
MUNICIPAL RISK REDUCTION PLAN
MRRP
SÃO PAULO

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CONTEXTUALIZATION

The Municipal Risk Reduction Plan (PMRR) of the City of São Paulo arises from the pressing need for the Municipal Public Authority to establish feasible metrics and guidelines for the development and implementation of both structural and non-structural measures capable of mitigating and/or eliminating risks in areas of precarious occupation. In this regard, a proposal was outlined for the coordinated action of Municipal Public Administration Bodies, with the overarching objective of providing tools, directives, and planning that effectively reduce risks in predominantly irregularly occupied areas within the municipality of São Paulo.

The plan also seeks to demonstrate that the evolution of territorial occupation and the social needs that must be addressed render the perpetuation of ad hoc, systematic interventions—based on a dehumanized policy and limited to mere indices and parameters—incompatible. From this understanding, a paradigm shift is proposed, grounded in a more comprehensive territorial vision, through the definition of instruments that allow for harmonious, rational, integrated, and equitable interventions.

Furthermore, it is important to recognize the legitimacy of emergency actions, as it is impossible to anticipate all exceptional circumstances that make urgent responses necessary in situations posing imminent risk to widely protected legal rights, notably human life. Nonetheless, due to the very nature of such actions—particularly their limitation to only the portion necessary to address the emergency—they do not constitute definitive solutions to the inherent problems of precarious occupations.

In this context, a series of instruments was developed aligned with urban development objectives, which differ substantially from actions taken under the influence of temporal preferences. These are guidelines for coordinated action by the Public Administration over the territory, observing coherent spatial strategies and the determinations of long-term Public Policies, such as the Strategic Master Plan (PDE), which, due to its temporal scope, includes periodic updates in its regulatory framework.

The FDTE – Foundation for the Technological Development of Engineering was tasked with understanding issues related to territorial occupation risks from social and administrative perspectives, in order to propose the best possible technical solutions for interventions aimed at improving the quality of life of residents, as consolidated in the São Paulo Municipal Risk Reduction Plan. Activities related to the scope of the contract between the Municipal Public Administration and FDTE were based on data collected between May 2023 and June 2024.

A deep understanding of the evolution of the urban fabric and the expansion of informal settlements—as phenomena intrinsically linked to the history of municipal development—is crucial for conceptualizing the economic, social, political, and cultural aspects of society and their consequences, all resulting from human action on the environment.

Historically, modern urban planning emerged in the late 19th and early 20th centuries as a response to public health problems following increased rural-to--urban migration, which led to rising poverty, inadequate housing, and limited economic opportunities in urban agglomerations. This growth brought significant challenges to public authorities, including security, health, education, access to basic services, and, equally importantly, housing issues.

Historical evaluation of urban planning issues demonstrates the difficulties faced by Brazilian municipal administrations in promoting adequate territorial organization capable of achieving the full development of the city's social functions and preventing irregular land occupation, along with its severe consequences.

The paradigm intended to be broken here is the continuation of disordered and unsustainable urban growth, which exposes residents to natural disasters.

Thus, as the aspects that needed to be addressed within the PMRR were delineated—and as new situations arose, prompting reconsideration and refinement of opinions and principles—it became clear that interventions in risk areas should be proposed from a new perspective.

Regularization initiatives, infrastructure improvements, and housing programs are among the strategies used to address the challenges of informal urban settlements, alongside others discussed later in this Plan, including measures aimed at infrastructure improvements to make areas more resilient.

In this sense, the studies that guided the innovations and methodologies proposed in the PMRR derive from awareness of historical evolution and current data, reflecting the need to harmonize and stabilize the coexistence of humans and the environment.

Photo: Jardim Comercial II

DOCUMENT STRUCTURE

The PMRR was structured to facilitate the reader's understanding. In this regard, the present instrument was developed in a phased manner, allowing for gradual assimilation of the inherent issues and, above all, the sensitivity and complexity involved in surveying and planning risks in the municipality of São Paulo. It is expected that, with all these resources at hand, the reader will ultimately be able to understand the proposals presented in the Action Plan.

In the meantime, it is important to clarify that, from a functional perspective, this document is organized into three Blocks. The first Block addresses issues related to risk areas from legal, administrative, territorial, and occupancy perspectives. The second Block has a temporal approach, corresponding to field-collected data that demonstrate the situation of risk areas and the resources required to enable solutions. The final Block addresses the actions assigned to implement solutions in risk areas.

From a graphical perspective, the present instrument is divided into five chapters.

The first chapter compiles the main current regulations that legally justify and guide the development of the PMRR. In this way, the chapter presents a regulatory overview at the Federal, State, and Municipal levels, as well as a brief context of the international scenario. Notably, the chapter also details the competences and responsibilities of the various bodies that make up the Municipal Public Administration, linking them to the obligations set forth in Art. 300 of the PDE – Strategic Master Plan of the Municipality of São Paulo, and, where appropriate, addressing ongoing actions by the PMSP – Municipal Government of the City of São Paulo.

The sections "**Territory**" and "**Risk**" (Blocks B and C, respectively) aim to provide an in-depth analysis of issues related to occupation, housing, waste, rainfall, and geology, and their direct relationship with the existence and evolution of registered landslide and flood risk areas in the municipality. The intrinsic links of this Plan to other Municipal Public Administration initiatives—particularly the Municipal Housing Plan, the Solid Waste Management Plan, and the Municipal Sanitation Plan—are also demonstrated. A detailed description is provided of the procedures practiced by Civil Defense in risk areas.

The fourth section, entitled "**Current Situation of Risk Areas**," establishes the temporal framework for the dissection of areas that underpinned the formation of this instrument. It is therefore dedicated to presenting all activities executed for the development of the PMRR, which enabled a deep and realistic understanding of the current situation of risk areas in the municipality of São Paulo, in all its aspects and details, while also addressing the resources needed to manage the issue.

For the preparation of this Plan, hundreds of risk areas were studied, and, based on prioritization criteria, certain areas were selected for field visits. A multidisciplinary approach—encompassing social studies, civil construction, geotechnics, hydrology, geology, architecture, and urbanism—was applied, allowing for a thorough understanding of the realities and problems on site. Based on this survey, intervention projects were developed for some of the visited areas to mitigate risk. Moreover, it is certain that the data collected within the scope of the PMRR will serve as benchmarks for other areas mapped by Civil Defense.

It is from this diligently developed work that the resources for defining several operational strategies derive, highlighting the innovative decision of the Municipal Public Administration to already propose structural engineering actions for the areas under project. Furthermore, the chapter addresses how the budget could reflect the Municipal Risk Reduction Plan, enabling the organization of financial resources required to support executive actions in implementing the activities proposed in the PMRR.

Finally, the section entitled "**Action Plan**" lists and describes the twenty best strategies with potential to provide structured solutions to the challenges of risk areas, aiming to enhance the resilience of the municipality of São Paulo.

Table 1: Subsection of Article 300 of the PDE (Fonte: PMRR)

Article	Content	Document Structure
Item I	Analysis, characterization and sizing of areas at risk of flooding, landslides and erosion classified according to type and degree of risk;	Risks Action Plan
Item II	Analysis, quantification, and characterization of families living in the risk areas mentioned in the previous item, according to demographic, socioeconomic, and housing profiles, among other aspects	Risks Current Situation of Risk Areas Action Plan Appendix 1, Appendix 3, and Appendix 4
Item III	Strategies for coordination with the implementation of the Municipal Housing Plan, mainly regarding urban, legal, land, and environmental regularization of precarious and irregular settlements;	Territory Current Situation of Risk Areas Action Plan
Item IV	Strategies for coordination with the implementation of the Integrated Solid Waste Management Plan;	Territory Action Plan
Item V	Definition of actions and interventions necessary for the implementation of structural works to reduce risks and adopt safety and protection measures, establishing priorities, deadlines, and estimates of costs and required resources;	Situation of Risk Areas Action Plan Appendix 2
Item VI	Definition of strategies for preventive relocation of residents from risk areas, when this is the only or most effective alternative to ensure residents' safety conditions, according to objective and recognized technical criteria and fair and democratic procedures.	Territory Risks Situation of Risk Areas Action Plan



Photo: Camarazal

A B C D E

LEGAL OVERVIEW

LEGAL AND ADMINISTRATIVE OVERVIEW OF RISK AREAS IN THE MUNICIPALITY OF SÃO PAULO

The development of the PMRR stems from the urgent demand of the municipality of São Paulo to consolidate the provisions established by Federal Law No. 12,608 of April 10, 2012, which regulates, through the PNPDEC – National Policy for Civil Protection and Defense, coordinated action among the Union, the States, the Federal District, and the Municipalities, with the objective of encompassing and solidifying public policies necessary for the reduction, mitigation, and/or elimination of risks. In this context, it is recommended that, through in-depth and site-specific studies, methodologies be developed for urban planning, health, environment, climate change, water resources management, geology, infrastructure, education, science and technology, and other sectoral policies.

In this sense, it is clear and evident that the primary objective of the aforementioned Law is to establish guidelines so that the actions of the Public Administration—exercised under the powers conferred by law—result in the effective safeguarding of fundamental values. Indeed, beyond legal parameters and linkages, the development of the PMRR is grounded in a set of fundamental legal principles, interrelated, namely the principles of legality, proportionality, and human dignity, which are highlighted here for summary reference.

It is important to note that the national legal framework was originally conceived in a scenario radically different from the present one. Therefore, meticulous application of the Fundamental Principles of the Brazilian State is indispensable, as these are legal mechanisms that transcend contextual normative dimensions. In this regard, the principle of human dignity constitutes the democratic foundation upon which the Federative Republic of Brazil is established (Art. 1, III of the Federal Constitution).

Thus, the PMRR is a corollary of the principle of human dignity and constitutes both a subjective right of every individual and a duty of the public authorities. This right receives specific legal protection as it falls within the category of personal rights, requiring the State to provide essential care to the population, particularly in terms of housing quality, safety, and, most importantly, the safeguarding of human life.

This means that principles should not necessarily be seen as superior norms but rather as mandates or requirements for optimization—i.e., norms that demand the realization of a right to the greatest possible extent, given the factual and legal circumstances of each case.

However, to fully understand the essential element that enshrines this right, it is necessary to view the legislative construction from a much broader perspective.

LEGAL FRAMEWORK

All federative entities possess some form of competence to address issues related to risk areas. For a better understanding of how responsibilities are distributed, Table 2 below presents a compilation of legal instruments that establish and regulate disaster risk management.

Table 2: Legislation Related to Risk Area Management

Law	Content	Scope
Municipal Decree No. 15.191 of August 7th, 1978	Establishes the Municipal Civil Defense System.	Municipal
Municipal Decree No. 15.539 of December 8th, 1978	Amends Articles 1, 4, 8, 9, and 12 of Decree No. 15.191, of August 7th, 1978.	Municipal
Law No. 6.766 of December 19th, 1979	Regulates the subdivision of urban land and provides other measures.	Federal
Municipal Decree No. 47.534 of August 1st, 2006	Reorganizes the Municipal Civil Defense System.	Municipal
Law No. 12.340 of December 1st, 2010	Provides for the transfer of federal resources to state, federal district, and municipal agencies and entities for response and recovery actions in areas affected by disasters, and establishes the Special Fund for Public Calamities, among other provisions.	Federal
Law No. 12.608 of April 10th, 2012	Establishes the National Policy for Civil Protection and Defense (PNPDEC); provides for the National System for Civil Protection and Defense (SINPDEC) and the National Council for Civil Protection and Defense (CONPDEC); authorizes the creation of a disaster information and monitoring system; amends Laws No. 12.340 of December 1st, 2010, No. 10.257 of July 10th, 2001, No. 6.766 of December 19th, 1979, No. 8.239 of October 4th, 1991, and No. 9.394 of December 20th, 1996; and provides other measures.	Federal

Law	Content	Scope
Internal Order of the Mayor – PREF No. 1 of January 9th, 2013	Establishes guidelines on procedures for the preventive removal of residents in geological risk areas in the Municipality of São Paulo.	Municipal
Law No. 16,050 of July 31st, 2014	Approves the Urban Development Policy and the Strategic Master Plan of the Municipality of São Paulo, and repeals Law No. 13,430/2002.	Municipal
Law No. 12.983 of June 2nd, 2014	Amends Law No. 12.340 of December 1st, 2010, to provide for the transfer of federal resources to state, federal district, and municipal agencies and entities for preventive actions in risk areas, as well as for response and recovery actions in areas affected by disasters; regulates the National Fund for Public Calamities, Protection and Civil Defense; and amends Laws No. 10.257 of July 10th, 2001 and No. 12.409 of May 25th, 2011, repealing provisions of Law No. 12.340 of December 1st, 2010.	Federal
Municipal Decree No. 58.199 of April 18th, 2018	Provides for the reorganization of the Municipal Secretariat for Urban Security, changes the name and allocation of certain appointed and commissioned positions, and introduces amendments to Decrees No. 52.649 of September 15th, 2011, No. 55.003 of April 4th, 2014, No. 42.819 of January 31st, 2003, and No. 50.945 of October 26th, 2009.	Municipal
Decree No. 64.673, of December 16th, 2019	Reorganizes and renames the State Program for the Prevention of Natural Disasters and the Reduction of Geological Risks, and provides related measures.	Estadual
Decree No. 10.692, of May 3rd, 2021	Establishes the National Register of Municipalities with Areas Susceptible to Large-Scale Landslides, Flash Floods, or Related Geological or Hydrological Processes.	Federal

Law	Content	Scope
Decree No. 11.219, of October 5th 2022	Regulates Art. 1-A, Art. 3, Art. 4, Art. 5, and Art. 5-A of Law No. 12,340 of December 1, 2010, regarding mandatory transfers of federal financial resources to the States, the Federal District, and Municipalities for the execution of preventive actions in disaster risk areas and response and recovery actions in areas affected by disasters.	Federal
Bill No. 636-A, 2023	Amends Law No. 12,340 of December 1, 2010, to increase the effectiveness of the Civil Protection and Defense Contingency Plan.	Federal
Municipal Law No. 17.975, of July 8th, 2023	Provides for the mid-term review of the Strategic Master Plan of the Municipality of São Paulo, approved by Law No. 16.050 of July 31st, 2014.	Municipal
Decree No. 11,655, of August 23rd, 2023	Amends Decree No. 11,219 of October 5th, 2022, which regulates Art. 1-A, Art. 3, Art. 4, Art. 5, and Art. 5-A of Law No. 12,340 of December 1st, 2010, regarding mandatory transfers of federal financial resources to the States, the Federal District, and Municipalities for preventive actions in disaster risk areas and response and recovery actions in areas affected by disasters.	Federal
Law No. 14,750, of December 12nd, 2023	Amends Laws No. 12,608 of April 10, 2012, and 12,340 of December 1st, 2010, to improve the instruments for accident or disaster prevention, the recovery of areas affected by them, the monitoring of accident or disaster risks, and the production of early warnings.	Federal

1. INTERNATIONAL CONTEXT

Established in 1989, October 13th was designated by the United Nations (UN) as the International Day for Disaster Risk Reduction, demonstrating that the issue had already become a global agenda item at the time, as well as the need to develop responses to unavoidable disasters.

At the Third United Nations World Conference on Disaster Risk Reduction, held in 2015 in the city of Sendai, Japan, the Sendai Framework for Disaster Risk Reduction[1] was adopted. Its primary goal was the prevention of new disaster risks and the reduction of existing ones. The framework's objectives were guided by the implementation of integrated and inclusive economic, structural, legal, health, cultural, educational, environmental, technological, and political measures aimed at preventing and reducing exposure to hazards and disasters.

The goals proposed by the Sendai Framework established a 15-year time frame for achieving its outcomes. The global effort, led by the UN Office for Disaster Risk Reduction (UNDRR), highlights that progress depends on multisectoral and multidisciplinary action across various levels of government.

Although the aforementioned international document does not have binding legal authority, it is essential to emphasize that the commitment signed demonstrates the engagement of UN Member States in establishing guidelines for local action and investment in the development of methodologies necessary for resilience in risk management.

2. NATIONAL FRAMEWORK

Turning to the scope of **federal legislation**, reference can be made to **Law No. 6,766 of December 19, 1979**, known as the **Lehmann Law**, which establishes in Article 3 the **prohibition of land subdivision in swampy areas, flood-prone regions, and sites lacking adequate geological conditions for construction and building**.

1 United Nations (UN), Sendai Framework for Disaster Risk Reduction 2015–2030. Sendai, 2015. Available at: https://www.undrr.org/publication/sendai-framework-disaster-risk-reduction-2015-2030

It is noted that the aforementioned legal provision acted as a **preventive measure** against risks. Once the possibility of harm to populations residing in areas with characteristics similar to those described in Article 3 of Law No. 6,766/1979 is identified, the **State**, guided by its **fundamental principles**, safeguards the population from potential harm.

2.1. THE 1988 FEDERAL CONSTITUTION

It was only after the promulgation of the **1988 Federal Constitution** that the subject acquired the necessary robustness to clearly define the **responsibilities of the federative entities**, as established below:

> **Article 21. The Union shall have the power to:**
> XVIII – plan and promote permanent protection against public calamities, especially droughts and floods;
>
> **Article 22. The Union has exclusive authority to legislate on:**
> XXVIII – territorial defense, aerospace defense, maritime defense, **civil defense** and national mobilization;
>
> **Article 23. The Union, the States, the Federal District, and the Municipalities have shared competence to:**
> VI – protect the environment and combat pollution in any of its forms;
> VII – preserve forests, fauna, and flora;
> IX – promote housing construction programs and the improvement of housing and basic sanitation conditions;
> X – combat the causes of poverty and marginalization, promoting the social integration of disadvantaged groups;
>
> Sole Paragraph. Supplementary laws shall establish the rules for cooperation among the Union, the States, the Federal District, and the Municipalities, with a view to achieving balanced development and well-being on a national scale.
>
> **Article 24. It is within the concurrent legislative competence of the Union, the States, and the Federal District to legislate on:**
> I – tax, financial, penitentiary, economic, and **urban law**;
> VI – forests, hunting, fishing, fauna, conservation of nature, **protection of soil** and natural resources, environmental protection, and pollution control.

Article 30.It is within the competence of Municipalities to:
I – legislate on matters of local interest;
II – supplement federal and state legislation as appropriate;
VIII – promote, where applicable, proper territorial planning through the management and control of the use, subdivision, and occupation of urban land.

2.2. FEDERAL LEGISLATION

Beyond the normative instruments that, due to their relevance, inaugurate this chapter, at the federal level, special attention should be given to the following instruments, here briefly outlined.

Law No. 10,257, of July 10, 2001, known as the City Statute, regulates Articles 182 and 183 of the Federal Constitution, establishing public-order and social-interest norms governing the use of urban property in favor of the **collective good**, **citizen safety** and **well-being** and **environmental balance**.

This legal instrument serves as a cornerstone for the preparation of the Municipal Risk Reduction Plan (PMRR), as it seeks to establish general guidelines for public policies aimed at ensuring the full development of the social functions of cities and urban properties.

Also at the federal level, Law No. 12,340, of December 1, 2010, provides for the transfer of resources from the Union to the agencies and entities of the States, the Federal District, and the Municipalities for the implementation of disaster-risk prevention actions, as well as response and recovery actions in disaster-affected areas, and for matters concerning the National Fund for Public Calamities, Protection, and Civil Defense. This demonstrates the coordinated action of the Executive Branch across its various levels.

Of equal importance is Federal Decree No. 10,692, of May 3, 2021, which established the National Registry of Municipalities with Areas Susceptible to Large-Scale Landslides, Flash Floods, or Related Geological or Hydrological Processes.

Furthermore, the most recent publication on the subject is Federal Decree No. 11,219, of October 5, 2022, which provides for the mandatory transfer of financial resources from the Union to the States, the Federal District, and the Municipalities for the implementation of disaster-risk prevention, response, and recovery actions.

As for the procedural aspects, the declaration of a state of emergency or public calamity by Municipalities, States, and the Federal District shall be made by the Chief Executive of the respective federative entities, which are part of the National System for Protection and Civil Defense (SINPDEC), whenever it is necessary to establish a special legal status for the implementation of relief and humanitarian assistance actions, restoration of essential services, and recovery of disaster-affected areas[2]. After such a declaration, the process of recognizing the local situation and providing legal assistance and support begins, as prescribed by law. It is worth emphasizing that this legal instrument is considered an exceptional measure, necessary for a responsive approach to disasters already occurred, enabling the adoption of remedial and contingency strategies.

Finally, while recognizing the essential role of such responsive mechanisms in disaster management, it must be stated that the Municipal Risk Reduction Plan (PMRR), by adopting a preventive and proactive approach to risk management and disaster prevention, ultimately seeks to minimize the need for declarations of states of emergency or public calamity.

From the excerpt above, it can be observed that the preparation of the Municipal Risk Reduction Plan (PMRR) will require the joint action of various Departments that make up the basic structure of the Municipal Public Administration.

However, before addressing the specific roles and responsibilities of each Department—particularly in comparing the defined competencies of each administrative body with the core content proposed for the PMRR, as set forth in Article 300 of the Strategic Master Plan (PDE)—it is considered appropriate to present, through the historical evolution of municipal regulations, the development and normative framework that underpin the current theme.

To that end, it is first necessary to highlight the foundational municipal legislation guiding the remaining regulations. The Organic Law of the Municipality of São Paulo (Lei Orgânica do Município – LOM), in its essence, safeguards the guarantee of fair and equal access for all to the conditions necessary for a dignified existence. Its provisions also emphasize the preservation of the territory, natural resources, and the environment.

In light of these principles, reference must be made to the municipal legislation on building regulations—Municipal Law No. 13,558 of April 14, 2003, and Municipal Law No. 13,876 of July 23, 2004—through which the minimum con-

2 Article 1 of Normative Instruction No. 2, dated December 20, 2016.

ditions for the regularization of constructions were established. At that time, the Legislative and Executive Branches had already demonstrated concern for defining minimum safety and habitability standards, such as hygiene, structural stability, and safe use of buildings.

It is evident, therefore, that even before specific risk-mitigation regulations were introduced, the Municipal Public Administration already showed concern for regulating land occupation based primarily on the geographical characteristics of each site, aiming to prevent settlement in irregular or underdeveloped areas, which are often the most vulnerable to natural events during rainy periods, such as flooding and landslides.

Subsequently, as shown in Annex I – Legislative Catalogue, the Municipality of São Paulo expanded its focus on several thematic areas related to the subject, such as Municipal Law No. 14,223 of 2006, which governs the organization of elements composing the city's urban landscape, as well as other laws establishing conservation units, environmental protection areas, and environmentally protected natural parks.

Complementing these legal instruments, special mention should be made of Law No. 16,402 of March 22, 2016, which governs the subdivision, use, and occupation of land in the Municipality of São Paulo, in accordance with the provisions of the Strategic Master Plan (PDE). This law—known as the Land Subdivision, Use and Occupation Law (LPUOS)—constitutes a true regulatory milestone in São Paulo's urban policy.

It must be noted that zoning should not become a static representation of the status quo, but rather function as an instrument guiding urban development and management, supported by a social pact that provides political legitimacy. In this context, the LPUOS and the PDE operate in mutual synergy, as cohesive legal frameworks that reinforce and enable sustainable urban development.

This brief overview of the normative framework leading to the preparation of the Municipal Risk Reduction Plan of São Paulo provides the foundation for the next section, which examines the competencies assigned to Municipal Administrative Bodies, to later correlate them with the core content proposed in Article 300 of the PDE.

