure the design process and later the operation stage: the resilient infrastructure dimension, the institutional dimension, and the social capital dimension (Baereswyl, 2014; Cabrera *et al.*, 2020; Riquelme, 2022). As a complement, and considering the recommendations of the International Seminar for Disaster Reduction (ISDR, 2017), a fourth dimension related to education and delivery of information to the community regarding risk is incorporated.

Figure 10 presents the collaborative construction of the concept of "Resilient public spaces." First, it highlights the tangible and intangible aspects that will allow the development of resilient public spaces. The built area and infrastructure are tangible, and social capital is intangible. These two areas are articulated thanks to two hybrid dimensions: institutionality and access to education and information.

Secondly, the infrastructure dimension is conceptualized in two large groups: safe flows, defined by evacuation routes; and safe spaces to stay, such as parks and squares, located in safe areas not affected by the considered risks. The aim is to move towards flexible, multifunctional spaces designed for people, adaptable to the different stages of the disaster management cycle, and capable of responding to everyday requirements. In addition, these spaces should support prevention through education and empowerment of the affected communities. They should also be places to meet, collect, provide support, and organize the response after the disaster. However, these measures are insufficient as resilient public spaces can act as spatial and social support, housing the community, allowing its organization and strengthening.

For sheltering in a public space to be consolidated as resilient, it is necessary to combine coordinated actions between municipal units that, in general, tend to work in a compartmentalized way: the new Disaster Risk Management Departments, such as ties to SENAPRED and those in charge of developing Communal Plans for Disaster Risk Reduction



Figure 10. Collaborative construction of "Resilient public spaces".
Source: Preparation by the authors based on Baereswyl (2014), Cabrera *et al.* (2020), and Riquelme (2022)

and Communal Emergency Plans; the SECPLAN Communal Planning Secretariats, as units to formulate projects in public spaces; and the DIDECO Community Development Directorates, as those responsible for territorial management and community outreach.

Last, and not least, coordination between the State actors involved is needed, so that the information currently collected through Local Governments can be systematized and transformed into strategies to address disaster risk from the territories, understanding the available public spaces in safe areas as a potentially resilient network, capable of supporting Disaster Risk Management at all stages, while building a database that translates into several invaluable inputs when updating Regional Planning Instruments.

VII. CONCLUSIONS

This work reviews the foothills of the Metropolitan Region, an inhabited territory subject to seismic, landslide, and flood risks. Implementing Law 21,364 modernizes the institutions linked to disaster prevention and response. It includes municipalities as relevant actors within the disaster management cycle, opening up a broad range of possibilities regarding how the state can address this problem. The Communal Disaster Risk Reduction Plan is a concrete and strategic option to adopt the National Strategic Plan for Disaster Risk Reduction guidelines and all the necessary actions to reduce vulnerabilities in the territory of its competence.

Implementing resilience strategies from local governments, such as educating and informing the community and providing the possibility of organizing, grouping, and sheltering in spaces of daily use such as the parks and squares of the commune (located outside the risk areas), empowers inhabitants of the risk areas or close to them to actively prepare, prevent unwanted situations, and respond to the imminent occurrence of a disaster. All this is being done while progress is being made on an urban policy and suitable regulatory changes that allow clear positions to be taken from the territory against risk at different scales, and of course, that considers the community as a relevant actor.

The condominium and closed passage typology that abounds in La Reina Alta and is seen especially in the blocks of the eastern edge of the commune, the most vulnerable to the analyzed risks, represents a greater difficulty when considering an eventual disaster. This makes the need to strengthen, maintain, and inform evacuation routes even more urgent so that they can respond, if necessary. There is also a lack of permanent public spaces located in safe spaces (apart from Las Perdices Park, La Reina, and Talinay squares), considering the estimate that about 4,260 people live in areas affected by risk associated with the San Ramón Fault and/or the cordilleran ravines.

Las Perdices Park, which was analyzed concerning the proposed resilient design criteria for the infrastructure dimension, shows great potential to become a resilient public space. Its location outside the risk areas (SFR or ravines) and its linear development from North to South allow people affected by an eventual disaster to move along the available roads and organize themselves in the potential meeting spaces. From this, it is important to understand urban resilience as a concept beyond improving infrastructure. It should seek standards to optimize institutionality, social capital, and community education, providing information regarding specific risks.

VIII. CONTRIBUTION OF AUTHORS

CRedit:

Conceptualization: M.R.F., J.I.C.; Data curation: M.R.F., J.I.C.; Formal analysis: M.R.F., J.I.C.; Acquisition of financing: J.I.C.; Research: M.R.F., J.I.C.; Methodology: M.R.F., J.I.C.; Project Management: J.I.C.; Resources: J.I.C.; Software: M.R.F.; Supervision: M.R.F., J.I.C.; Validation: M.R.F., J.I.C.; Visualization: M.R.F.; Writing - original draft: M.R.F., J.I.C.; Writing - revision and editing: M.R.F., J.I.C.

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