COMPETENCIES OF MUNICIPAL ADMINISTRATIVE BODIES

As of 2024, the Municipal Government of São Paulo maintains an institutional structure that enables the decentralized operation of its administrative bodies in accordance with their specific functions and competencies, thereby supporting actions related to risk areas. Table 3 provides a simplified overview of the correlation between the actions prescribed in the PDE—as foundational content for the PMRR—and the administrative units currently responsible for their execution.

Table 3: Items and Their Correlations with Municipal Administration

Article	Content	Responsible Administrative Unit
Art. 300, Item I	Analysis, characterization, and sizing of areas at risk of flooding, landslides, and erosion, classified according to type and degree of risk.	Civil Defense; Secretariat of Green and Environment; Executive Secretariat for Climate Changes; Center for Climate Emergency Management
Art. 300, Item II	Analysis, quantification, and characterization of families living in the risk areas mentioned in the previous item, according to demographic, socioeconomic, and housing profiles, among other aspects.	Municipal Secretariat of Housing; Municipal Secretariat of Social Assistance and Development
Art. 300, Item III	Strategies for coordination with the implementation of the Municipal Housing Plan, mainly regarding urban, legal, land, and environmental regularization of precarious and irregular settlements.	Office of the City Attorney; Secretariat of Green and Environment; Municipal Secretariat of Urban Planning and Licensing; Municipal Secretariat of Housing
Art. 300, Item IV	Strategies for coordination with the implementation of the Integrated Solid Waste Management Plan.	Municipal Secretariat of Subprefectures (especially SELIMP); SP Regula; Secretariat of Green and Environment
Art. 300, Item V	Definition of actions and interventions necessary for the implementation of structural works to reduce risks and adopt safety and protection measures, establishing priorities, deadlines, and estimates of costs and required resources.	Municipal Secretariat of Urban Infrastructure and Works; Municipal Secretariat of Subprefectures
Art. 300, Item VI	Definition of strategies for preventive relocation of residents from risk areas, when this is the only or most effective alternative to ensure residents' safety conditions, according to objective and recognized technical criteria and fair and democratic procedures.	Municipal Secretariat of Housing; Municipal Secretariat of Social Assistance and Development; Municipal Government Secretariat

Although Civil Defense holds a leading role in risk management, the effective implementation of the present Plan requires the coordinated interaction of the various functions performed by different Municipal Administrative Bodies. Accordingly, the following section details the competencies of these administrative structures, establishing their respective correlations with the core content proposed in Article 300 of the PDE for the PMRR.

Civil Defense

The Civil Defense, which operates under the Municipal Secretariat for Urban Security, is the primary agency responsible for implementing the PMRR's initiatives as a planning instrument for addressing the negative impacts of climate change and natural disasters in the Municipality of São Paulo.

Accordingly, it is the main body responsible for fulfilling Item I of Article 300, transcribed below:

> **Article 300**
> (...)
> I – Analysis, characterization, and assessment of areas at risk of flooding, landslides, and erosion, classified by type and level of risk.

All geological and hydrological risk areas mapped within the Municipality of São Paulo are made publicly accessible through GeoSampa. For each mapped area, the Civil Defense is responsible for preparing an individualized report including: risk characterization; roof count and sectoral classification by degree of risk; risk mitigation alternatives; and comparison with previous reports for the same area (where applicable). In addition to risk mapping, the Civil Defense also develops a contingency plan for each area. There is no fixed periodicity for updating these data; however, for sectors classified as high-risk (R4), the interval between surveys should not exceed one year, while in areas classified as low-risk (R1), updates may occur every three years.

Analysis of the two most recent Civil Defense reports indicates that the average update interval for reports covering geological risk areas was 3.8 years, decreasing to 2.8 years in high-risk sectors (which represent 70% of these areas).

In April 2018, through Municipal Decree No. 58,199/18, which provides for the reorganization of the Municipal Secretariat for Urban Security, the COMDEC – Municipal Civil Defense Commission – became a specific unit of this Secretariat, and its attributions were presented. Still as a result of the reorganization, COMDEC became composed of four divisions, namely: DOP – Operations Division, DPREV – Prevention Division, DRESP – Response Division – acting in actions related to rescue and assistance in disaster situations – and DDEC – Civil Defense Divisions.

A. DOP – *Operations Division*

The DOP – Operations Division, through the CCOI – 24-Hour Integrated Control Center of the City of São Paulo, is responsible for **receiving**, **identifying**, and **validating** occurrences, subsequently establishing the necessary activations so that the proper inspections and measures are carried out with the bodies of the Municipal Public Administration, in accordance with the nature of the verified facts.

B. DPREV – *Prevention Division*

The DPREV – Prevention Division can be understood as one of the most important tools available to Civil Defense in the planning, development, and implementation of environmental risk management and community mobilization. Aiming to minimize or eliminate the risk to vulnerable communities, DPREV, indicating the necessary structural and non-structural measures, is based on assessments and data collection, which are obtained through the following activities:

B.1. Mapping of geological risk areas – assessment and classification of areas susceptible to slope landslides and stream bank collapses;

B.2. Mapping of hydrological risk areas – assessment and classification of areas susceptible to flood and inundation processes;

B.3. Mapping of technological risk areas – assessment and classification of areas susceptible to urban fires and structural ruptures;

B.4. Mobilization and education – development of social mobilization actions in communities and schools located in risk areas, with the objective of raising awareness and promoting risk perception among the population, in order to make it active in the management of risks in its territory;

B.5. Preventive Civil Defense Plans – preparation and operationalization of preventive plans that aim to intensify prevention, emergency response, and social assistance actions to reduce threats to the physical integrity of citizens.

There are currently three major plans in operation in the Municipality of São Paulo, namely: the Summer Rain Preventive Plan, the Contingency Plan for Low Temperature situations, and the Contingency Plan for Low Humidity situations.

B.6. Handling of administrative proceedings – The handling of administrative proceedings consists of analyzing and responding to Administrative Processes from various origins (Public Prosecutor's Office, Civil Police, other municipal secretariats, etc.), through which risk assessments are requested and consequently require the execution of inspections and preparation of technical reports to support, for example, land stabilization works, maintenance and drainage works, removal actions, environmental license exemptions, among others.

C. DRESP – *Response Division*

The DRESP – *Response Division* is responsible for acting in actions related to rescue and assistance in disaster situations, as well as maintaining qualified and trained teams, on a 24-hour on-call schedule, to provide rescue and assistance to populations affected by disasters.

It is the responsibility of DRESP to prepare, in an integrated manner with the competent units, contingency plans and response action guidelines, as well as to plan and execute operations and simulated exercises to improve the capacity to respond to natural and technological disasters.

In 2024, DRESP is subdivided into ten (10) Response Teams, which act in attending to occurrences in the municipality.

D. DDEC – *Civil Defense Divisions*

The DDECs are branches of COMDEC in the territories of the Subprefectures. Therefore, in each of the thirty-two (32) Regional Administrations there is a Civil Defense Division, which is responsible for implementing the guidelines and measures of prevention, operation, and response in risk management and emergency situations in the territories, as well as articulating integrated action with local actors in risk management actions and in attending to emergency situations.

SIURB – Municipal Secretariat for Urban Infrastructure and Public Works

Created in 1977 through Law No. 8,658, under the name of Secretariat of Public Roads, the current Municipal Secretariat for Urban Infrastructure and Public Works – SIURB – was recently reorganized through Municipal Decree No. 62,009 of November 25, 2022, establishing, among its many competences, the responsibility for carrying out drainage works, road systems, and structural

repairs, as well as providing emergency assistance during periods of heavy rain, which may pose risks to life and to public and private property.

It is known that the urbanization process of a municipality requires robust investments in infrastructure works, which, in their great majority, are the responsibility of SIURB – Municipal Secretariat for Urban Infrastructure and Public Works. In fact, the mentioned Secretariat concentrates numerous attributions that have the power to modify the structure of the City of São Paulo and, consequently, the life of its inhabitants.Therefore, it is correct to say that SIURB plays a fundamental role in achieving the constitutional concept of the social function of the city.

At the municipal level, it is up to SIURB to outline, design, plan, and execute the interventions that play a fundamental role in structuring the metropolis of worldwide recognition that is São Paulo, greatly contributing to the well-being of its inhabitants.

In the same sense, based on the Strategic Master Plan, SIURB is responsible for the actions provided for in Item V of Article 300.

> **Art. 300. (...) V –** definition of the actions and interventions necessary for the implementation of structural works for risk reduction and adoption of safety and protection measures, with the establishment of priorities, deadlines, and estimates of costs and necessary resources;

CGE – Center for Climate Emergency Management

The CGE – Center for Emergency Management – is the body of the São Paulo City Hall responsible for monitoring meteorological conditions in the Capital. Mirrored on preventive models existing in other world metropolises, it was created in November 1999, after a large-scale flood that affected the region of the Anhangabaú tunnel in March of the same year.

With the support of real-time radar images, satellite images, numerical forecast models, radiosonde, meteorological station data, and a telemetric network, the CGE team operates 24 hours a day, including weekends and holidays, providing weather forecasts, trends, and data collected through in-person service, telephone, emails, and constant updates on the CGE website.

In partnership with COMDEC during the rainy season, which covers the months from November to April, the Center is dedicated to the Summer Rain Preventive Plan – PPCV, carried out in partnership with several agencies to prevent the harmful effects caused by the heavy rains recorded during the period.

In this work, the CGE performs the function of notifying and keeping the participating agencies informed about the predicted meteorological conditions, accumulated rainfall, among others.

Also in partnership with COMDEC, during the driest months, the CGE is responsible for monitoring the relative air humidity indices and, in the colder months, for reporting low temperatures. When temperatures are below 13ºC, the SMADS – Municipal Secretariat for Social Development – carries out the work of assisting homeless people in the city's shelter centers.

Since its implementation, the CGE has built a vast history of meteorological data, which help not only the bodies linked to the Municipal Public Administration but also other national meteorological bodies, as well as various research fronts, knowledge expansion, and information dissemination.

Already incorporating the joint and closely connected activities, the CGE is responsible for the preliminary analyses included in Item I of Article 300 of the PDE, which assist decision-making by the other involved bodies.

> **Art. 300. (...) I –** analysis, characterization, and sizing of areas at risk of flooding, landslides, and stream bank collapse, classified according to type and degrees of risk;

SEHAB - Municipal Housing Department

The Municipal Housing Department, created by Municipal Law No. 10,237 of December 17, 1986, is the central and superior body of the Municipal Social Housing Policy, with the Metropolitan Housing Company of São Paulo – COHAB/SP as its operational agency, as established in the programs and actions of the Municipality's Housing Policy.

It is the responsibility of the Municipal Housing Department, as a body of the Direct Municipal Administration: to manage and execute the Municipal Social Housing Policy; to promote Urban and Land Regularization of Precarious Settlements, Allotments, and Irregular Subdivisions; to establish agreements and partnerships with public or private entities, national and international, necessary for the execution of projects within the scope of the Department.

To the Municipal Housing Department, one of the fundamental pillars for achieving the interdependent activities of the PMRR, fall the actions described in items II, III, and VI of Article 300 of the PDE.

Article 300.
(...)
II – analysis, quantification, and characterization of families residing in risk areas mentioned in the previous item, according to demographic, socioeconomic, and housing profiles, among other aspects;
III – strategies for articulation with the implementation of the Municipal Housing Plan, mainly in relation to urban, legal, land, and environmental regularization of precarious and irregular settlements;
VI – definition of strategies for carrying out preventive relocations of residents in risk areas, when this is the only or most effective alternative to ensure the safety conditions of residents, in accordance with objective and recognized technical criteria and fair and democratic procedures.

In addition to these obligations related to Article 300, SEHAB develops actions related to risk area management, emergency temporary assistance, compensation for improvements, housing demand, housing provision, and land regularization.

SEPM - Executive Secretariat of the Reservoirs' Springs Area Program

Established by Municipal Decree No. 60,531 of September 13, 2021, the SEPM – Executive Secretariat of the Reservoirs' Springs Area Program, linked to SEHAB – Municipal Housing Department, aims to establish guidelines, develop, implement, and evaluate the actions provided for in the Reservoirs' Springs Area Program.

The aforementioned program is an important initiative of the São Paulo City Government regarding the urbanization of precarious settlements, the process of land regularization, and housing assistance; thus establishing a close connection with the propositions of this Municipal Risk Reduction Plan, which has thoroughly addressed sensitive issues regarding the improvement of living conditions and the promotion of urban qualification of precarious settlements.

SMADS - Municipal Department of Social Assistance and Development

SMADS – the Municipal Department of Social Assistance and Development – aims to manage policies related to social assistance in the city of São Paulo through the execution, monitoring, and constant evaluation of the Municipal Social Assistance Policy as part of SUAS – the Unified Social Assistance System.

Social Assistance has its responsibilities safeguarded since the enactment of the Organic Law of the Municipality, which established, in its Article 15, the social assistance actions under the jurisdiction of the Municipality of São Paulo.

Furthermore, as established by Municipal Law No. 16,974 of August 23, 2018, the Municipal Department of Social Assistance and Development is part of the Direct Municipal Public Administration, and as such, it is through this Department that the municipality applies the provisions set forth by Federal Law No. 8,742 of December 7, 1993 – whose purpose is the organization of Social Assistance, and through which it is established that such legal support is a duty of the State and a right of every citizen.

In this regard, it is worth mentioning that Municipal Decree No. 58,103 of February 26, 2018, reorganized the Municipal Department of Social Assistance and Development, defining in its legal text its purposes and organizational structure.

It is verified, therefore, that social assistance actions are supported by various legal provisions within the Brazilian legal framework. This is because the State, in its utmost protection and observance of fundamental principles, and of international treaties related to social assistance, must enforce social protection, which primarily aims to guarantee human life and reduce harm to the population.

Thus, in order to implement end policies, such as assistance in the comprehensive care of individuals and families in situations of social vulnerability, the Department has three main management resources: the Municipal Social Assistance Plan (PLAS), the Municipal Social Assistance Council (COMAS), and the Municipal Social Assistance Fund (FMAS), which are responsible for granting, managing, or guiding families regarding social assistance benefits, such as those of an emergency nature (shelter and food and hygiene supplies).

The Department also offers, through the Social Assistance Reference Centers (CRAS), assistance to families residing in territories with higher levels of social vulnerability.

Therefore, and in accordance with items II, III, and VI of Article 300 of the PDE, it can be inferred that the activities of SMADS and SEHAB are developed pari passu.

SMUL – Municipal Department of Urbanism and Licensing

The Municipal Department of Urbanism and Licensing – SMUL was re-established on December 31, 2020, through Municipal Decree No. 60,038/2020 and regulated by Municipal Decree No. 60,061 of February 3, 2021, with the responsibility to coordinate and conduct governmental actions aimed at urban planning and development, as well as to formulate and execute the policy for licensing and urban control of subdivision, land use, and occupation.

On July 27, 2023, Municipal Decree No. 62,602/2023 partially modified the organizational structure of the Department.

As already mentioned, territorial planning, expressed through building licensing and the control of use, subdivision, and occupation of urban land, is a municipal responsibility provided for in Article 30 of the Federal Constitution of 1988, ratified by the City Statute and the Organic Law of the Municipality, and detailed in the São Paulo Strategic Master Plan.

In this context, among the responsibilities of the Department are licensing buildings and facilities – regarding construction, renovation, reconstruction, requalification, demolition, and regularization – and land subdivision, as well as licensing the installation and operation of safety equipment and systems, fuel and chemical storage, and similar activities, standardizing the application and regulation of legislation, especially concerning official safety and accessibility rules.

Furthermore, it is important to emphasize that SMUL is responsible for managing the Municipal Geographic Information System (SIG-SP), which brings together geospatial information, including geological and hydrological risk areas and other territorial, demographic, and social characterization data (as stated in Article 35 of Municipal Decree No. 60,061 of February 3, 2021).

Additionally, SMUL is also responsible for developing a permanent and continuous process of monitoring, evaluating, and improving legislation related to urban planning and development, including those related to the PDE, the Regional Strategic Plans of the Regional City Halls and Neighborhoods, Subdivision, Land Use and Occupation, Urban Operations, and other urban instruments.

In line with the above, SMUL's actions are closely related to the provisions of item III of Article 300 of the PDE, embodied in the proper regularization of buildings.

> **Article 300.**
> (...)
> III – strategies for articulation with the implementation of the Municipal Housing Plan, mainly in relation to urban, legal, land, and environmental regularization of precarious and irregular settlements.

SMSUB – Municipal Department of Subprefectures

The SMSUB – Municipal Department of Subprefectures, recently reorganized by Municipal Decree No. 59,775 of September 18, 2020, has the function of providing managerial and administrative support to the Mayor's decisions regarding the performance of the Subprefectures and their requests; carrying out managerial monitoring of the goals and activities of the Subprefectures; creating indicators to measure human and material resources based on quality standards and the reality of each region; proposing to the Mayor and coordinating solutions for the proper development of intersectoral and institutional relations maintained by the Subprefectures; and evaluating the fulfillment of general and sectoral guidelines in the action, planning, and regional management exercised by each of them, based on municipal legislation.

Notwithstanding this, as provided by the LO – Organic Law of the Municipality of São Paulo, it is incumbent upon the Subprefectures to exercise public administration at the local level, occupying a hierarchical level equivalent to that of the Municipal Secretariats.

With regard to the autonomy of the Subprefectures, Article 80, I, of the Organic Law provides that they are an integral part of the Direct Administration, and in this sense, Law No. 16,974 of August 23, 2018, which provides for the organization of the Direct Municipal Public Administration, establishes in its Article 1, XXV, that the 32 (thirty-two) Subprefectures are municipal bodies that are

part of the basic structure of the Direct Municipal Public Administration, making only the reservation, in §1 of Article 1, that the Subprefectures are operationally and technically linked to SMSUB – Municipal Secretariat of Subprefectures.

It is essential to emphasize that this linkage is strictly technical-operational in nature, and in no way affects the autonomy granted to the Subprefectures; the sole purpose is to assign to SMSUB the competence to assist the Subprefectures in the articulation and integration of intersectoral initiatives developed in their territories and to coordinate initiatives that promote the standardization of services provided to citizens by the Subprefectures, without interfering in internal matters that concern only the bodies that exercise local administration.

Thus, SMSUB, in coordinated action with the Subprefectures and other responsible bodies, is responsible for the actions provided for in items IV and V of Article 300 of the PDE.

> **Article 300.**
> (...)
> IV – strategies for articulation with the implementation of the Integrated Solid Waste Management Plan;
> V – definition of the actions and interventions necessary for the implementation of structural works for risk reduction and the adoption of safety and protection measures, establishing priorities, deadlines, and estimates of costs and required resources;

Finally, in a brief aside, in addition to the regulations governing the existence and operation of the Regional Prefectures, there are also relevant provisions intrinsically related to the theme of the PMRR, among which it is worth highlighting Municipal Decree No. 59,135 of December 12, 2019, which regulates, at the municipal level, the contracting of emergency works and services through the Subprefectures.

The regulation in question defines mandatory procedures for carrying out emergency works and services, with the predominant participation of the Subprefectures, but also relying on the subsidiary actions of SMSUB – Municipal Secretariat of Subprefectures, SMSU – Municipal Secretariat of Urban Security, and SF – Municipal Secretariat of Finance; being a clear example of the interdependence (and essential synergy) of the structuring bodies of the Public Administration of the Municipality of São Paulo.

An emergency situation, which can be defined as the recognition by the Municipal Public Authority of an abnormal situation, caused (or not) by disasters and having great potential to cause irreparable harm to the affected community, does not allow the implementation of preventive actions. Action is taken urgently, in search of immediate solutions to prevent the spread or extension of the damage.

SELIMP – Executive Secretariat of Urban Cleaning

Created following the extinction of AMLURB – Municipal Urban Cleaning Authority, through Decree No. 61,036 of February 7, 2022, SELIMP – Executive Secretariat of Urban Cleaning, linked to SMSUB – Municipal Secretariat of Subprefectures, has the legal attributions of managing, regulating, and supervising the **indivisible urban cleaning services**.

It is known that indivisible services are those that benefit society in a diffuse manner; thus, these services cannot be measured individually, since their purpose is directed to the entire population.

In the analysis of the services defined as indivisible urban cleaning services, whose contractual management belongs to SELIMP, one can identify services capable of assisting in risk reduction, notably with regard to the risks of floods and inundations. In this context, as an example, one can cite the cleaning and unclogging of storm drains, manholes, inspection chambers, rainwater galleries, and related infrastructure.

In addition to such services, the collection of bulky objects and unusable materials discarded on the streets of the city of São Paulo also stands out. The removal of such materials, through the operation called *cata-bagulho* (bulky waste collection), allows for the reduction of irregular dumping and its consequences, both in the environmental and social spheres, as well as in risk reduction.

The legal attribution to manage such services binds SELIMP to the premises of the PMRR, thus it is understood that the aforementioned Executive Secretariat is responsible for the actions provided for in item IV of Article 300 of the PDE.

> **Article 300.**
> (...)
> IV – strategies for articulation with the implementation of the Integrated Solid Waste Management Plan;

SP-REGULA – Regulatory Agency for Public Services of the Municipality of São Paulo

Created by Law No. 17,433 of July 29, 2020, the Regulatory Agency for Public Services of the Municipality of São Paulo – SP REGULA – an autonomous agency linked to the Mayor's Office – has administrative, financial, and budgetary autonomy and is responsible for regulating and supervising delegated services of the Municipality of São Paulo.

Following the extinction of AMLURB – Municipal Urban Cleaning Authority, SP REGULA became responsible for the management, supervision, and monitoring of divisible urban cleaning services in the municipality. Thus, among the

functions assigned to this Agency, the management of services related to the collection of solid waste in the Municipality of São Paulo stands out.

From the briefly summarized information, it is verified that SP REGULA has a strong connection with the PMRR, since waste management is related to the actions provided for in item IV of Article 300 of the PDE.

> **Article 300.**
> (...)
> IV – strategies for articulation with the implementation of the Integrated Solid Waste Management Plan;

SVMA – Municipal Secretariat of Greenery and the Environment

The SVMA – Municipal Secretariat of Greenery and the Environment, created by Municipal Law No. 11,426 of October 18, 1993, and reorganized by Municipal Law No. 14,887 of January 15, 2009, and by Municipal Decree No. 58,625 of February 8, 2019, has the purpose of planning, organizing, and coordinating environmental protection activities in the Municipality of São Paulo, maintaining relationships and contacts for technical-scientific cooperation with environmental bodies and entities, establishing criteria aimed at optimizing environmental protection actions in the Municipality, as well as carrying out activities compatible, related, and complementary to its area of activity.

The work of SVMA is intrinsically related to the theme of the PMRR – Municipal Risk Reduction Plan. This is because the environmental theme, notably the protection of natural resources and the preservation of environmental reserve areas, is essential for the observation and achievement of the aforementioned Municipal Plan.

It can be said that SVMA's actions permeate all the propositions of the PMRR in the sense that its activities anticipate and seek to foresee possible environmental degradations capable of generating future risks. Thus, it can be said that its role is provided for in items I, III, and IV of Article 300 of the PDE.

> **Article 300.**
> (...)
> I – analysis, characterization, and sizing of flood, landslide, and erosion risk areas, classified according to type and degree of risk;
> III – strategies for articulation with the implementation of the Municipal Housing Plan, mainly concerning the urbanistic, legal, land tenure, and environmental regularization of precarious and irregular settlements;
> IV – strategies for articulation with the implementation of the Integrated Solid Waste Management Plan.

SF – Municipal Secretariat of Finance

Created under Decree-Law No. 333 of December 27, 1945, and initially named the Secretariat of Finances, the SF – Municipal Secretariat of Finance – underwent numerous legislative changes until reaching its current structure.

According to Municipal Decree No. 58,030 of December 12, 2017, which reorganized the structure of said Department and established its duties, it is verified – within the extensive list of responsibilities delegated to the Department – that the Secretariat of Finance is responsible for administering municipal finances, promoting fiscal and tax policies, managing municipal taxation and the collection and application of public resources, articulating and assisting in the dialogue and coordination among the planning areas of other bodies and entities of the Municipal Public Administration and, notably, the Secretariat is also responsible for monitoring, planning, supporting the execution and ensuring the continuity of the budgetary guidelines and implementations of the entire Municipal Public Administration.

Through careful observation of the duties established in the current regulations, it is certain to say, in a rather summarized way, that the SF is linked to the PMRR due to the budgetary dependence for the applicability of the actions, guidelines, and intervention procedures derived from the PMRR. Under this premise, it is concluded that the proper management, reallocation, and allocation of resources make it possible for numerous interventions – originating from and conceived within the present study – to become leading and effectively applicable measures.

SGM – Municipal Secretariat of Government

The SGM – Municipal Secretariat of Government, established by Municipal Decree No. 53,685 of January 1, 2013, as part of the basic structure of the Direct Public Administration, has undergone successive reorganizations over time. Said Department is part of the Mayor's Office and has as its main duties to assist and advise the highest Municipal Authority in the performance of its functions and in matters related to the coordination and integration of Government actions, as well as to prepare rules and decisions, promoting their publication and preservation.

The SGM – Municipal Secretariat of Government acts in a coordinating capacity alongside other Departments that comprise the Direct and Indirect Municipal Administration. Because it is close to the Mayor's Office, the said Department frequently participates in Working Groups established to monitor, deliberate, and follow up on matters that require inter-secretarial dedication.

That is, in matters that usually depend on the synchronous performance of several Departments – since the issue encompasses multiple aspects and different areas of the Municipal Public Administration – the SGM, in exercising its legally defined duties and competencies, supports the demands and organizes the work, thereby enabling the Mayor's Office to act on more sensitive matters.

SEPEP – Executive Secretariat of Planning and Priority Deliveries

The Executive Secretariat of Planning and Priority Deliveries – SEPEP – became part of the basic structure of the SGM – Municipal Secretariat of Government – when it was reorganized through Municipal Decree No. 63,390/2024.

SEPEP has duties[3] that are deeply linked to the implementation of the PMRR, among which the following stand out: to guide the definition of strategies that will direct governmental policies, programs, and plans; to establish guidelines for the preparation of municipal planning, coordinating coherence among existing sectoral plans, including with regard to investment definition and better resource allocation; to establish an intersecretarial governance structure, coordinating the monitoring bodies of the Secretariats regarding the progress of monitored projects; to create, at a central level and in a systematized way, before municipal bodies and entities, methods and routines for monitoring major governmental policies and programs, in order to produce guidance and technical reports; to assist other municipal bodies in reviewing policies and programs and in making qualified decisions based on monitored performance indicators; and to promote the integration of data produced and made available by the Municipal Secretariats.

In this sense, it can be said that SEPEP is a fundamental body to direct the efforts of the Municipal Public Administration in the transformative process expected to be achieved through the execution of the PMRR proposals.

3 Article 30-E of Decree No. 59,000, dated October 7, 2019.

SECLIMA – Executive Secretariat of Climate Change

The Executive Secretariat of Climate Change – SECLIMA – of the Municipal Secretariat of Government (SGM), has regulatory provision in Article 5, item VI, of Decree No. 60,038/2020 and primarily seeks to include the climate variable, climate change, and the improvement of environmental resource management in the decision-making processes of the Municipal Government.

The duties of SECLIMA are ordinarily defined in Decree No. 60,290/2021, but among all of them, due to its strict link to the PMRR, the one established in Article 8 of Ordinance SGM/SECLIMA No. 3/2021 stands out, which assigns SECLIMA – Executive Secretariat of Climate Change – the general coordination of the PPCV – Preventive Plan for Summer Rains, with operational support from the Municipal Coordination of Civil Defense (COMDEC) of the Municipal Secretariat of Urban Security.

Briefly, the PPCV – Preventive Plan for Summer Rains, established under Ordinance No. 1,123/2021, arises from the need for the Municipal Government to establish a preventive plan for the management of risks associated with the summer rainfall period, when stormwater flow increases considerably, heightening hydrological and geological risks, with consequent disturbances and/or (even irreparable) damage to the population. It is implemented annually between September 1 and March 31 of the following year and is subdivided into two phases: the preparation phase, from September 1 to October 31; and the execution phase, from November 1 to March 31 of the following year.

Therefore, the PPCV's primary objective is to intensify preventive, emergency response, and social assistance actions, guided by the integration of public services, in order to reduce threats to the physical integrity of residents, provide rapid response in emergency situations, and promote effective social assistance support to communities affected by rain-related incidents.

PGM – Municipal Attorney General's Office

The PGM – Municipal Attorney General's Office – a legal body directly linked to the Mayor's Office – was created by Municipal Law No. 10,182 of October 30, 1986, and was initially part of the former Secretariat of Legal Affairs. With the publication of the LO – Organic Law of the Municipality – its permanent character was recognized. Later, with the publication of Municipal Law No. 16,974 of August 23, 2018, its technical, administrative, and budgetary autonomy was formally recognized.

In this regard, it is observed that the PGM – Municipal Attorney General's Office – has the purpose of supporting the highest Municipal Authority, defining the Municipality's technical-legal position, performing consulting and advisory legal activities for the Executive Branch, as well as exclusively representing the Municipality in judicial matters.

In relation to the PMRR theme, the PGM is the legal body responsible for acting on behalf of the Municipality of São Paulo in matters concerning irregular occupations, repossession actions, possessory disputes, and other actions related to the present subject.

The performance of the Municipal Attorney General's Office, in consonance with (but not limited to) the provisions of Article 300 of the PDE, resonates in the activities set forth in item III, as follows:

> **Article 300**.
> (...)
> III – strategies for articulation with the implementation of the Municipal Housing Plan, mainly in relation to the urbanistic, legal, land tenure, and environmental regularization of precarious and irregular settlements.

ON THE UNIFIED ACTION OF MUNICIPAL PUBLIC ADMINISTRATION BODIES

From the regulations and considerations presented, it is deemed appropriate to state that the PMRR demonstrates adequate and self-sufficient content, in full observance of the enabling law and the principle of legality. That is: the totality of what is outlined in this Plan neither falls short of nor exceeds the scope granted by law, since the measures proposed herein are objectively based and strictly connected to their purposes.

Consistent with the entire normative hierarchy, the PMRR precisely implements the objectives and principles broadly established in other regulations, notably the PDE. This is because it is within this municipal-level instrument that public policies as mitigation measures in the corresponding geographic area are defined – rehabilitating and complementing its space.

In fact, the implementation of the strategies established in the PMRR requires the cooperation of several municipal public administration bodies, through the decentralization of tasks and responsibilities, in such a way as to enable, cooperatively and coordinately, the management of public affairs across different fronts but with common interests. In this regard, the alignment of current legislation with the competencies of the involved Public Bodies is proposed so that the outlined actions (both structural and non-structural), whose primary purpose is risk mitigation, may be consolidated in the short, medium, and long term.

Thus, with a view to pursuing the general interest, following a gradual sequence of commands that are progressively less abstract and more concrete, it is correct to state that the involvement of the Secretariats comprising the GTI – Intersecretarial Working Group (Ordinance SGM No. 481, published in December 2021) is a *sine qua non* condition for the successful development of the actions proposed in the PMRR.

From all the foregoing, and especially in observance of the requirements established in Article 300 of Municipal Law No. 16,050 of July 31, 2014, it is understood that for the continuity of the PMRR – Municipal Risk Reduction Plan – the joint action of several Departments of the Municipal Public Administration will be necessary. In this regard, in comparison with the definitions established in current regulations, it is verified that the SMSU – Municipal Secretariat of Urban Security – is the Department responsible for the actions corresponding to item I of Article 300, Municipal Law No. 16,050 of July 31, 2014.

Furthermore, after detailed analysis of items II, III, and VI of the aforementioned Law, it is verified that the primary responsibility for their fulfillment lies with SEHAB – Municipal Secretariat of Housing. Regarding the provisions of item IV, joint action will be required from SMSUB – Municipal Secretariat of Subprefectures, the Subprefectures themselves, and SP REGULA – Regulatory Agency for Public Services of the Municipality of São Paulo. Finally, it is verified that the actions defined in item V fall within the responsibilities of SIURB – Municipal Secretariat of Urban Infrastructure and Works, SMSUB – Municipal Secretariat of Subprefectures, and the Subprefectures.

Finally, it should be emphasized that the designation of SMSU, SEHAB, SMADS, SIURB, SMSUB, and SP REGULA as the bodies responsible for the actions established in Article 300 of Municipal Law No. 16,050 of July 31, 2014, is made without prejudice to the participation of other bodies of the Direct and Indirect Municipal Public Administration, in order to compose and implement the actions of the intended Plan, thereby fulfilling and, above all, achieving the purpose of the legislation regarding the mitigation and/or elimination of risks located within the Municipality of São Paulo.

“When there’s flooding, we immediately get anxious because of the families who live in the lower area.”

Resident of a Risk Area

Photo: Tribo


ABCDE
TERRITORY

TERRITORY

The municipality of São Paulo, founded in 1554, is colossal in both numbers and size. As the main financial, corporate, and commercial center of Latin America, it is the most populous city in Brazil, in the Americas, in all Portuguese-speaking countries, and throughout the Southern Hemisphere.

São Paulo, once a rural powerhouse marked by vast coffee plantations, has transformed into Brazil's largest metropolis. It is accurate to say that since its founding, São Paulo has been a political, economic, and social powerhouse. The city welcomes immigrants from all over the world, as well as Brazilians from various regions who seek in São Paulo the opportunity for better living conditions and employment.

History shows that the city's growth and urbanization face challenges as massive as the numbers that define it. With approximately 21 million inhabitants—and over 20 million in the greater metropolitan area—it constitutes the seventh-largest urban agglomeration on the planet.

São Paulo accounts for nearly 35% of the State of São Paulo's GDP (Gross Domestic Product) and leads in the production of goods and services, being responsible for a large share of Brazil's total scientific output.

Although the city's HDI (Human Development Index) is considered very high (0.805)—the 14th highest in the state and the 28th in Brazil—its distribution is uneven.
The central districts generally present an index above 0.9. However, as one moves away from the city center toward more peripheral regions (the city's fringes), the indicator gradually decreases, reaching values close to 0.7.

The social disparity between central and outlying regions is mainly due to historical factors, as the greatest investments in urban infrastructure were concentrated around the Pinheiros, Tietê, and Tamanduateí rivers—areas chosen by São Paulo's economic elite as residential zones in the 18th century.

The historically observed pattern reveals the unrestrained (economic and population) growth that shaped the municipality's urbanization, characterized by territorial occupations that preceded municipal planning itself.

To better serve the diverse regions that make up São Paulo, initiatives were created to allow the Public Administration to monitor local issues more effectively. For this purpose, the city was administratively subdivided into smaller hubs called Subprefeituras (Subprefectures), which helped restore a sense of community by bringing local political leaders closer to popular demands.

Based on the principle of proximity and the empirical practices of public administration, territorial boundaries for the Subprefeituras were defined by grouping districts with similar characteristics—thus establishing the division of São Paulo into 32 Subprefeituras.
Figure 1 shows the map of the municipality and its Subprefeituras.

Decentralization granted the Subprefeituras the responsibility to monitor, supervise, and manage local affairs, and to that end, political, administrative, and financial autonomy was established. However, these initiatives alone were not sufficient to create parity among the various districts and subdistricts of São Paulo.

Many public policies, especially those directed toward vulnerable populations, face long-established historical data and prevailing realities. In other words, São Paulo's urbanization process has produced a significant legacy that must be addressed by the Municipal Administration to ensure everyone's right to the city and that the city, in fact, fulfills its social function.

Thus, since the municipality of São Paulo cannot be considered homogeneous—due to the specific characteristics, features, and, above all, the social and economic complexities of each area—the studies developed for the preparation of the Municipal Risk Reduction Plan (PMRR) carefully analyzed the issues specific to each region.

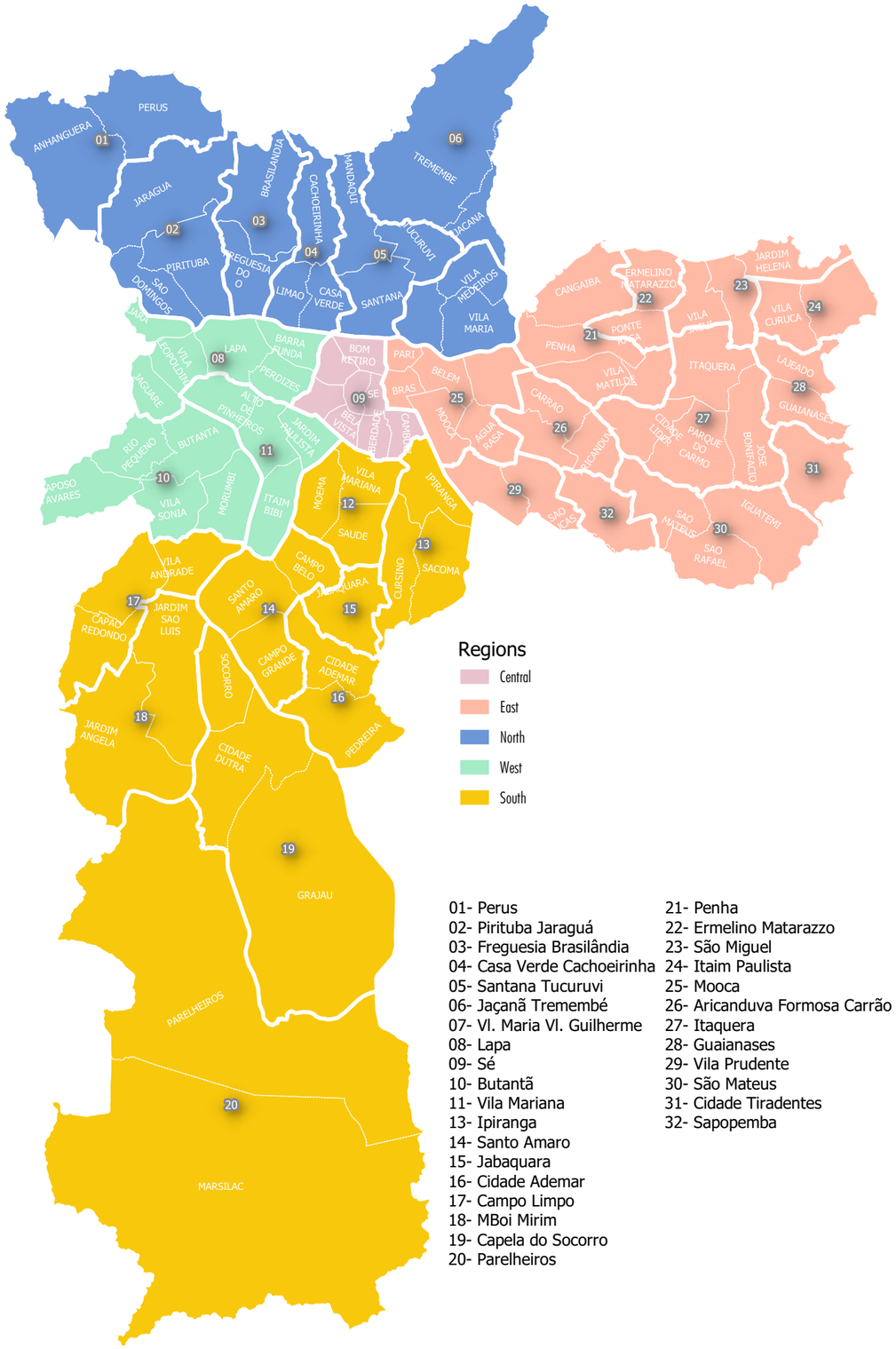


Figure 1: Map of the 32 Subprefectures in the Municipality of São Paulo (Data Source: GeoSampa, 2024)

OCCUPATION

The occupation of the metropolitan region, of which São Paulo is a part, is the result of a long historical process. A continuous thread links the colonial-era village to today's vast São Paulo macrometropolis—based on physical, geographic, social, economic, and environmental features and attributes.

These characteristics influenced the formation and occupation of the territory—from the *Vila de São Paulo de Piratininga* to the city's development into a metropolis and, ultimately, into today's macrometropolis.

Understanding the physical environment in which the built environment was established and how the city evolved in terms of land use and occupation is essential for comprehending its current situation and potential risks.

To properly contextualize this topic, it is necessary to provide an introduction on the history of São Paulo's territorial occupation.

Floodplain areas (*várzeas*) have always played an essential role in the formation of São Paulo and were therefore the first to be occupied, hosting various activities essential to human development.

It was precisely in the territory between the Pinheiros, Tietê, and Tamanduateí rivers—in the higher and drier areas—that the city's first neighborhoods were built. Over time, the floodplains have undergone continuous transformations, such as landfill projects, watercourse rectifications, and even the covering of rivers, followed by the construction of road systems over former riverbeds.

A brief review of key historical milestones essential to São Paulo's urban development highlights the first rectification works on the Tamanduateí River, dating back to the 18th century. These works facilitated floodplain occupation by reducing flood risks.

In 1810, new works were carried out, including ditch openings and the construction of the *Aterrado do Brás*.
By 1841, the river rectification had begun under Bresser's project, covering the stretch from the *Várzea do Carmo* to the Tietê River.

By the late 19th century, the Tamanduateí River had undergone significant changes, including a westward shift of its mouth by 3 km, through the opening of a 5.5 km canal connecting the mouth of the *Ribeirão Anhangabaú* to the Tietê River.

As for hillside occupations farther from the city center, these occurred in a disordered manner—mostly through irregular settlements on low-value lands or lands without a "visible owner."

This new frontier, due to its physical and environmental features associated with geological or ecological factors, is partially or entirely unsuitable for human settlement.

Bezerra and Chaer[4] point out that "*the fragility of the physical environment in these places is best known through the occurrence and imminent danger of landslides, floods, and collapses—commonly referred to as risk situations in urban planning terminology, which in this case represent risks to the population*."

These informal settlements, which disregarded physical and regulatory boundaries, generate not only urban and environmental imbalances but also pose risks to the lives of their inhabitants due to the fragility of the areas they occupy.

Moreover, they lack even minimal infrastructure to ensure proper social functioning: inadequate road layouts; deficient stormwater drainage systems; nonexistent water supply, sewage, and solid waste collection; long distances to education and health facilities; lack of employment opportunities; and absence of leisure spaces, as well illustrated in Figure 2.

Raquel Rolnik[5] succinctly summarized this issue, emphasizing that "**precarious settlements** were self-produced by their own residents using whatever means were available to them [...] on fragile lands or areas unsuitable for urbanization, such as steep slopes and floodplains, as well as the vast peripheral expansion zones over rural areas—thus producing a city outside the city, devoid of the infrastructure, facilities, and services that characterize urbanity."

4 BEZERRA, M. C. L.; CHAER, T. M. S.Regulação Fundiária e os Conflitos com as Normas do Código Florestal para APP Urbana. E-Metropolis, São Paulo, No. 10, Vol. 3, pp. 26–36, September 2012.

5 ROLNIK, Raquel. Pactuar o território – desafio para a gestão de nossas cidades. São Paulo, 2008. Available at: https://grabois.org.br/2008/08/01/pactuar-o-territrio-desafio-para-a-gesto-de-nossas-cidades/
Accessed on: March 17, 2024.

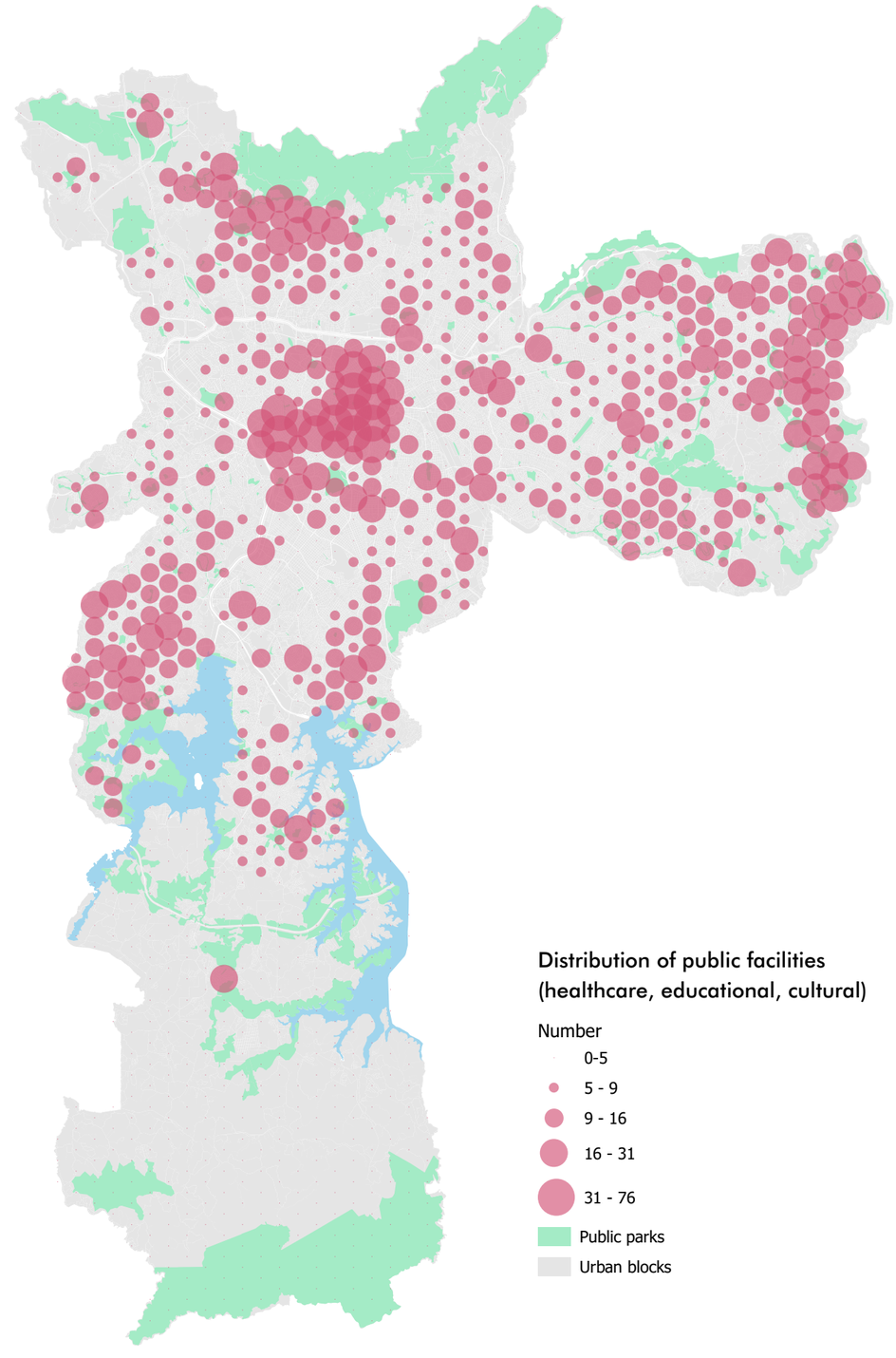


Figure 2: Distribution of Public Facilities[6]

6 Map created using data from GeoSampa, available at: https://metadados.geosampa.prefeitura.sp.gov.br/geonetwork/srv/por/catalog.search; last accessed May 15, 2024.

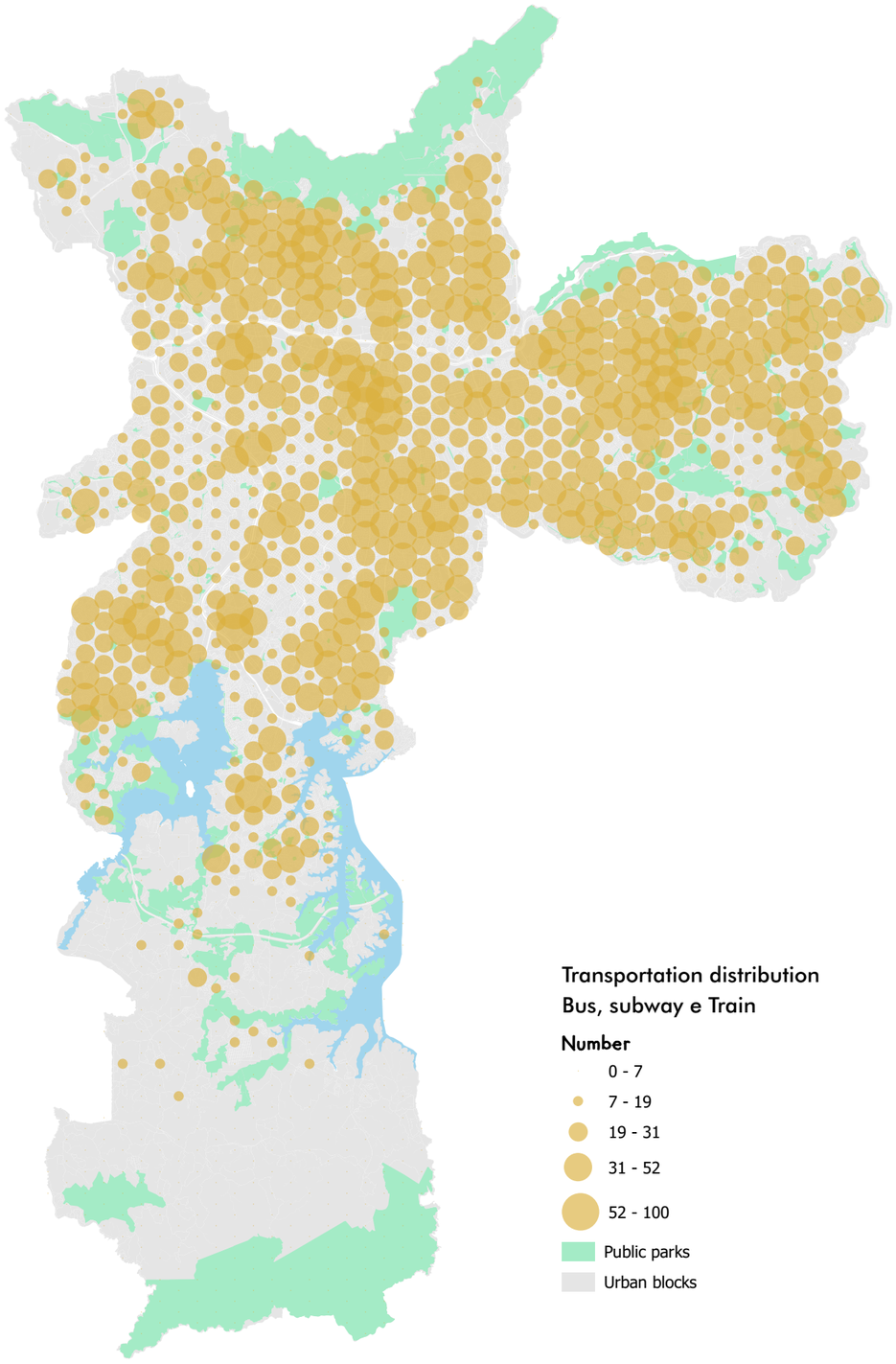


Figure 3: Transportation Distribution in the Municipality[7]

7 Map created using data from GeoSampa, available at: https://metadados.geosampa.prefeitura.sp.gov.br/geonetwork/srv/por/catalog.search; last accessed May 15, 2024.

Another relevant aspect, regarding occupation by precarious settlements, is the difference between the delimitation of the risk perimeter and that of the precarious settlement (slums or irregular subdivisions). Figure 4 shows an example in which the perimeters are almost coincident. In the image on the left, in blue, is the perimeter of the Tijuco Preto II slum, located in Itaim Paulista (East Zone); in the image on the right is the risk perimeter IT-10.



Figure 4: Example of (Almost) Overlapping Perimeters (Source: SEHAB)

The most frequent situations are those in which the perimeter of the settlement is larger than the risk perimeter, possibly encompassing one or more risk areas. Figure 5 illustrates one such case. In the image on the left, in blue, one can see the irregular subdivision Jardim Damasceno, located in Brasilândia (North Zone), and in the image on the right, the risk sectors FO-01, FO-02, FO-13, FO-27, and FO-28.

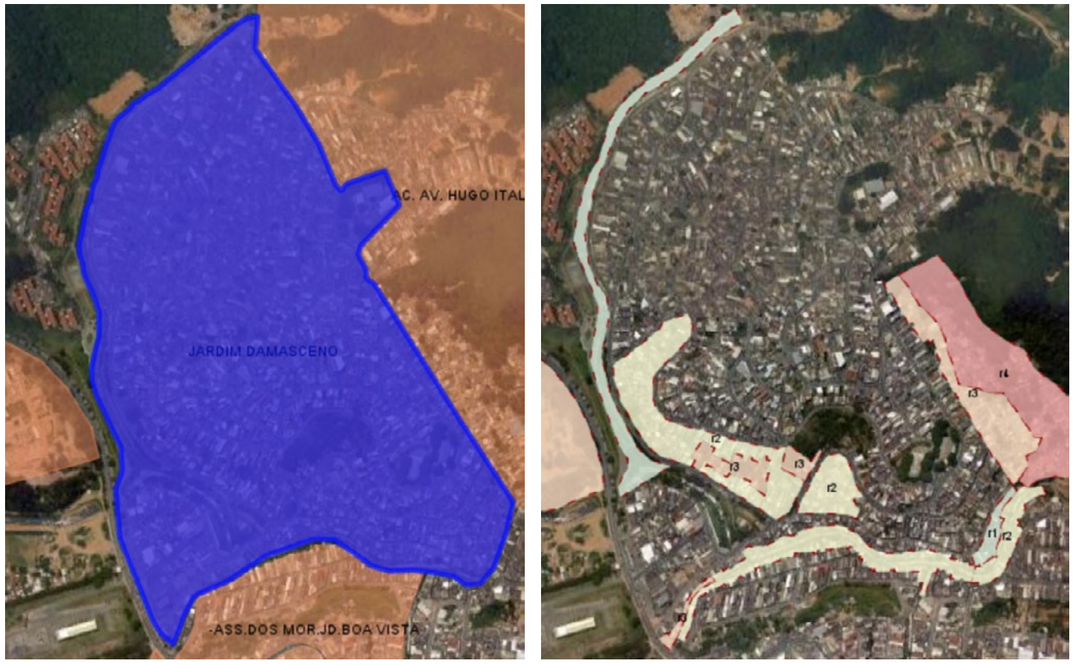


Figure 5: Example Where the Settlement Perimeter Is Larger Than the Risk Perimeter (Source: SEHAB)

Another very common situation is the lack of coincidence between the risk and subdivision/slum perimeters. A risk perimeter may cover more than one settlement, without corresponding exactly to the total set of settlements intersected by the risk area. This case is illustrated in Figure 6, where the image on top shows, in yellow, the slums, and in orange, the irregular subdivisions; and the image below shows the risk area JT-07.

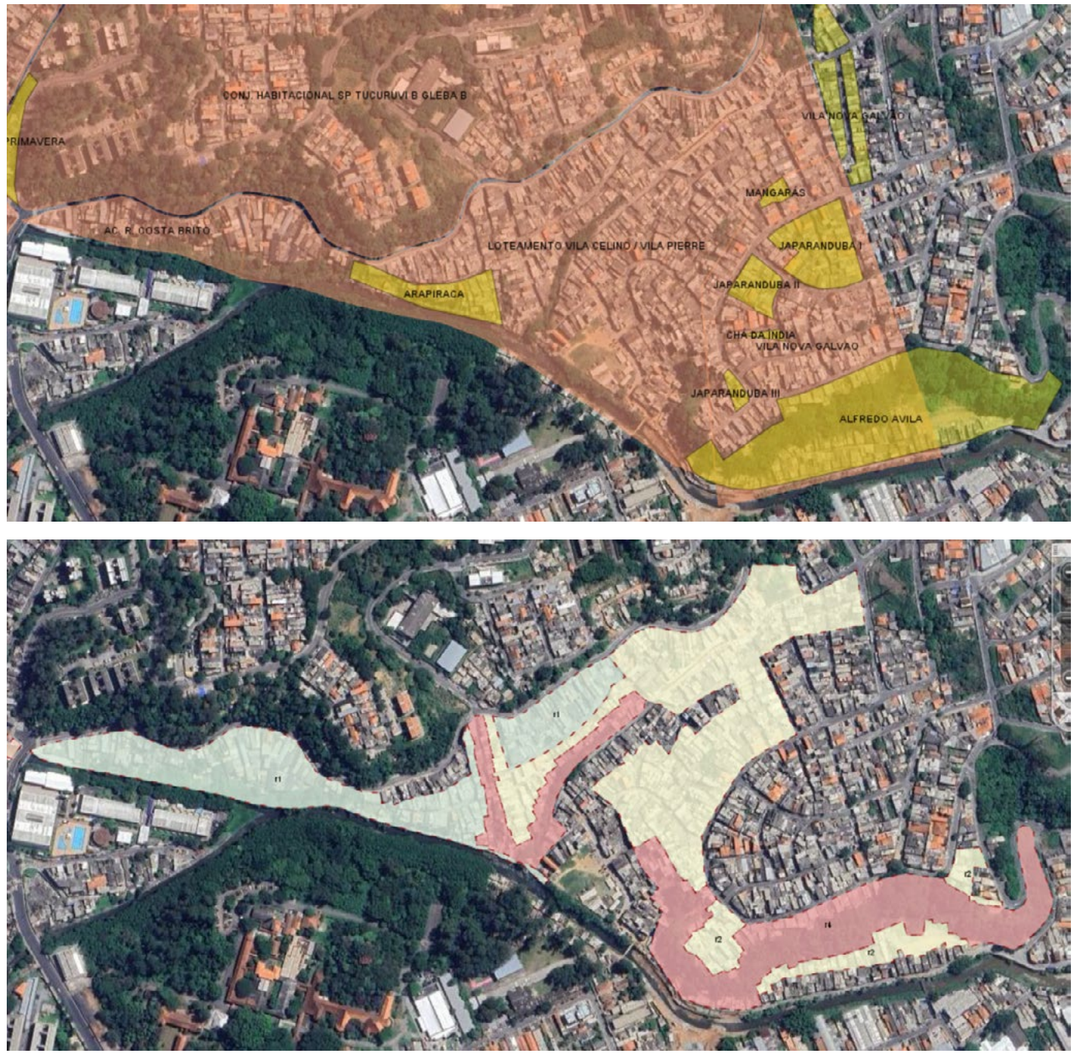


Figure 6: Example Where the Risk Perimeter Covers More Than One Settlement (Source: SEHAB)

Regarding the classification of slums and irregular subdivisions to identify necessary interventions, as well as to estimate the resources needed to carry them out and define prioritization for action, the 2016 Municipal Housing Plan (PMH) proposes classifying settlements into three typologies, aligned with the National Housing Plan: (i) consolidated; (ii) consolidable; and (iii) non-consolidable.

i. **Consolidated:** settlements already equipped with basic urban infrastructure but presenting land tenure irregularities and possible demands for social actions, installation of facilities, public services, and housing improvements (such as home renovation).

ii. **Consolidable:** settlements that present favorable conditions for maintaining all or part of the population on-site through urban intervention and environmental recovery, including the implementation of full infrastructure, opening or adaptation of the road system, land regularization, execution of geotechnical consolidation works, construction of social facilities, and promotion of housing improvements.

iii. **Non-consolidable:** settlements whose physical and environmental characteristics make the land unsuitable for housing occupation, for which the total removal of dwellings is recommended. This also includes land with legal restrictions on occupation, making it inappropriate for housing consolidation, such as highway ramps, areas beneath viaducts, or high-voltage power line corridors.

The classification of slums and irregular subdivisions into these categories also indicates the appropriate approaches to addressing the geological and hydrological risk areas contained within each settlement.

Considering that geological and hydrological risk situations should not exist in consolidated settlements, the slums and irregular subdivisions with the presence of risk are limited to those classified as consolidable and non-consolidable.

In the case of **non-consolidable** settlements, it is necessary to consider the total removal of dwellings at risk, the construction of new housing units for the resettlement of affected families, the execution of works to eliminate the risk, and practical measures to prevent reoccupation of the land.

Regarding **consolidable** settlements, it is important to note that this category encompasses a wide variety of situations and levels of precariousness, requiring case-by-case analysis to identify which services and works are needed, and which houses can be consolidated or must be removed. In these cases, integrated intervention should be carried out, focusing on land regularization.

Some of these areas are already at a more advanced stage of urbanization and currently benefit from specific public policies.

Such is the case of **Paraisópolis**, which, since its occupation in the 1960s, has undergone several waves of urbanization and today is extensively covered by public policies aimed at improving its infrastructure and regulating its land tenure.

Even so, it still has three areas with potential risk (Figure 7), one of which will be mitigated through the requalification of the Antonico[8] creek, already in progress. This represents an important step forward, as the area has a population exceeding 100.000 people and hillsides with slopes greater than 40%.



Figure 7: Risk Areas Mapped in Paraisópolis and Jardim Colombo in 2024 (Source: GeoSampa)

8 https://capital.sp.gov.br/w/obras-de-urbanização-transformam-a-comunidade-de-paraisópolis-na-zona-sul

A similar situation is found in **Heliópolis**, which, since the beginning of its occupation in the 1970s, has seen its population explode—reaching over 200,000 residents[9] by 2024.



Figure 8: Risk Areas Mapped in Heliópolis in 2024 (Source: GeoSampa)

9 https://tramas-urbanas-al.proec.ufabc.edu.br/heliopolis-sao-paulo

It is an already consolidated area that has undergone several improvement cycles, including stream canalization, construction of housing complexes, and, since 2004, an ongoing land regularization process. Despite this, two flood-risk areas still persist (Figure 8).

However, population growth has occurred at a faster pace than the municipal administration's ability to provide adequate infrastructure improvements. As a result, social, educational, mobility, public safety, and housing deficiencies are still observed.

Consequently, it is possible to see that the remaining natural disaster risk areas in the city are precisely located in the zones farthest from the city center—mainly those with less developed urban infrastructure and especially in irregular settlements.

POPULATION

The most recent demographic census shows that in 2022, São Paulo reached a population of 11.4 million inhabitants, representing a significant slowdown in the growth rate compared to previous surveys. Even so, this means an increase of 200,000 new residents compared to 2010. When compared to 1980, the city gained 3 million new residents—more than the entire population of Belo Horizonte and roughly equivalent to the combined populations of Recife and Curitiba. This population is predominantly White and Brown (90%), 53% female, and features a rapidly aging age structure.

The table below presents the population by Subprefecture for the 2010 and 2022 Censuses[10]

10 Database available at: http://dados.prefeitura.sp.gov.br/pt_PT/dataset/indice-de-desenvolvimento-humano-municipal; last accessed May 15, 2024.

Table 4: Population Characteristics of Subprefectures Overall and by Risk Area[11]

SUB-MUNICIPAL OFFICE							
NAME	Abbre-viation	Population (2010)	HDI 2011	Average HDI – Risk Areas	Maximum HDI – Risk Areas	Minimum HDI – Risk Areas	Population (2022)
Aricanduva-Formosa-Carrão	AF	270.119	0,826	0,776	0,870	0,638	268.218
Butantã	BT	428.105	0,862	0,719	0,925	0,510	466.719
Campo Limpo	CL	606.414	0,796	0,676	0,792	0,447	675.370
Capela Do Socorro	CS	594.602	0,724	0,710	0,837	0,638	605.595
Casa Verde-Cachoeirinha	CV	311.299	0,801	0,713	0,826	0,639	308.008
Cidade Ademar	AD	412.282	0,761	0,703	0,821	0,652	414.809
Cidade Tiradentes	CT	211.207	0,694	0,665	0,730	0,620	194.280
Ermelino Matarazzo	EM	207.848	0,772	0,731	0,798	0,660	202.374
Freguesia-Brasilândia	FO	406.337	0,747	0,715	0,870	0,692	379.493
Guaianases	GU	268.589	0,712	0,690	0,750	0,638	273.044
Ipiranga	IP	462.233	0,830	0,709	0,898	0,518	480.385
Itaim Paulista	IT	372.170	0,727	0,678	0,727	0,613	345.447
Itaquera	IQ	523.218	0,753	0,695	0,782	0,632	549.323
Jabaquara	JA	222.860	0,827	0,703	0,842	0,639	214.700
Jaçanã - Tremembé	JT	292.493	0,774	0,740	0,883	0,657	284.229
Lapa	LA	306.110	0,895	0,761	0,921	0,653	339.243
M'Boi Mirim	MB	561.847	0,718	0,672	0,802	0,316	576.311
Mooca	MO	344.549	0,858	0,824	0,896	0,718	377.484
Parelheiros	PA	141.158	0,663	0,665	0,718	0,643	164.872
Penha	PE	472.379	0,737	0,702	0,793	0,665	471.637
Perus	PR	146.165	0,712	0,712	0,786	0,665	163.359
Pinheiros	PI	288.631	0,940	0,923	0,923	0,923	285.391
Pirituba-Jaraguá	PJ	435.596	0,773	0,702	0,774	0,658	478.808
Santana-Tucuruvi	ST	325.179	0,871	0,832	0,832	0,832	319.320
Santo Amaro	SA	237.781	0,897	0,762	0,881	0,653	271.757
São Mateus	SM	427.094	0,718	0,691	0,777	0,651	453.971
São Miguel	MP	371.032	0,739	0,729	0,761	0,686	345.769
Sapopemba	SB	284.373	0,747	0,675	0,783	0,453	266.611
Sé	SE	432.337	0,873	0,781	0,781	0,781	424.153
Vila Mariana	VM	345.938	0,933	0,741	0,779	0,712	337.944
Vila Maria-Vila Guilherme	MG	297.601	0,799	0,880	0,933	0,723	276.141
Vila Prudente	VP	246.419	0,822	0,724	0,803	0,649	243.534

11 For the calculation of the Human Development Index (HDI) for Risk Areas, data were obtained from São Paulo's Open Data platform: http://dados.prefeitura.sp.gov.br/pt_PT/dataset/indice-de-desenvolvimento-humano-municipal, last accessed May 15, 2024. This dataset includes a table ("Base de Dados do IDHM 2000 e 2010") listing HDI, Income HDI, Education HDI, and Longevity HDI values for Human Development Units (UDHs). Since UDHs cover the entire city and have smaller-scale boundaries than the Subprefectures, a spatial intersection was conducted between the shapefiles of UDHs and Risk Areas. A weighted average of the intersecting areas was then used to calculate the HDI for the Risk Areas.

Currently, the Campo Limpo and Capela do Socorro Subprefectures are the largest, each exceeding 600,000 residents. However, there are already 11 Subprefectures with populations above 400,000. In fact, only three Subprefectures have fewer than 200,000 inhabitants: Parelheiros, Cidade Tiradentes, and Perus.

Comparing the two most recent censuses, the Subprefectures of Lapa, Butantã, Campo Limpo, Pirituba-Jaguará, Mooca, and Santo Amaro showed the largest population increases (over 30,000 each), while Freguesia-Brasilândia, Itaim Paulista, São Miguel Paulista, and Vila Maria–Vila Guilherme recorded the largest declines (over 20,000 each).

From this comparison, one can infer that there has been a significant population densification in the expanded central area of the municipality (with an increase of around 30.000 people between surveys) and a reduction of 183,.00 people in the city's peripheral zones. This is an important trend, as the more central areas are at a more advanced stage of urban infrastructure development. This phenomenon directly reflects the effects of recent municipal master plans.

Even so, the southernmost peripheral Subprefectures received nearly 150,000 new residents, many of whom settled informally in areas prone to flooding and landslides—thus expanding the city's risk areas.

Regarding the population living in risk areas, as will be detailed later, the number recorded in the 2022 Census reaches 490.000 people.

For the Human Development Index (HDI) analysis, only data from the 2010[12] Census were available. For this purpose, three ranges were established:

Range 1: < 0.7
Range 2: ⩾ 0.7 and < 0.8
Range 3: ⩾ 0.8

12 BRAZILIAN INSTITUTE OF GEOGRAPHY AND STATISTICS (IBGE). Brazilian Census 2010. Rio de Janeiro: IBGE, 2012.

The 785 risk areas in São Paulo were classified according to their Average HDI (HDI-M), Education Dimension (HDI-E), Longevity Dimension (HDI-L), and Income Dimension (HDI-R) within these ranges. The results are presented in Table 5 and Graph 1, respectively. All data compiled for this assessment are included in Annex 3.

Table 5: HDI Stratification

HDI Range	Medium HDI (IDH-M)	High HDI (IDH-E)	Low HDI (IDH-L)	Risk Area HDI (IDH-R)
1	412	659	15	559
2	325	106	368	192
3	48	20	402	34

It is notable that only in the Longevity Dimension is there a marked discrepancy in the distribution across ranges. The Average HDI, Education HDI, and Income HDI for the risk areas show a concentration in Ranges 1 and 2.

When analyzing areas classified in Range 1 across all dimensions, there are 15 risk areas; in Range 3, there are 17 risk areas. This can be better visualized in the figure below, which presents all HDI dimensions and their stratification by range.

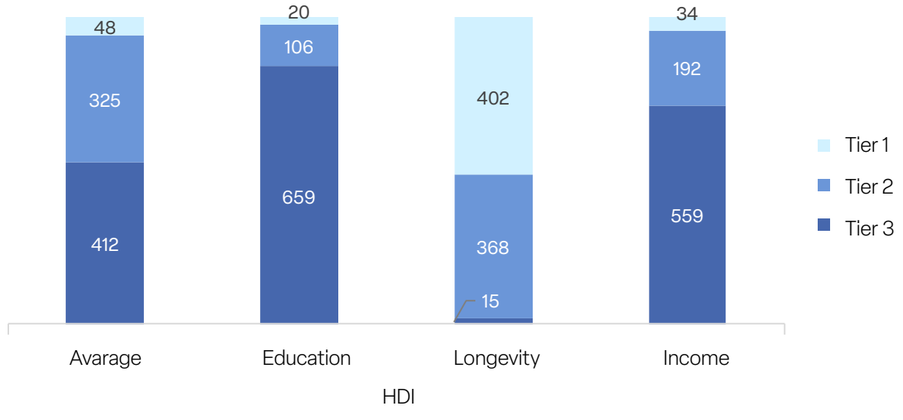


Chart 1: Distribution of Ranges in the Human Development Index (HDI) Dimensions (Source: 2010 Census)

HOUSING

The City Statute, among its many objectives, seeks to implement the principle of the social functions of the city, as formalized in Article 182 of the Federal Constitution of 1988[13]. In this regard, Federal Law No. 10,257/2001 establishes, in its Article 2, item I, that:

> Article 2 – Urban policy aims to organize the full development of the social functions of the city and urban property, through the following general guidelines:
> I – guaranteeing the right to sustainable cities, understood as the right to urban land, housing, environmental sanitation, urban infrastructure, transportation and public services, work and leisure, for present and future generations;

There is, therefore, a recognition that the right to a sustainable city arises from the fulfillment of its social function, as a way of guaranteeing human dignity. As Saule Júnior[14] explains, the right to a sustainable city:

> "[...] comprises the inherent rights of people living in cities to have decent living conditions, to fully exercise citizenship, to expand fundamental rights (individual, economic, social, political and environmental), to participate in the management of the city, and to live in an ecologically balanced and sustainable environment."

The city is, in fact, a diffuse right, since the holder of this right is the collectivity. Therefore, it must be ensured that sustainable development and the well-being of people are intrinsic to its transformation process. Carvalho Filho[15] defines the right to the city, relating it to sustainability, stating that:

> "[...] the right to sustainable cities is, in fact, the fundamental right of urban populations. Hence, we can affirm that this right must be the prevailing goal of all urban policy. As urbanization is a process of transforming the city with a view to improving the conditions of urban order, it is necessary that this process does not lose sight of this guarantee attributed to the collectivity. Without granting this right the importance it must hold, no urban policy action will achieve the well-being of inhabitants and users."

13 Federal Constitution of 1988, Article 182: "Urban development policy, carried out by the municipal government in accordance with general guidelines established by law, aims to ensure the full development of the social functions of the city and the well-being of its inhabitants."

14 SAULE JR., Nelson. Novas Perspectivas do Direito Urbanístico Brasileiro. Porto Alegre: Sérgio Antonio Fabris Editor, 1997.

15 CARVALHO FILHO, José dos Santos. Comentários ao estatuto da cidade. Rio de Janeiro: Lumen Juris, 2005, pp. 35–36.

The housing issue in the municipality of São Paulo has proven to be quite challenging. The housing deficit continues to grow even with the explosion of developments observed in this century, when more than 800,000 units were sold in just over two decades (Graph 2).

This is because most of these developments are inaccessible to the poorest population and are concentrated in the expanded central area of the municipality. This reality, consequently, contributes to the advancement and perpetuation of the undesirable situation of irregular occupation of vacant lots without proper infrastructure, resulting in new risk areas.

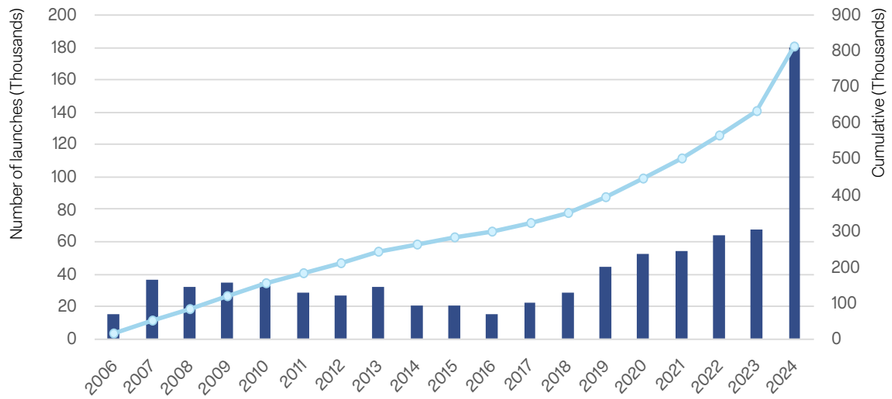


Chart 2: Evolution of Real Estate Developments (Annual and Cumulative) in the Municipality of São Paulo[16]

The Strategic Master Plan of São Paulo (Municipal Law No. 16,050/2014, amended by Municipal Law No. 17,975/2023 – Intermediate Review) establishes a series of guidelines related to the housing issue, especially concerning Social Interest Housing (HIS) and the promotion of urbanization and land regularization of precarious settlements, establishing planning instruments such as the Special Zones of Social Interest (ZEIS) and ZEIS Management Councils.

16 The 2024 data reflect an expected projection by the sector.

The aforementioned plan (Strategic Master Plan – PDE) also points to the need for integration between the management of risk areas and the municipality's housing actions. Regarding the PMRR, the need for this integration can be observed particularly in items II, III, and VI of Article 300 of the PDE (transcribed below), which define the minimum content of the PMRR:

> II – analysis, quantification and characterization of families living in the risk areas mentioned in the previous item [flooding, landslide and bank erosion], according to demographic, socioeconomic and housing profiles, among other aspects;
> III – strategies for articulation with the implementation of the Municipal Housing Plan, mainly regarding urban, legal, land and environmental regularization of precarious and irregular settlements;
> VI – definition of strategies for carrying out preventive relocations of residents from risk areas, when this is the only or most effective alternative to guarantee the safety conditions of residents, in accordance with objective and recognized technical criteria and fair and democratic procedures.

It should be clarified that the Municipal Housing Plan (PMH) establishes general guidelines for the municipality's housing policy over a 16-year horizon.

The first PMH prepared in São Paulo resulted in Bill No. 509/2011[17], representing a major advance by systematizing the results of a long process of structuring the Municipal Housing Secretariat for mapping, analyzing, and defining parameters for intervention in slums and irregular allotments in the municipality[18].

In 2016, the PMH was revised according to the parameters required by the current PDE (Municipal Law No. 16,050/2014), substantially changing the content of the first PMH. Thus, Bill No. 619/2016 focused on surveying the different housing needs, estimating the housing deficit and demand, and defining programs and action strategies to address the housing issue in the municipality, covering all its diversity[19].

17 Law No. 11,632, dated June 22, 1994, establishes the Municipal Housing System, but it should not be confused with the Municipal Housing Plan, which is one of the instruments that comprise the system.

18 In addition to Bill No. 509/2011, the process of drafting the first Municipal Housing Plan (PMH) resulted in the publication "Plano Municipal de Habitação – A Experiência de São Paulo," available at habitasampa.inf.br.

19 Alongside Bill No. 619/2016, SEHAB developed an illustrated version of the 2016 Municipal Housing Plan (PMH) (Caderno PMH), available at CadernoPMH.pdf (habitasampa.inf.br), to support public discussion.

Although both the need for a new review of the PMH and its approval by law are observed, part of Bill No. 619/2016 has been implemented and, in practice, guides the municipality's housing policy.

With regard to the current actions of the Housing Secretariat, as set forth in the PMH/2016, the following stand out:

Integrated Intervention in Precarious Settlements: this refers to the urbanization of slums and irregular subdivisions with the objective of consolidating existing constructions and ensuring decent housing. Its aim is to resolve the housing precariousness of settlements through the implementation of basic infrastructure works, public facilities and services, and environmental recovery, including the elimination of risk. It also includes actions to promote adequate health and safety conditions in housing, social support for families, and land regularization of the settlements.

Provisional and Definitive Housing Assistance: aims to assist families removed from precarious settlements, whether to enable the execution of public works (including integrated interventions) or due to imminent risk situations or disasters. Provisional housing assistance consists of granting a financial benefit to supplement household income in order to subsidize housing[20] costs.Temporary financial benefits are valid for twelve (12) months, renewable for another twelve (12), except for occupations consolidated for more than ten (10) years on municipal land, which receive the benefit continuously until definitive assistance is provided.

Definitive housing assistance (housing provision) consists of offering new housing units or compensating for the constructions (improvements) removed from precarious settlements. The granting of each of these benefits is guided by specific regulations and procedures.

It is also important to mention that, in addition to analyzing families' eligibility according to the criteria established in legislation, the granting of housing assistance also depends on the availability of resources from the Secretariat.

20 The financial aid benefits are structured as follows:
– Housing Rent Assistance: a temporary or ongoing benefit ranging from R$400.00 to R$600.00 per family, as an income supplement;
– Housing Support Grant: a one-time benefit of up to R$2,400.00 per family to cover housing expenses (cannot be combined with rent assistance);
– Moving Assistance Grant: a one-time payment of up to R$900.00 per family to cover moving costs;
– Emergency Card: a prepaid card provided to the head of household affected by a disaster, containing R$1,000.00 as a one-time emergency relief payment.

It is worth highlighting that the articulation between the PMH and the PMRR is essential due to the intrinsic relationship between risk areas and the slums and irregular subdivisions of the Municipality. This relationship arises from the fact that the lack of affordable housing for low-income populations induces the irregular occupation of vacant land, which often consists of areas unsuitable for construction, such as stream banks and steep slopes, resulting in risk areas.

Considering this intrinsic relationship between risk areas and slums and irregular subdivisions, it is necessary for the City Hall to be structured to operate in these areas in order to promote cooperation among the various departments involved, avoiding overlap and fragmentation of actions in the territory.
In this regard, it is worth mentioning that SEHAB has a database of projects developed under the "Renova SP Program." The interventions defined by SEHAB as priorities during the program's duration resulted in the development of urban intervention projects in several precarious settlements, covering the implementation of basic infrastructure, adaptation of the existing road system, canalization and environmental recovery of streams, environmental sanitation (water supply, sewage, drainage, and solid waste collection), risk elimination, and construction of housing units for the resettlement of families displaced by the interventions.

Finally, it should be emphasized that the proposal for interventions in risk areas must be based on the premise of mitigating risk with the minimum possible displacement of families. The decision to remove families should only be considered when there is no technical or governance feasibility to effectively mitigate the risk. In such cases, the displaced families must receive provisional assistance through rental aid until definitive housing assistance is provided, in accordance with Decree No. 61.282/2022.

Even with the creation of innovative programs such as Pode Entrar, the housing deficit remains above 500,000 housing units, as this calculation includes inadequate dwellings located in slums and irregular subdivisions, which, given their occupation and construction conditions, generate other risks such as fire (associated with inadequate electrical installations and high construction density) and collapse (associated with the quality of materials used in construction and the occupation of contaminated land).

The São Paulo City Hall (PMSP) has several thematic programs currently in operation, which seek to accelerate pre-construction processes (such as registration, project design, budgeting, and land tenure detailing) in specific areas and facilitate the search for resources for their implementation. Among them, the Manancial and Renova Programs stand out.

RESERVOIRS' SPRINGS AREA PROGRAM

The Reservoirs' Springs Area Program, under the responsibility of the Executive Secretariat of the Reservoirs' Springs Area Program, was created in the mid-1990s and implemented through the so-called Guarapiranga Program, which carried out urbanization and land regularization actions in precarious settlements (slums and irregular subdivisions), specifically in the Guarapiranga watershed region, later extending to the Billings area as well.

In December 2021, an Agreement was signed between Sabesp and the São Paulo City Hall (PMSP). This partnership involves investments in the regularization of sanitary sewage systems in housing clusters located near the surroundings of the Guarapiranga reservoir. Sabesp provides technical assistance and oversees the execution of water supply and sewage works carried out by SEHAB; once completed, the utility company assumes operation of the water and sewage networks in that region.

Thus, the Program's general objectives are to promote the urban and environmental upgrading of precarious settlements (slums or irregular subdivisions) located in the watershed protection areas in the southern zone of the city. To this end, it proposes the following actions:

1. Urbanization of precarious settlements;

2. Land regularization;

3. Provisional and definitive housing assistance for families resettled from areas of geological and hydrological risk, construction sites, and environmentally fragile locations;

4. Implementation of parks, leisure areas, and public facilities.

Furthermore, through the implementation of these proposed actions—particularly the installation of basic sanitation services—the Program aims to contribute to the decontamination of the Billings and Guarapiranga reservoirs and to the environmental protection of the areas influenced by these watersheds.

The actions for urban and environmental upgrading include works related to infrastructure, mobility, containment of geological risk areas, stream canalization, park development, construction of housing units and public facilities, as well as parks and public squares.

Concurrently with the urban and environmental upgrading actions, the land regularization process for property titling is initiated so that, upon completion, families receive the ownership titles to their homes.

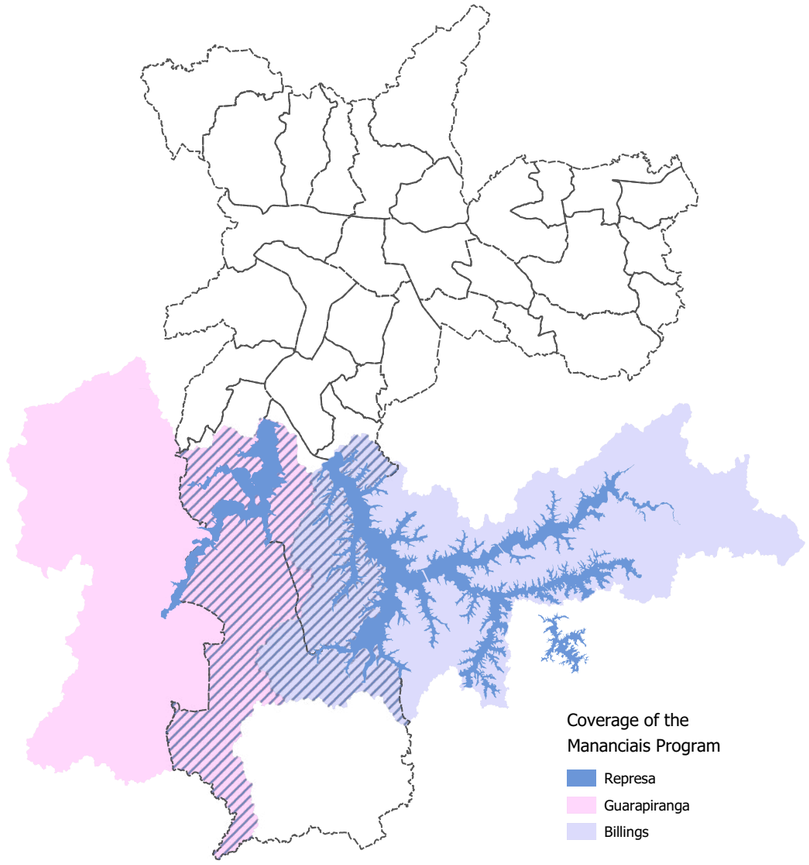


Figure 9: Coverage Area of the Mananciais Program (Source: GeoSampa, 2024)



Figure 10: Photo of Construction Work in Morro dos Macacos – Mananciais Program (Source: https://capital.sp.gov.br/web/habitacao)

SOLID WASTE

In a *lato sensu* approach, waste encompasses all materials discarded by human beings, including their excreta. In the strict sense, it refers specifically to urban solid waste and construction and demolition waste.

In Public Administration, waste management is classified into divisible and indivisible services. Divisible services include household and healthcare waste collection, which is carried out by concessionaires under the supervision of SPRegula. Indivisible services correspond to urban cleaning services, which are contracted through public works agreements and fall under the supervision of SELIMP. These are categorized as essential and complementary services.

The essential indivisible services include:

Conservation and cleaning of public-use assets of the Municipality;

Sweeping and cleaning of streets, viaducts, overpasses, squares, tunnels, stairways, passageways, alleys, shelters, monuments, restrooms, and other public spaces;

Scraping and removal of soil, sand, and any materials carried by rainwater onto paved streets and public spaces;

Weeding of street beds, as well as conditioning and collection of the resulting waste, and irrigation of unpaved streets and public spaces within the urban area;

Cleaning and unclogging of manholes, storm drains, inspection wells, rainwater galleries, and related structures;

Cleaning of open public areas;

Cleaning of flood control areas and detention tanks.

Complementary indivisible services comprise other urban cleaning activities with landscape or urbanistic purposes.

Due to the difficulty of differentiating between garbage and rubble—since both are often mixed—the accumulated material identified in risk areas is collectively referred to as solid waste. One of the negative characteristics of irregular settlements and risk areas is that improper waste disposal aggravates the risk of landslides and flooding. In addition to overloading rainwater collection and drainage systems, accumulated waste can become unstable masses on slopes.

Given the complexity of this issue, further in-depth study and the development of dedicated plans are necessary. In this regard, the city of São Paulo already has two well-structured action lines on waste management, consolidated in the Integrated Solid Waste Management Plan (PGIRS) and the Municipal Basic Sanitation Plan (PMSB), detailed below.

Even so, there remains a large number of illegal dumping sites throughout the city. In all 200 risk areas visited during the preparation of this PMRR, a significant presence of improperly disposed waste and rubble was observed.

Figure 11 illustrates the risk areas with irregular waste and rubble disposal.

Upon closer examination, it was found that 46% of the surveyed sectors with irregular waste deposits had an IPVS[21] score of 6.0. Only 0.8% of sectors with irregular solid waste disposal showed an IPVS of 1.0 (Graph 3).

In other words, the risk area sectors with higher IPVS values were also those where irregular solid waste accumulation was most frequently observed.

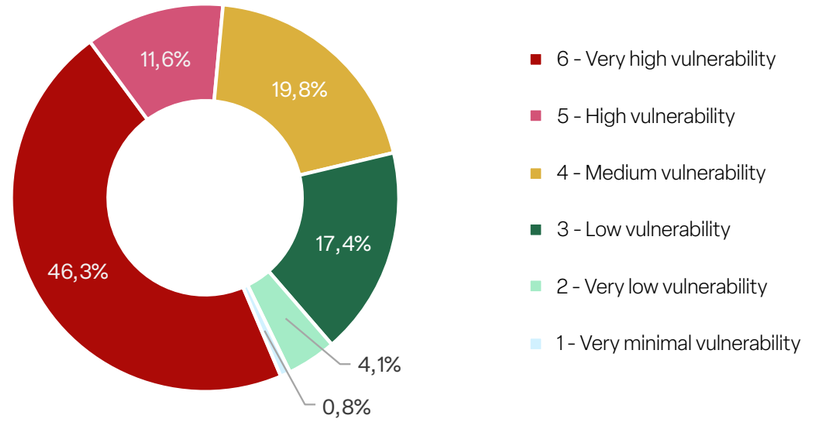


Chart 3: Classification of the IPVS in Areas with Solid Waste and Sewage Disposal in the Surveyed Risk Areas (Source: PMRR)

21 The São Paulo Social Vulnerability Index (IPVS) is an indicator that measures the state's population according to social vulnerability groups, based on income, education, and family life cycle dimensions.

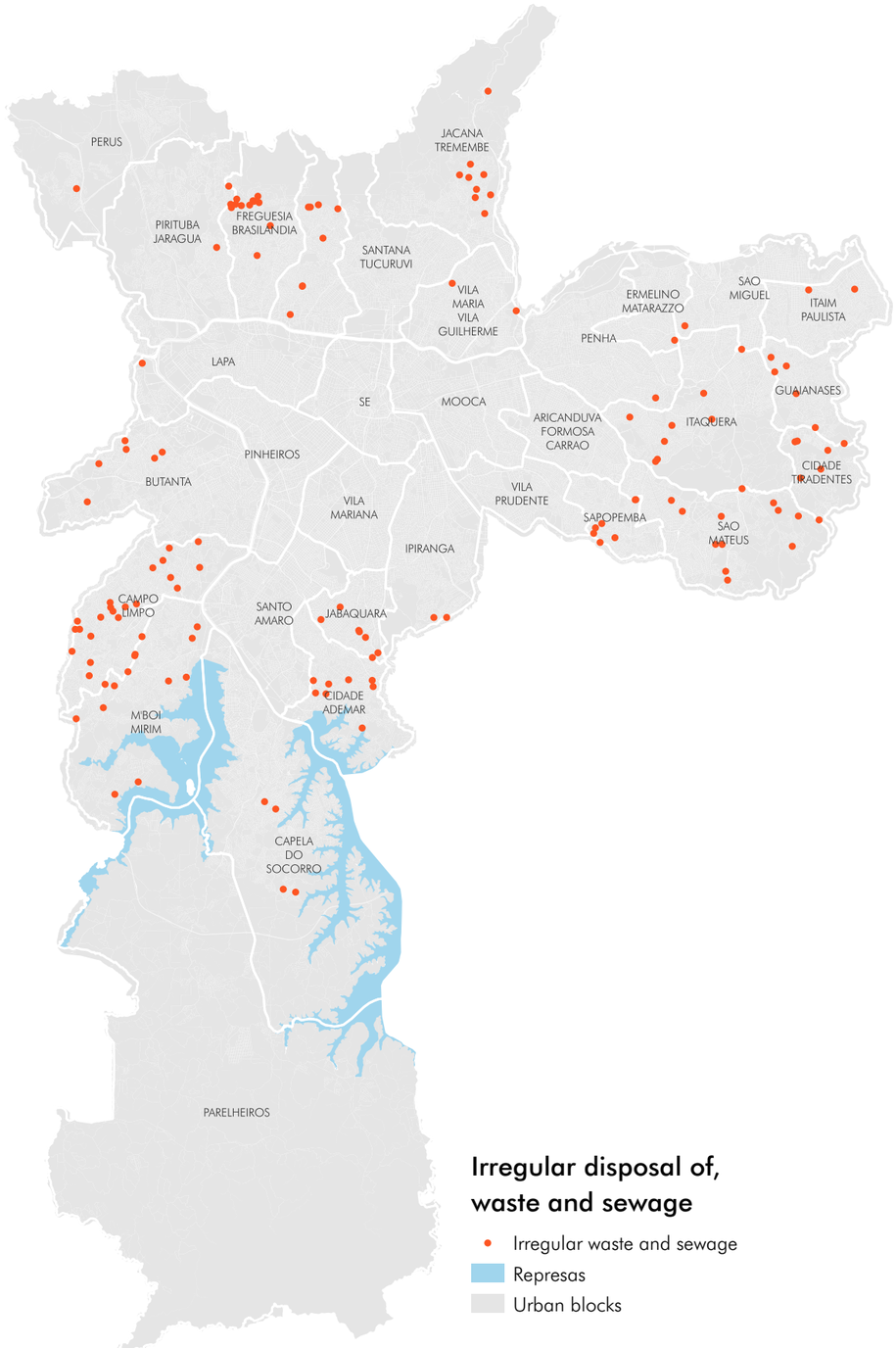


Figure 11: Known Locations of Irregular Waste and Sewage Disposal (Source: PMRR)

INTEGRATED SOLID WASTE MANAGEMENT PLAN (PGIRS)

With the establishment of the National Solid Waste Policy (Law 12.305/2010), the city of São Paulo, in 2014, set out a 20-year plan for the collection, transport, treatment, and disposal of solid waste. The plan emphasized the need to improve waste management according to its source characteristics and was formalized through the Integrated Solid Waste Management Plan (PGIRS), published under Municipal Decree No. 54.991, dated April 2, 2014.

The fundamental guidelines of the PGIRS include: non-generation, reduction, reuse, recycling, treatment of solid waste, and environmentally appropriate final disposal of rejects (materials with no recovery potential using current technologies).

The plan's actions were designed to be implemented progressively and in an integrated manner across municipal administration departments. At that time, responsibility for planning and intersectoral coordination under the PGIRS lay with the Municipal Urban Cleaning Authority (AMLURB), which was definitively dissolved in 2022.

Following AMLURB's dissolution, the management of solid waste was divided between two entities, the Executive Secretariat for Urban Cleaning (SELIMP), under the Municipal Secretariat of Subprefectures (SMSUB), responsible for indivisible urban cleaning services; and the Municipal Public Services Regulatory Agency (SP Regula), which now oversees divisible services, including household waste collection.

The PGIRS requires an update every four years, ideally aligned with the city's Multi-Year Plan (PPA), to ensure continuous improvement of the structures and commitments needed to guarantee the economic and financial sustainability of waste management services.

Despite these frameworks, field surveys conducted for the development of this PMRR revealed that irregular waste disposal remains a widespread issue in risk areas. Figures 12 and 13 illustrate some of these illegal dumping sites in hillside (CL-33) and stream (CL-31) areas.

In all areas with irregular waste disposal, large numbers of rats, cockroaches, and mosquitoes were found, posing significant public health risks to residents.

It is important to emphasize that the conFigure tion of settlements in risk areas—mostly irregular constructions, even those long consolidated—conflicts with the city's land use and occupation regulations. This misalignment makes it difficult for municipal authorities to perform regular waste collection, leading to the formation of heavily accumulated garbage and debris sites. The issue extends far beyond urban aesthetics, as it exacerbates existing risk conditions.

Although the current PGIRS does not explicitly address risk areas, responsible agencies have been working together to improve the collection and disposal logistics, which still occur less frequently than required by each region's needs.

Given the socio-environmental nature of this issue, illegal dumping sites ("pontos viciados") have received special attention, through socio-educational projects and public policies related to recycling centers and eco-points, such as the Project Descarte.

The Project Descarte is a joint initiative between SELIMP and local communities, which has already eliminated 88 illegal dumping sites across São Paulo. Identified "hotspots" are first cleaned and revitalized, and then urban cleaning agents conduct community outreach to raise awareness about proper waste handling and disposal.

Another successful initiative, involving collaboration between the Municipal Administration and street sweeping and waste collection consortia, is the Project Revitaliza SP. This program aims to revitalize former illegal dumping areas through cleaning, curb and gutter maintenance, painting, and landscaping, carried out jointly with Subprefectures and local residents.





Figure 12: Waste Disposal CL-33 – Morro da Lua (Source: PMRR)



Figure 13: Household Waste Disposal CL-31 – Jardim do Colégio (Source: PMRR)

Graph 4 illustrates the recurrence found in the work plan aimed at household waste collection in 72 areas identified as being at hydrological (46) and geological (26) risk.
This is possibly one of the reasons that explains the high spatial correlation between the illegal solid waste disposal sites and the risk areas.

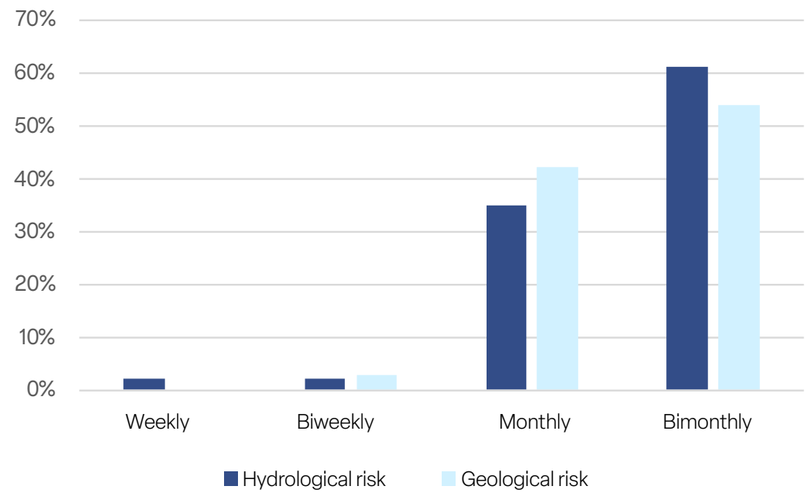


Chart 4: Frequency of Solid Waste Collection in Geological and Hydrological Risk Areas (Sample of 72 Areas) (Source: SELIMP)[22]

22 Data provided by the SELIMP team on June 13, 2024.

MUNICIPAL BASIC SANITATION PLAN (PMSB)

The Municipal Basic Sanitation Plan seeks to establish strategies for the universalization of sewage collection and the improvement of treatment processes.

Even though it is not specifically mentioned in Section VI of the PDE, addressing Basic Sanitation is an important point in a risk reduction plan, since it is well known that the irregular disposal of sewage can be a contributing factor to occurrences in risk areas.

The management of basic sanitation in the municipality of São Paulo has historically been shared between the City Hall and the State Government. Currently, there is an agreement between the City Hall, the State Government, and the Sanitation and Energy Regulatory Agency (ARSESP), as well as a service provision contract between the City Hall and Sabesp. This agreement is implemented through four-year goals and investments, which are established and managed by an intergovernmental administration.

The presence of raw sewage in the water bodies of risk areas was also frequently identified. An interesting fact, reported by residents in more than 10 visited areas, is that recent interventions carried out by SABESP for sewage collection have become sources of flooding problems. This is because the piping was laid along the watercourse, creating a barrier to water flow during periods of heavy rain. Figure 14 illustrates this situation.



Figure 14: Improperly Installed Sewage Pipeline in the Risk Area Vila Bella II – São Mateus (Source: PMRR)

RAINFALL AND HYDRODYNAMICS

Precipitation is a particularly important and variable element in both time and space, whose extreme events have the potential to cause significant impacts on the population, resulting in flooding, river and stream overflows, inundations, and landslides.

Historical data show that the total volume of rainfall over the São Paulo Metropolitan Region (RMSP) has been gradually increasing over the past 80 years: from around 1,000 to 1,500 mm/year in the 1940s and 1960s to 1,500 to 2,000 mm/year in the last 20 years (Graph 5). Despite this, a reduction in the number of rainy days in the city has been measured (Graph 6).

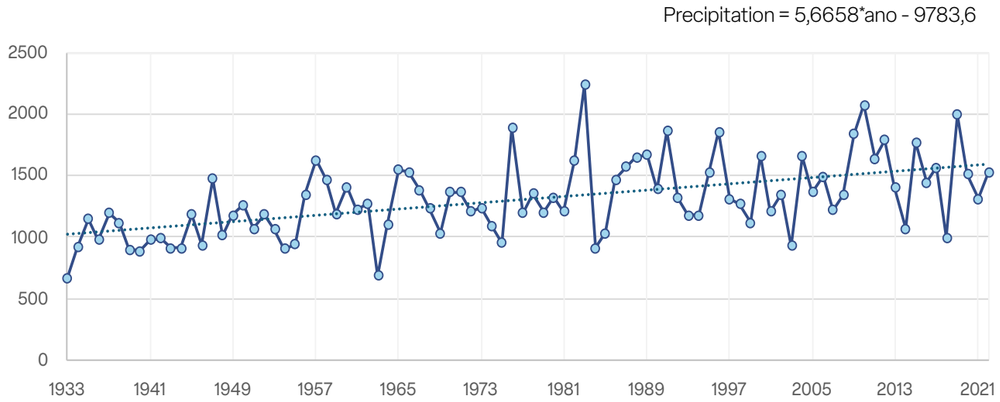


Chart 5: Evolution of Rainfall Volume Measured by IAG Over the Years at the USP Meteorological Station (Source: IAG, 2024)[23]

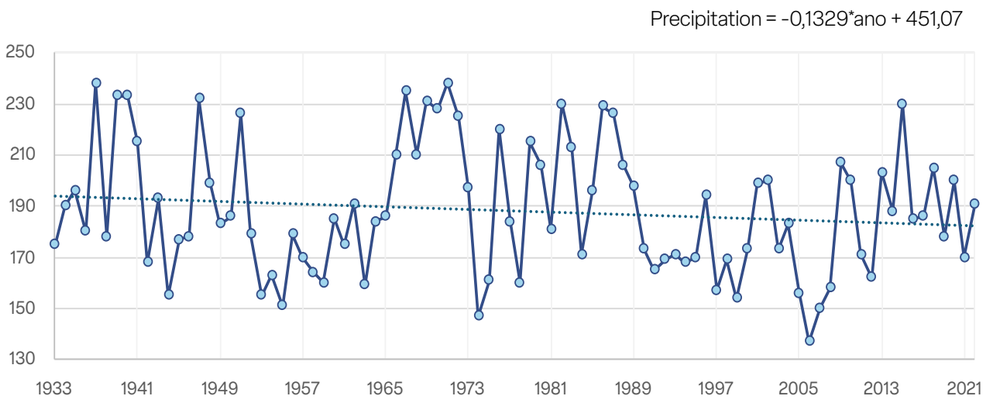


Chart 6: Evolution of the Number of Rainy Days Measured by IAG Over the Years at the USP Meteorological Station (Source: IAG, 2024)

23 Annual Climatological Bulletin of the Meteorological Station of IAG/USP / Technical Section of Meteorological Services – Institute of Astronomy, Geophysics and Atmospheric Sciences, University of São Paulo – Vol. 25, 2022. São Paulo: IAG/USP, 2024. ISSN 1415-4374.

These data confirm the general feeling among the population that the "land of drizzle" (*terra da garoa*) has become the "land of storms" (*terra da tormenta*), characterized by large volumes of rain falling over short periods and generating negative impacts on the population's mobility and safety.

Data from the Urano[24] system (which collects data from 80 rain gauges distributed throughout the municipality and surrounding areas) show that between 2017 and 2024, approximately 0.35% of the two-hour time windows (Graph 7) recorded rainfall[25] volumes exceeding 50 mm (ranging from 0.22% in 2018 to 0.45% in 2019).

In absolute numbers, this means that, every year, there were more than 100 two-hour time windows with rainfall exceeding 50 mm (257 events in 2017 and 127 in 2021) and at least one occurrence with rainfall exceeding 100 mm within 120 minutes (a record of seven such events in 2020). This is an important finding, as it directly impacts design rainfall calculations, as will be discussed later.

When the time window is extended to six hours (Graph 8), the figures become quite striking: an average of 1,000 time windows with rainfall above 50 mm and 25 windows with rainfall above 100 mm.

It was not possible to establish a spatial relationship for the maximum and average precipitation values, even with the application of various kriging[26] techniques.

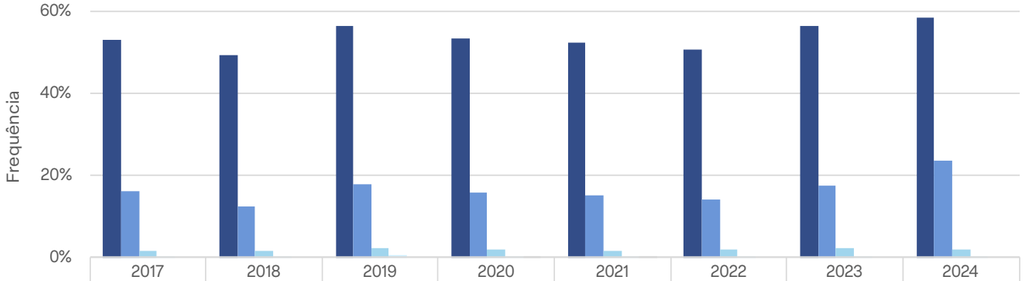
The municipality of São Paulo is located within the Upper Tietê River Basin (BHAT), receiving contributions from its six sub-basins: Billings–Tamanduateí, Cotia–Guarapiranga, Penha–Pinheiros, Alto Tietê–Cabeceiras, Juqueri–Cantareira, and Pinheiros–Pirapora. Internally, these contributions can be divided into 265 different sub-basins, distributed throughout the municipality. Most of these sub-basins drain into the Tietê River, which then carries the waters toward the interior of the State of São Paulo. There are also two large storage reservoirs: the Guarapiranga and Billings reservoirs.

24 URANO is a computational system developed by the São Paulo City Hall focused on micro-drainage management.

25 The concept of a time window is fundamental for interpreting the physical phenomena related to risk areas.

26 Kriging is a geostatistical interpolation technique that predicts measurements and observations at unknown locations based on previously collected data.

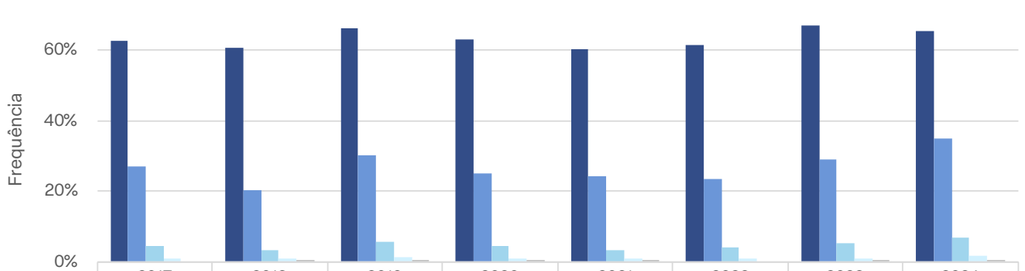
Proportion of 2-hour windows exceeding “i” mm during rainfall events (> 1 mm)



	2017	2018	2019	2020	2021	2022	2023	2024
3 mm	53,13%	49,51%	56,53%	53,39%	52,43%	50,61%	56,68%	58,44%
10 mm	16,02%	12,59%	17,73%	15,81%	15,27%	14,28%	17,42%	23,56%
30 mm	1,68%	1,40%	2,31%	1,78%	1,63%	1,83%	2,29%	2,06%
50 mm	0,24%	0,22%	0,45%	0,25%	0,28%	0,33%	0,37%	0,28%
100 mm	0,00%	0,00%	0,00%	0,01%	0,01%	0,00%	0,00%	0,00%

Chart 7: Proportion of 2-Hour Time Windows Exceeding Rainfall Thresholds Over the Years

Proportion of 6-hour windows exceeding “i” mm during rainfall events (> 1 mm)



	2017	2018	2019	2020	2021	2022	2023	2024
3 mm	62,72%	60,75%	66,06%	62,78%	60,24%	61,22%	66,79%	65,35%
10 mm	26,95%	20,08%	30,04%	25,05%	24,27%	23,39%	29,09%	34,77%
30 mm	4,37%	3,09%	5,81%	4,54%	3,36%	3,88%	5,06%	6,88%
50 mm	0,73%	0,76%	1,41%	1,09%	0,75%	0,85%	1,02%	1,56%
100 mm	0,00%	0,01%	0,05%	0,06%	0,02%	0,00%	0,01%	0,05%

Chart 8: Proportion of 6-Hour Time Windows Exceeding Rainfall Thresholds Over the Years

The municipality has an extensive network of rivers and streams totaling 4,500 km, with the main ones being the Tietê, Pinheiros, and Tamanduateí. Over time, artificial reservoirs (detention ponds and polders) have been created to mitigate rainfall peaks and the impacts of soil impermeabilization.

A significant portion of these water bodies has been covered, following the 19th-century hygienist doctrine. Since then, efforts have shifted to avoid this practice, and there is a growing movement to uncover and restore some of these waterways.

In addition to these water bodies, which make up the macrodrainage system, the municipality has an extensive network of stormwater galleries exceeding 5,000 km, and around 256,000 drainage elements, which make up its microdrainage[27]: 172,000 storm drains, 7,000 catch basins/grates, and 77,000 inspection wells.

For the technical assessment of rainfall impacts on the metropolis (and the corresponding design of engineering projects), design rainfalls are used, based on the Intensity–Duration–Frequency (IDF) relationship, developed by Martinez Júnior and Magni[28], and updated in 2015 according to Equation 1 (DAEE[29]). In summary, the rainfall intensity for a given period can be obtained by multiplying the intensity provided by the IDF curve by its corresponding duration.

Equation 1: IDF Curve – Municipality of São Paulo

$$i_{td,Tr} = 32{,}77(t_d+20)^{-0{,}878} + 16{,}1(t_d+30)^{-0{,}9306}.[-0{,}4692-0{,}8474\ \ln \ln(T_r/T_r-1)]$$

Valid for $0 \leq t \leq 1440$ min, where:
$i_{td,Tr}$ – Rainfall intensity [mm/min];
t_d – Rainfall duration [min];
T_r – Return period [years].

27 Data sourced from the URANO system.

28 JÚNIOR, F. M.; MAGNI, N. L. G. Precipitações Intensas do Estado de São Paulo. São Paulo: DAEE/CTH, 1999.

29 DAEE. MARTINEZ; PITERI. 2015 cited in DAEE. Precipitações Intensas do Estado de São Paulo. Revised Edition. São Paulo: DAEE/CTH, 2015.

Table 6 presents the results of the IDF curves for different recurrence times.

Table 6: IDF Curve Results for the Municipality of São Paulo

Duration (min)	Intensity (mm/min)				
	TR2	**TR5**	**TR10**	**TR25**	**TR100**
10	1.57	2.07	2.40	2.82	3.13
20	1.22	1.62	1.89	2.23	2.48
30	1.00	1.34	1.57	1.86	2.07
40	0.85	1.15	1.34	1.59	1.78
50	0.74	1.00	1.18	1.40	1.56
60	0.66	0.90	1.05	1.25	1.39
70	0.60	0.81	0.95	1.13	1.26
80	0.54	0.74	0.87	1.03	1.15
90	0.50	0.68	0.80	0.95	1.06
100	0.46	0.63	0.74	0.88	0.98
110	0.43	0.59	0.69	0.82	0.92
120	0.40	0.55	0.65	0.77	0.86

A simple comparison of the table data with the measured rain gauge records shows that the rainfall intensity designed for 100-year return periods was reached somewhere in the municipality during every year of analysis since at least 2017.

This demonstrates the difficulty of dealing with rainfall in such a highly urbanized area as São Paulo, and how uncontrolled occupation processes (such as the settlement of floodplain areas) create new challenges.

Moreover, it is important to highlight that atypical rainfall events have been recorded in various parts of the country and the world — for example, 539 mm recorded at the Jardim Botânico station in Porto Alegre in May 2024, and 683 mm in 24 hours in the municipality of São Sebastião.

GEOLOGY

The geology of the municipality of São Paulo is part of the Mantiqueira Province, a complex orogenic system whose structure developed during the Neoproterozoic Brasiliano–Pan-African Orogeny, resulting from the collision of distinct blocks that formed Western Gondwana (Almeida et al[30]; Heilbron et al[31]).

More specifically, the area is located within the interference zone, where there is a gradual transition boundary between the Southern Brasília Orogen and the Ribeira Orogen[32], represented by the Apiaí–São Roque and Embu Domains, respectively (Campos Neto[3333]; Heilbron et al.[34]). The structural context resulting from this block collision consists of a large system of folded rocks, intersected by faults and shear zones that deform the existing rocks to a high metamorphic grade (Trouw et al.[35]).

The main lithotypes present in the municipality of São Paulo are the Mesoproterozoic basement rocks of the Votuverava Group and Serra do Itaberaba Group, interbedded with the Neoproterozoic rocks of the Embu Complex, São Roque Group, and undifferentiated mylonitic rocks. These rock packages are intruded by Neoproterozoic granites and later serve as the basement for the Cenozoic rocks of the Taubaté Group and Quaternary alluvial deposits (Perrota et al.[36]).

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30 ALMEIDA, F. F. M.; HASUI, Y.; BRITO NEVES, B. B.; FUCK, R. A. Brazilian Structural Provinces: An Introduction. Earth-Science Reviews, v.17, n.1/2, pp.1–29, 1981.

31 HEILBRON, M. C. P. L.; PEDROSA-SOARES, A. C.; CAMPOS NETO, M. C.; SILVA, L. C.; TROUW, R. A. J.; JANASI, V. A. Província Mantiqueira. In: Geologia do continente sul-americano: evolução da obra de Fernando Flávio Marques de Almeida. São Paulo: Beca, 2004.

32 Tectonic province where diverse geological processes unfold, related to the interaction of lithospheric plates and the formation of major mountain ranges on Earth.

33 CAMPOS NETO, M. C. Orogenic Systems from Southwestern Gondwana: An Approach to the Brasiliano–Pan-African Cycle and Collage in Southeastern Brazil. In: CORDANI, U. G.; MILANI, E. J.; THOMAZ FILHO, A.; CAMPOS, D. A. (eds.). Tectonic Evolution of South America. Rio de Janeiro, 2000. p. 335–365.

34 HEILBRON, M. C. P. L.; PEDROSA-SOARES, A. C.; CAMPOS NETO, M. C.; SILVA, L. C.; TROUW, R. A. J.; JANASI, V. A. Província Mantiqueira. In: Geologia do continente sul-americano: evolução da obra de Fernando Flávio Marques de Almeida. São Paulo: Beca, 2004.

35 TROUW, R. A. J.; PETERNEL, R.; RIBEIRO, A.; HEILBRON, M.; VINAGRE, R.; DUFFLES, P.; TROUW, C. C.; FONTAINHA, M.; KUSSAMA, H. A New Interpretation for the Interference Zone between the Southern Brasília Belt and the Central Ribeira Belt, SE Brazil. Journal of South American Earth Sciences, v.48, pp.43–57, 2013.

36 PERROTA, M. M.; SALVADOR, E. D.; LOPES, R. C.; D'AGOSTINO, L. Z.; CHIEREGATI, L. A.; PERUFFO, N.; GOMES, S. D.; SACHS, L. L. B.; MEIRA, V. T.; GARCIA, M. G. M.; LACERDA FILHO, J. V. Geologia e recursos minerais do estado de São Paulo. São Paulo: CPRM, 2006.

Figure 15 illustrates the various geological formations that make up the municipality and the main fault zones.

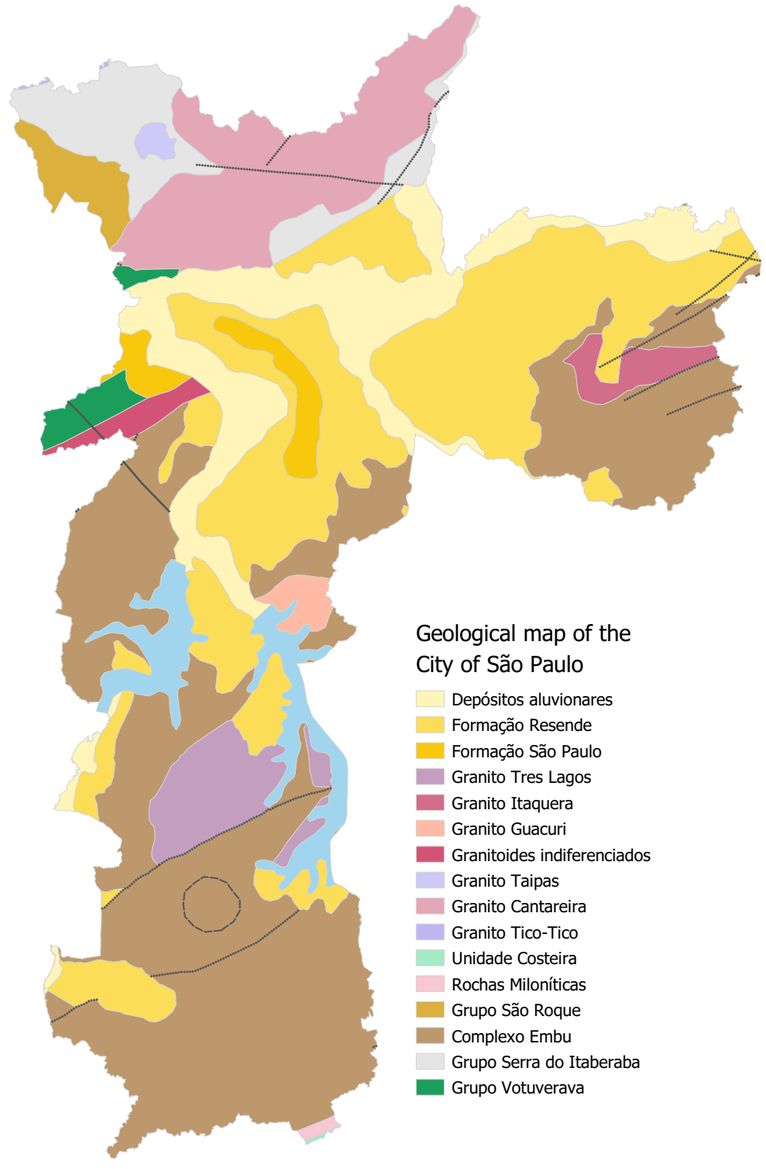


Figure 15: Geological Map of the City of São Paulo (Modified from Perrota et al., 2006)

This heterogeneous geological formation has resulted in considerable variation in crystalline basement depth across the territory. A compilation of existing data from the SIAGAS[37] system of the Geological Survey of Brazil indicates that there are regions with rock outcrops and others where the bedrock lies deeper than 150 meters (Figure 16). This is highly relevant information, as thin soil layers, combined with steep slopes, can configure areas with potential for landslides.

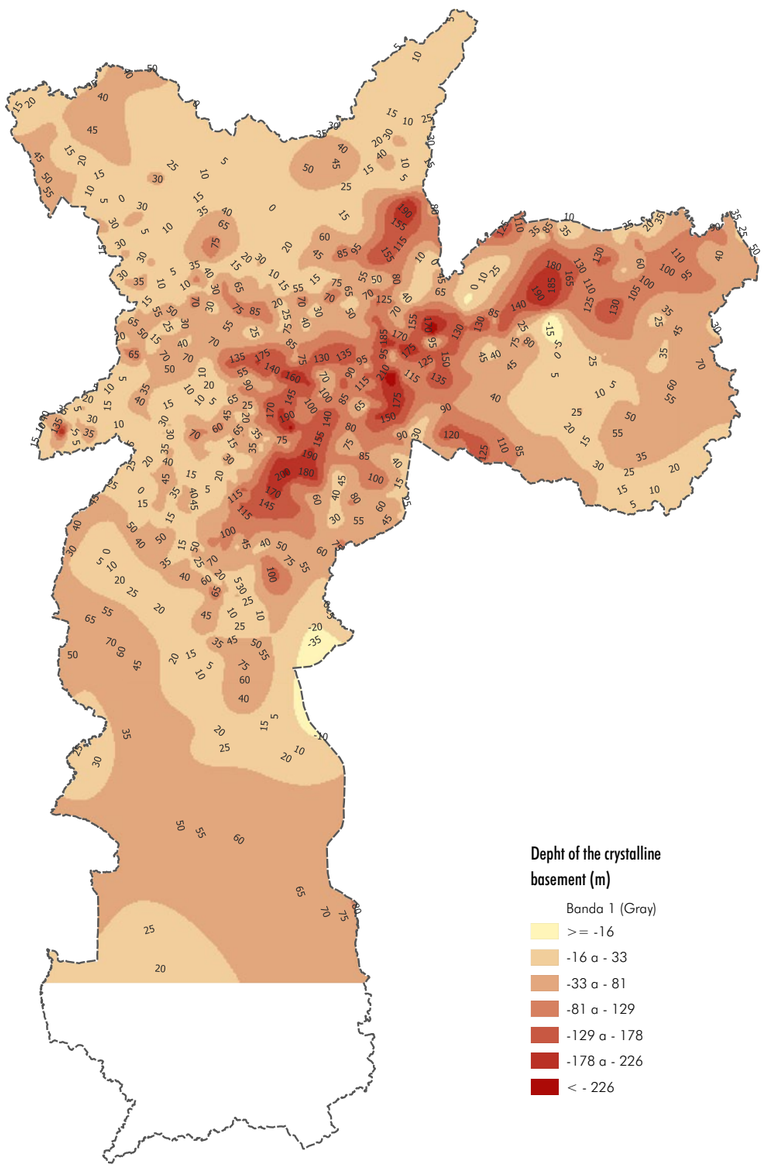


Figure 16: Depth of the Crystalline Basement in the Municipality of São Paulo (Source: SIAGAS)

37 The Groundwater Information System provides the results of well drillings and is maintained by the Geological Survey of Brazil (CPRM).

There is a long history of soil information for the municipality of São Paulo. The State Secretariat for Environment, Infrastructure and Logistics (SEMIL) developed the Atlas of Soil Susceptibility of the State of São Paulo[38], which relates the types of land occupation to the main geotechnical processes associated with weathering agents.

From this study, it can be observed that the urban area has a large extent (902.4 km²), spreading throughout the central region and expanding to other areas. There are also small mining zones with an approximate area of 4.7 km². In these portions, it was not possible to determine the pedological composition. The main soils mapped for the municipality of São Paulo are: Cambisol, Argisol, Latosol, Neosol, Organosol, and Gleysol (Figure 17).

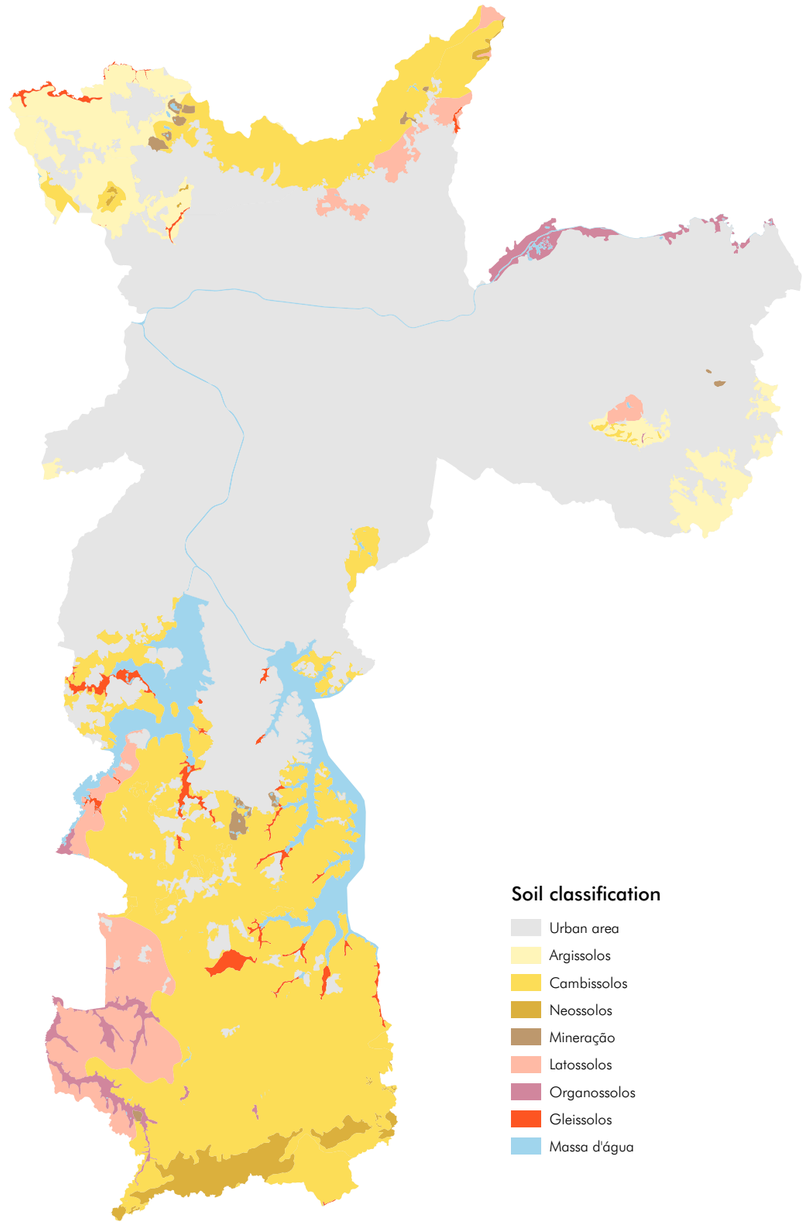


Figure 17: Representative Points of Geological Risk Sectors on Soil Classification Map (SIMA, 2022)

38 ROSSI, M.; NALON, M. A.; KANASHIRO, M. M. ATLAS DE SUSCETIBILIDADES DOS SOLOS DO ESTADO DE SÃO PAULO. São Paulo: Instituto de Pesquisas Ambientais, 2022.

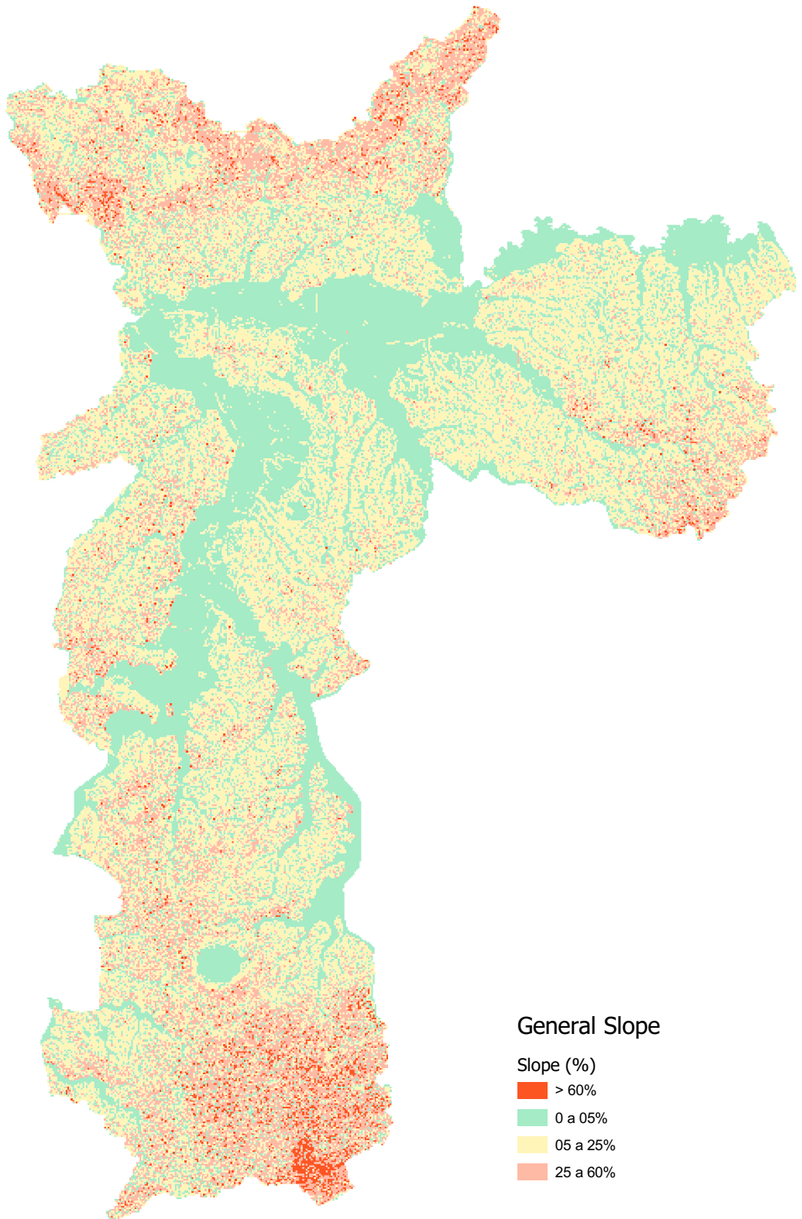


Figure 18: General Slope Map of the Municipality of São Paulo (Geotechnical Map, 2024)[39]

It is important to highlight that the scales used in geological studies are generally inadequate for the assessment and monitoring of urban risk areas, which require greater detail. Nevertheless, this set of collected and processed information constitutes a valuable resource for outlining prioritization and more efficient monitoring processes.

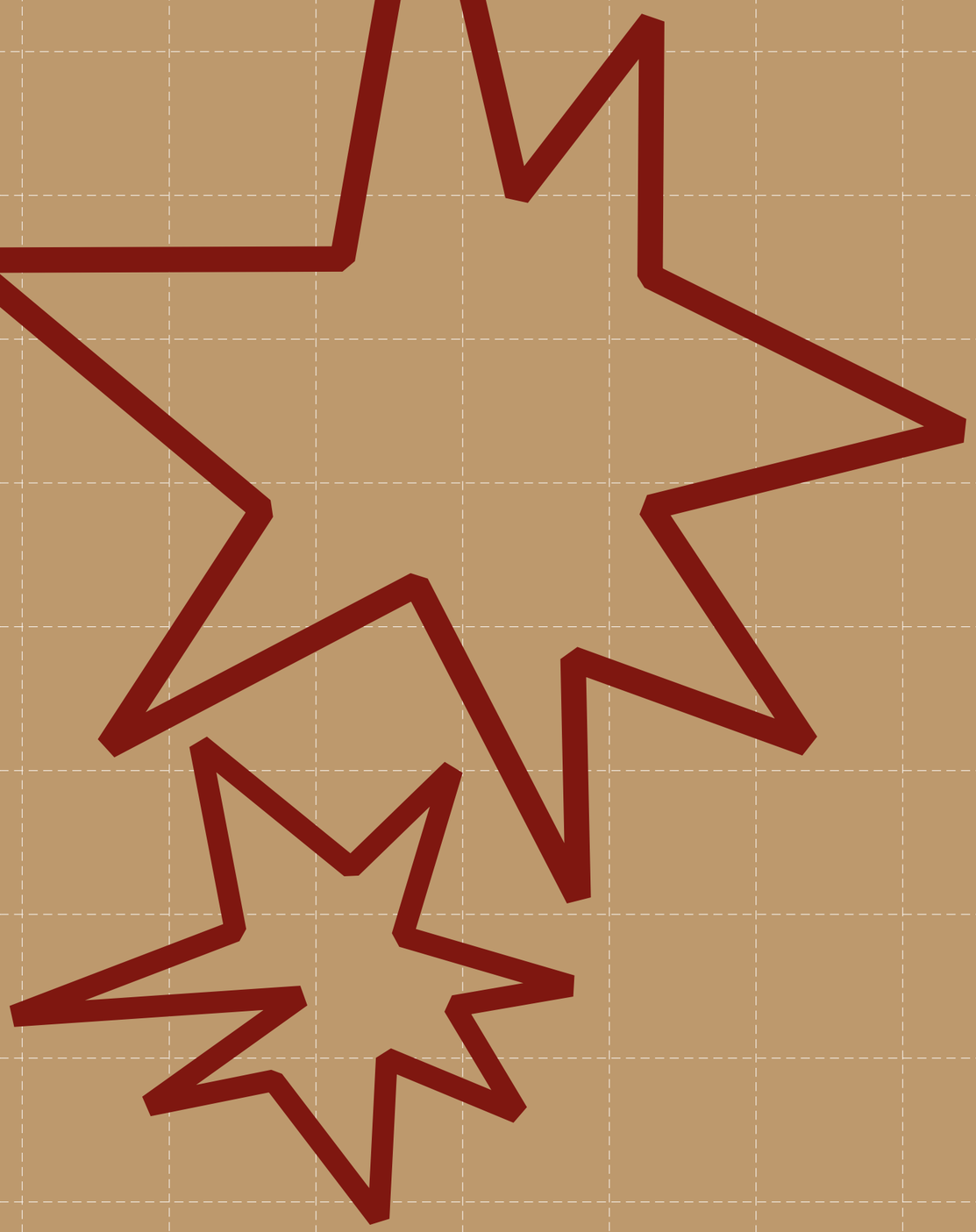
As a consequence of this geological formation process, topological analyses using point cloud data show that the central region of the municipality of São Paulo presents lower slopes, making flooding and inundation risks predominant; while the northern (Serra da Cantareira), eastern, and southwestern (Embu Complex) extremities have higher slopes, making these areas more prone to slope failures and landslides.

39 São Paulo City Hall (PMSP) / Municipal Secretariat for Urbanism and Licensing (SMUL), Municipal Secretariat for Subprefectures (SMSUB), Municipal Secretariat for Urban Security (SMSU), and the Institute for Technological Research of the State of São Paulo (IPT).

“The community expects the project to bring benefits and improvements. It’s a good thing that’s coming.”

Resident from a High-Risk Area

Foto: Francisco Munhoz Filho



RISKS

The National Policy for Protection and Civil Defense (PNPDEC) establishes that a ***Natural Disaster*** is the result of the impact of an adverse natural phenomenon on a social system (an exposed community), causing damage (material and human) and losses (socioeconomic) that exceed the affected population's capacity to cope with the impact. In urban environments, the most common types are floods, inundations, and landslides.

The probability of occurrence of these severe natural phenomena in a given area is strongly influenced by regional characteristics, such as: occupation and urbanization conditions, soil type, topography, vegetation, hydrology, and meteorological conditions, among others.

Carvalho (2020:38)[40] defines risk as:

"The probability of occurrence of a destructive process multiplied by the social or economic consequence resulting from that process. It involves the assessment of the probability of the destructive process occurring, the identification of the elements that may be affected by it, and the vulnerability of those elements."

Based on these criteria, the probability of severe natural phenomena occurring results from the combination of aspects related to the following characteristics:

Geomorphological and hydrological: such as the elevation of the occupation in relation to nearby rivers, soil type and strength, and slope inclination.

Occupational: existence of an efficient drainage system, degree of surface impermeability, and conditions of cut and fill areas.

Managerial: maintenance of stormwater pipes, dredging of rivers and streams, and waste collection.

The absence of structured planning and records hinders the implementation of effective interventions, since incomplete information makes it impossible to prepare accurate diagnoses and forecasts.

As a result, many of the actions carried out by the Municipal Public Administration to minimize situations that expose the population to natural disasters have been isolated and reactive, focused on the most evident areas, but do not provide definitive solutions for eliminating risks.

This is the primary purpose of this Municipal Risk Reduction Plan.

The National Civil Defense classifies natural disasters into four levels:

Level 1: Small-scale disaster, where the impacts are minor and losses are limited (loss ⩽ 5% of the municipal GDP). These are easily overcome using the municipality's own resources.

Level 2: Medium-intensity disaster, where the impacts are of some importance and the losses are significant, though not extensive (5% ⩽ loss ⩽ 10% of the municipal GDP). The affected municipality can overcome the event, provided there is special mobilization and management.

Level 3: Large-intensity disaster, with major damage and extensive losses (10% ⩽ loss ⩽ 30% of the municipal GDP). Normal conditions can be restored in the affected municipality with its own resources, supplemented by State and Federal funds. This characterizes a "State of Emergency" (SE – Federal Decree 7.257/2010, Art. 1, Art. 2 and its items, Art. 7).

Level 4: Disaster with highly significant impacts and extensive losses (loss > 30% of the municipal GDP). It cannot be overcome by the affected municipality unless there is external assistance (State, Federal, and/or International). This constitutes a "State of Public Calamity" (ECP – Federal Decree 7.257/2010, Art. 1, Art. 2 and its items, Art. 7).

It is worth noting that national initiatives are led by the National Center for Monitoring and Early Warning of Natural Disasters (CEMADEN), whose main function is to:

> "Carry out monitoring and issue alerts for natural disasters to help safeguard lives and reduce social, environmental, and economic vulnerability resulting from these events."[41]

CEMADEN mapped 1,942 municipalities susceptible to disasters associated with landslides, flooding, flash floods, and inundations, representing a 130% increase compared to 2012[42]. São Paulo is among them.

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40 CARVALHO, Celso Santos et al. CAJUFA 2020: Diretrizes para análise de risco geológico/geotécnico em áreas urbanas. São Paulo: Editora Europa, 2020.

41 https://www.gov.br/cemaden/pt-br/acesso-a-informacao/institucional-1/apresentacao. Accessed on 01/06/2024.

42 https://agenciabrasil.ebc.com.br/geral/noticia/2024-05/brasil-tem-1942-cidades-com-risco-de-desastre-ambiental. Accessed on 01/06/2024.

In 2024, specifically for the municipality of São Paulo, COMDEC and SMSU released an important document titled ***"Reconstructing the History of Risk Area Mapping in the Municipality of São Paulo"***, which states that the first surveys of risk areas took place around 1980 (with 240 mapped areas). In 2010, another major survey recorded 407 areas with geological risks (1,182 sectors), and currently (as of 05/01/2024) there are 785 registered areas with hydrological and geological risks.

In recent years, São Paulo's municipal government, through SIURB, has invested in risk mitigation works, as shown in the graph below, prepared based on data obtained from SIURB Digital.

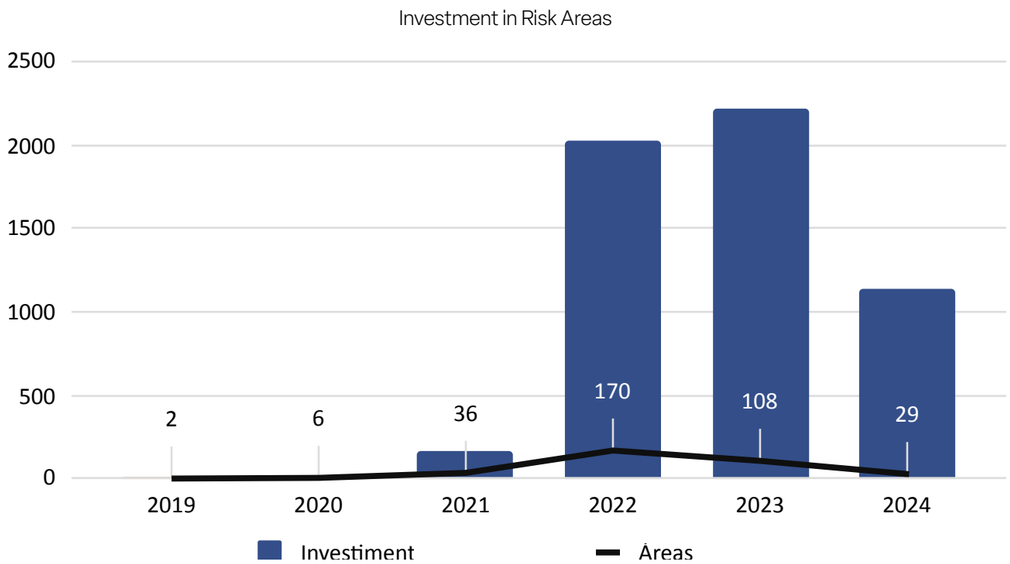


Chart 9: Investment in Risk Areas (Source: Based on Data from Siurb Digital)

MASS MOVEMENTS

The term "mass movements" encompasses situations of instability in soil, rock, or debris that pose risks to the safety of people and to directly or indirectly affected infrastructure.

The main trigger for mass movements is rainwater infiltration, which reduces the soil's resistance capacity by increasing pore pressure and decreasing shear strength/cohesion.

These events occur at specific points (rather than throughout an entire city) and have a high potential to endanger lives, due to the difficulty of evacuation, intense urban occupation, and the speed of onset.

Notable large-scale examples in Brazil include the disasters in Petrópolis/RJ and São Sebastião/SP, both with hundreds of fatalities. Medium-scale events, however, are widespread across the country — including in the São Paulo Metropolitan Region — such as in Taboão da Serra/SP (2003), Franco da Rocha/SP (2023), and Osasco/SP (2024).

The risk classification of a given area is determined through field inspections conducted by a multidisciplinary team of geologists and civil engineers specialized in geotechnics.

During these inspections, professionals look for signs of slope instability, such as cracks in the soil and buildings; tilted trees; evidence of past landslides. They also assess occupation characteristics (such as cuts, fills, and distance to the slope) and drainage features (e.g., the path of stormwater and wastewater).

The stability of a slope (and its safety factor) is evaluated according to NBR 11682 (2009), which requires consideration of the following parameters:

Soil characteristics: layer stratigraphy, shear strength in dry and saturated conditions, and friction angle;

Occupation characteristics: surcharge and exposure conditions;

Slope characteristics: topography and inclination.

At the end of the analysis, a comparison is made between the soil's resisting capacity and the applied stress to determine the Safety Factor (SF), as shown in Equation 2 below:

Equation 2: Safety Factor

Safety Factor = Resisting Capacity / Acting Stress

According to NBR 11682[43], the Safety Factor must be greater than 1.5 — meaning that the soil's resisting capacity must be at least 1.5 times higher than the acting forces under the worst conditions. This is the minimum threshold required to protect lives and prevent material and environmental damage.

An analysis of historical data from the municipality of São Paulo shows that, over the last two rainy seasons (2023 and 2023–2024), there were 599 reports of landslides (see Figure 19 and Graph 10). Fortunately, there were no records of major mass movements or deaths associated with these events.

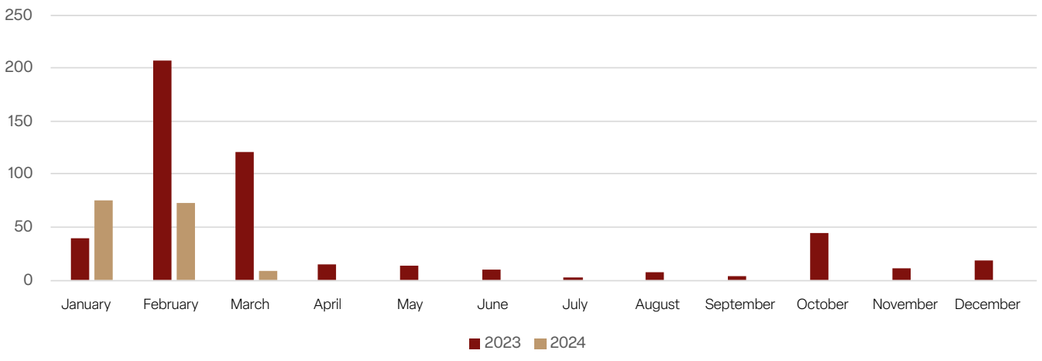


Chart 10: Landslide Reports in the Municipality of São Paulo Since January 2023 (Source: Urano System)

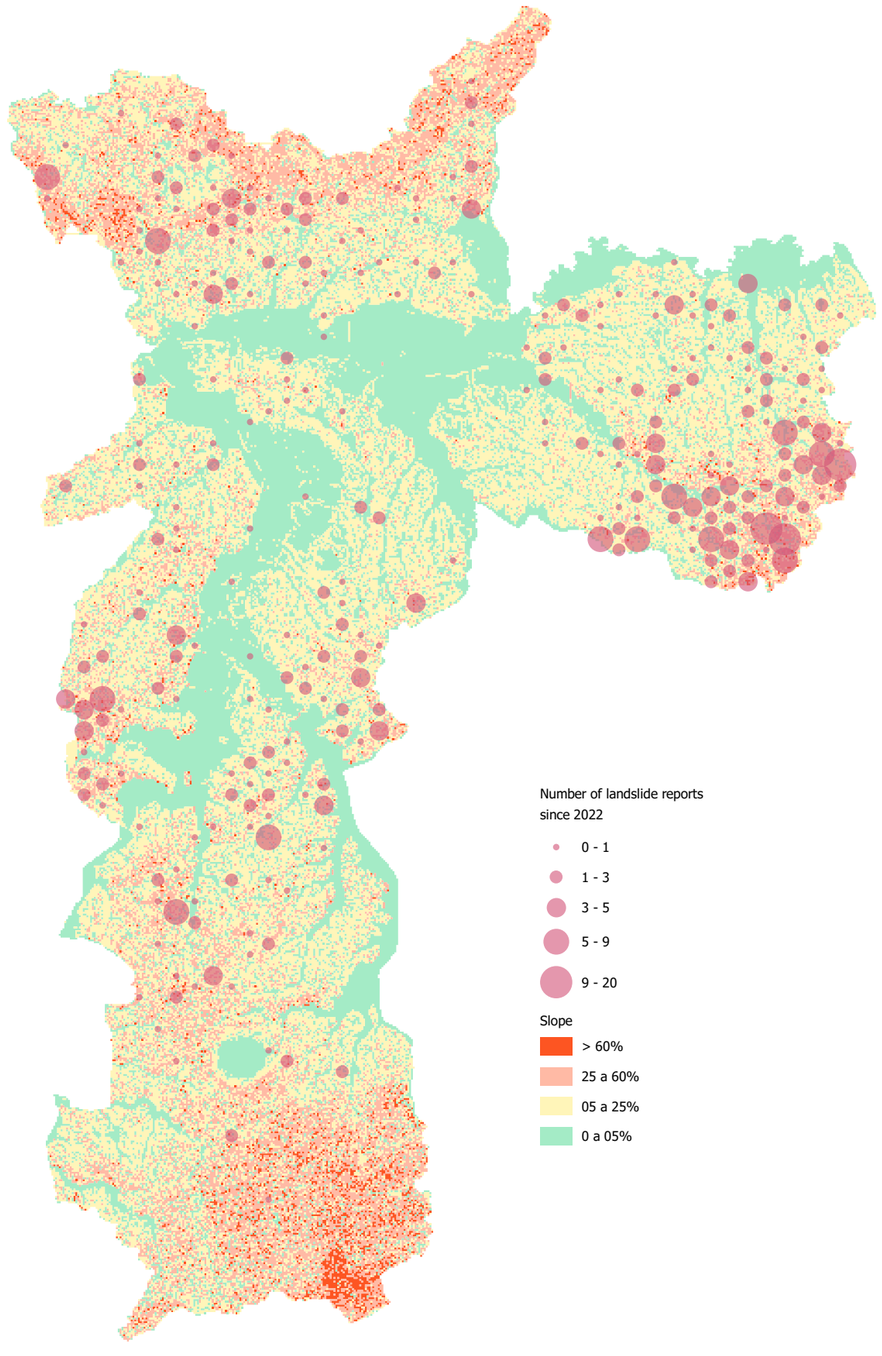
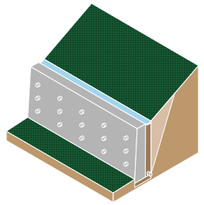


Figure 19: Landslide Reports (Source: Urano System)

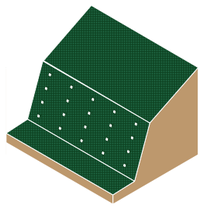
43 NBR 11682: Slope Stability. Brazilian Association of Technical Standards (ABNT), 2009.

When the evaluation of slope stability identifies that the safety factor is below the established value, a containment project is carried out. There are several possible alternatives, and the most commonly used in the municipality are:



Retaining Walls

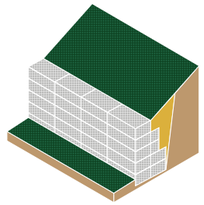
Retaining walls are vertical or almost vertical containment structures supported by shallow or deep foundations. They can be built with masonry (bricks or stones) or concrete (plain or reinforced), or even with special elements.



Anchored Green Soil

Slope reconfigured with the inclination provided in the design and covered with wire mesh and non-woven fabric, into which a set of fixed anchors are installed.

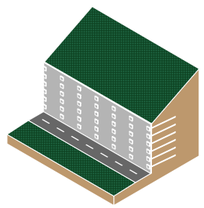
One of the advantages of this construction method is that it reinforces the material *in situ*, minimizing earth movement and maintaining the permeability of the areas.



Gabions

They consist of metallic cages made of galvanized steel wire in double-twisted hexagonal mesh and filled with stones arranged manually.

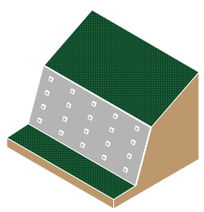
The main characteristics of gabion walls are flexibility, which allows the structure to adapt to differential settlements, and permeability.



Anchored Retaining Walls

An anchored retaining wall is a containment method that uses prestressed anchors to support the terrain. It is recommended for cuts in terrains with a large load to be contained.

Execution is carried out in the following stages: excavation of the first line; construction of the concrete wall or driving of steel profiles; drilling and insertion of the anchors; stressing of the anchors; excavation of the second line, and so on.



Soil Nailing

The installation process of injected nails generally consists of drilling a hole, inserting a steel bar, and injecting cement grout to fill the hole. The outer face of the slope may be covered with shotcrete and wire mesh, without structural function.

One of the advantages of soil nailing is that it reinforces the material *in situ*, being applicable for stabilizing potentially unstable slopes or subvertical excavations.

Since 2017, SIURB has carried out interventions at 78 locations in the city for containment works and actions aimed at mitigating geological risks on slopes (Figure 20). In particular, in the last two years, there has been a significant increase in this type of investment (Graph 11).

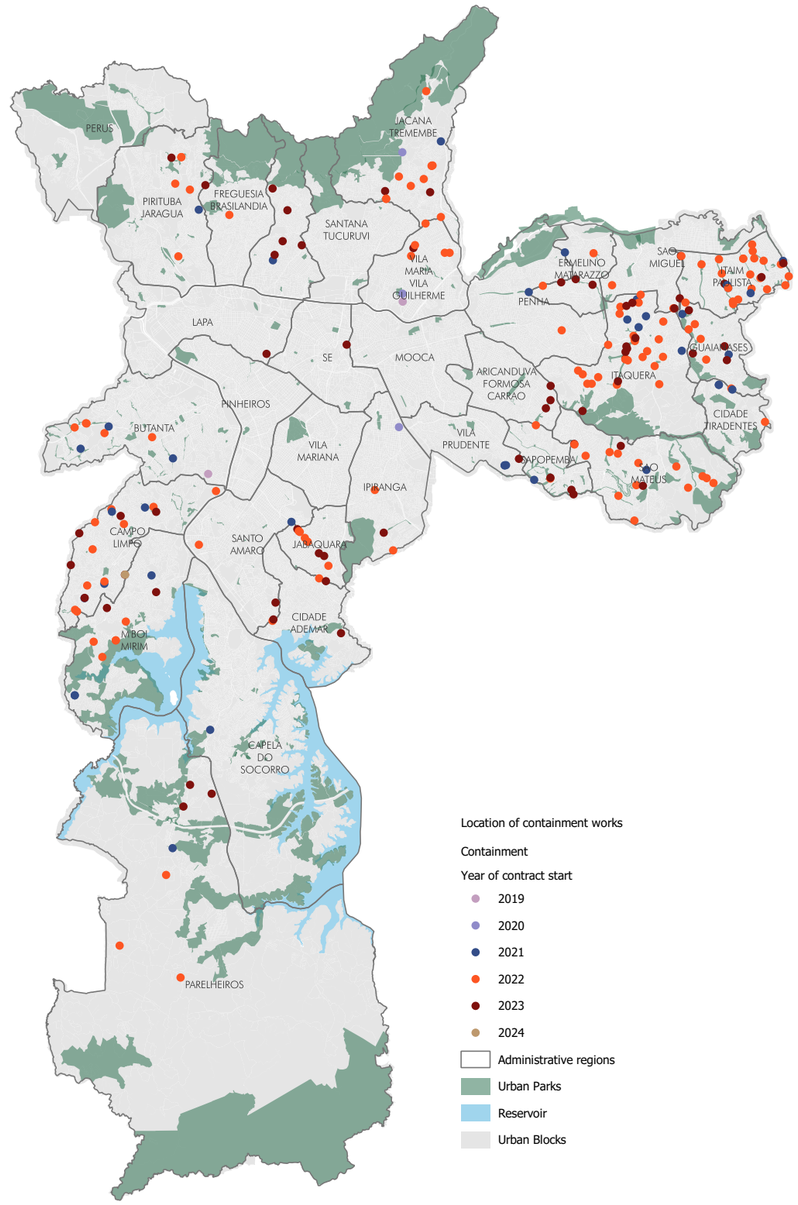


Figure 20: Location of Containment Works Implemented Since 2019 (Source: Siurbdigital System)

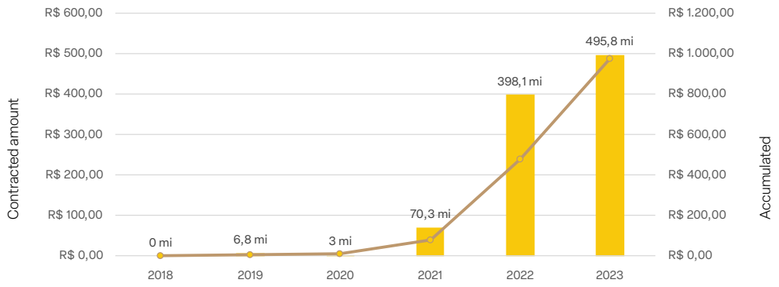


Chart 11: Annual Evolution of Contracted Values for Containment Works (Source: Siurbdigital System)

The comparative analysis of the geological formations of the municipality of São Paulo with the mapped geological risk sectors allows us to conclude that:

1. The points at risk of landslides are most frequently associated with the Embu Complex units, followed by the Cantareira Granite and the Resende Formation;

2. The sectors where landslides and undercutting processes occur show a similar distribution;

3. Similarly, the undercutting processes are also concentrated mainly in the Embu Complex, followed by the Resende Formation and the Cantareira Granite. This occurs due to the geological context mentioned earlier and the significant presence of these units in the municipality of São Paulo.

Table 7 and Figure 21 show the relationship between the type of risk and the geological formation.

Table 7: Correlation of Representative Points of Geological Risk Sectors by Lithological Units in the Municipality of São Paulo

Lithology	Landslide Geological Risk Sectors	Undercutting Geological Risk Sectors	Landslide and Undercutting Geological Risk Sectors
Embu Complex	392	176	41
Cantareira Granite	158	51	13
Resende Formation	77	123	9
Serra do Itaberaba Group	73	13	7
Três Lagos Granite	20	3	0
São Roque Group	20	4	1
Alluvial Deposits	15	21	0
Guacuri Granite	13	10	0
Votuverava Group	12	8	3
Undifferentiated Granitoids	9	3	1
São Paulo Formation	8	5	0
Itaquera Granite	5	5	1
Taipas Granite	2	3	1

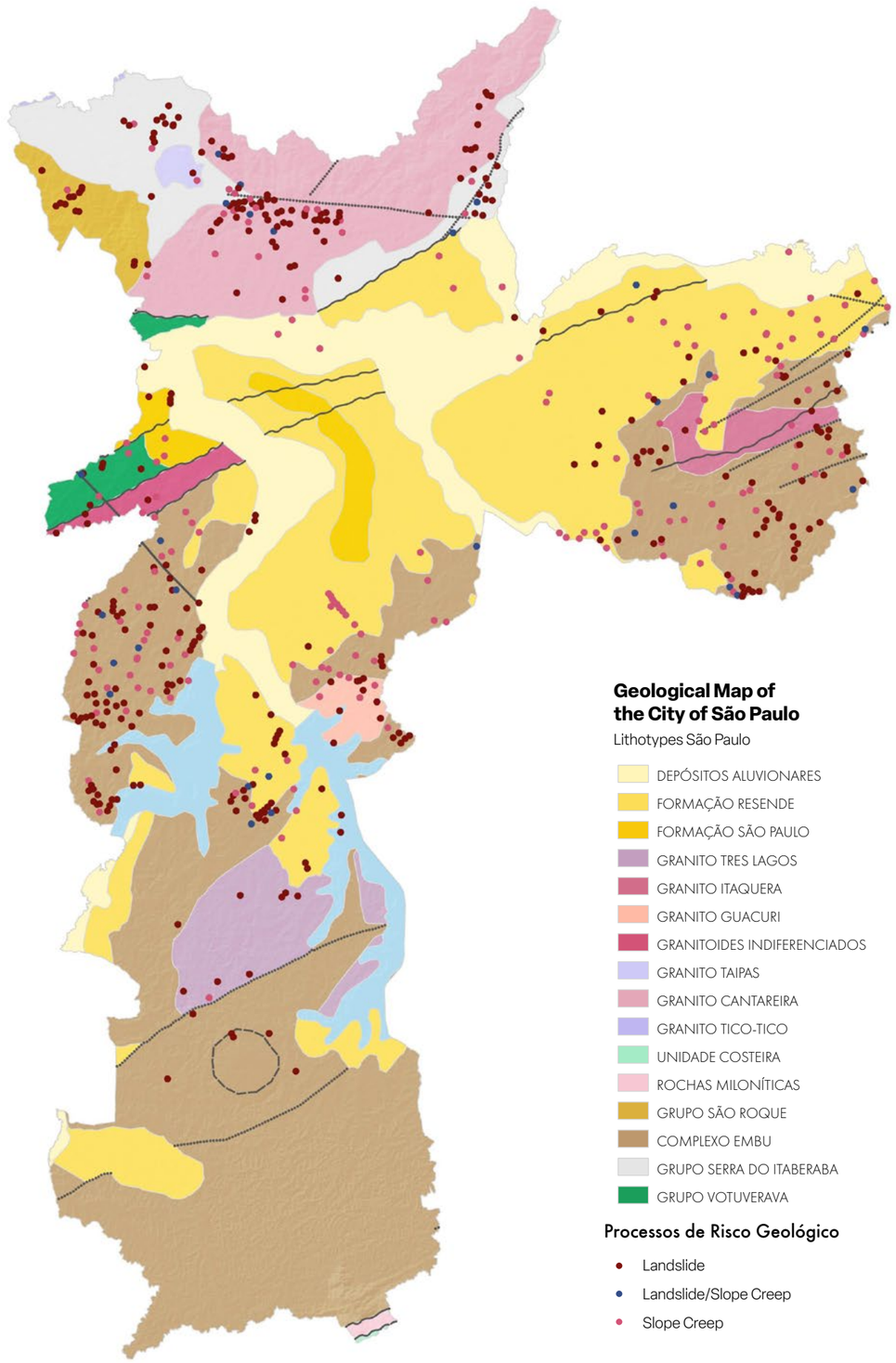


Figure 21: Geological Risks Mapped by Civil Defense (Adapted from Perrota et al., 2006, and GeoSampa data)

FLOODING AND INUNDATIONS

Flooding and inundations cause disruptions in the municipality, as they hinder urban mobility, affect quality of life, and cause material losses to the population. These phenomena are slower than landslides and, therefore, allow people more time to protect themselves. Consequently, they pose less risk to human life.

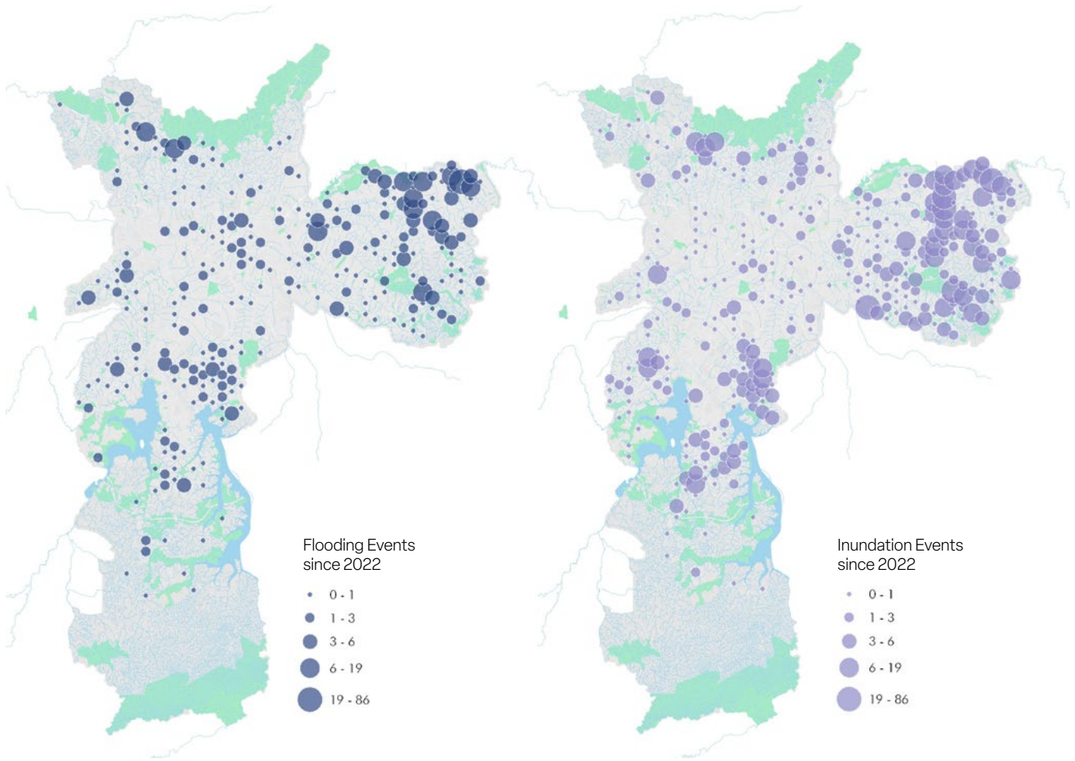
On the other hand, the impacts of flooding and inundations are felt by more people and for a longer time than geological ones, leaving the population homeless. Extreme cases, such as those recorded in 2024 in several cities in Rio Grande do Sul, clearly illustrate this situation. The south of Bahia, in 2021, and the north of Alagoas, in 2023, are other examples of flooding and inundations that caused major disruptions to the population.

It is important to highlight that, in this document, the term *flooding* refers to more localized occurrences with fewer people directly impacted, as they are more related to the micro-drainage system.

Inundations, on the other hand, are connected to the macro-drainage system. Therefore, they are generally more widespread disasters with greater potential to cause disruptions.

According to historical data from the municipality of São Paulo, there were 1,582 calls for flooding and inundations during the rainy season of 2023 and 2024 (Figures 22 and 23; Charts 12 and 13). These occurrences are distributed across all regions of the city.

Still based on historical analysis, since 2013 (Figure 24), there have been more than 12,810 calls, with the highest numbers concentrated in the Jacu Stream and Tijuco Preto watershed basins (877 and 645, respectively). The most affected districts were Jardim Helena (1,111) and Itaim Bibi (548).



Figures 22 e 23: Flooding and Inundation Events (Source: Urano System)

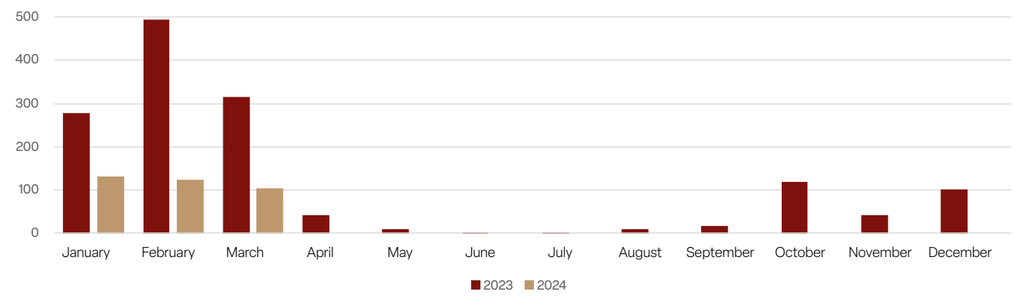


Chart 12: Reports of Flooding and Inundation Points in the Municipality of São Paulo Since 2023 (Source: Urano System)

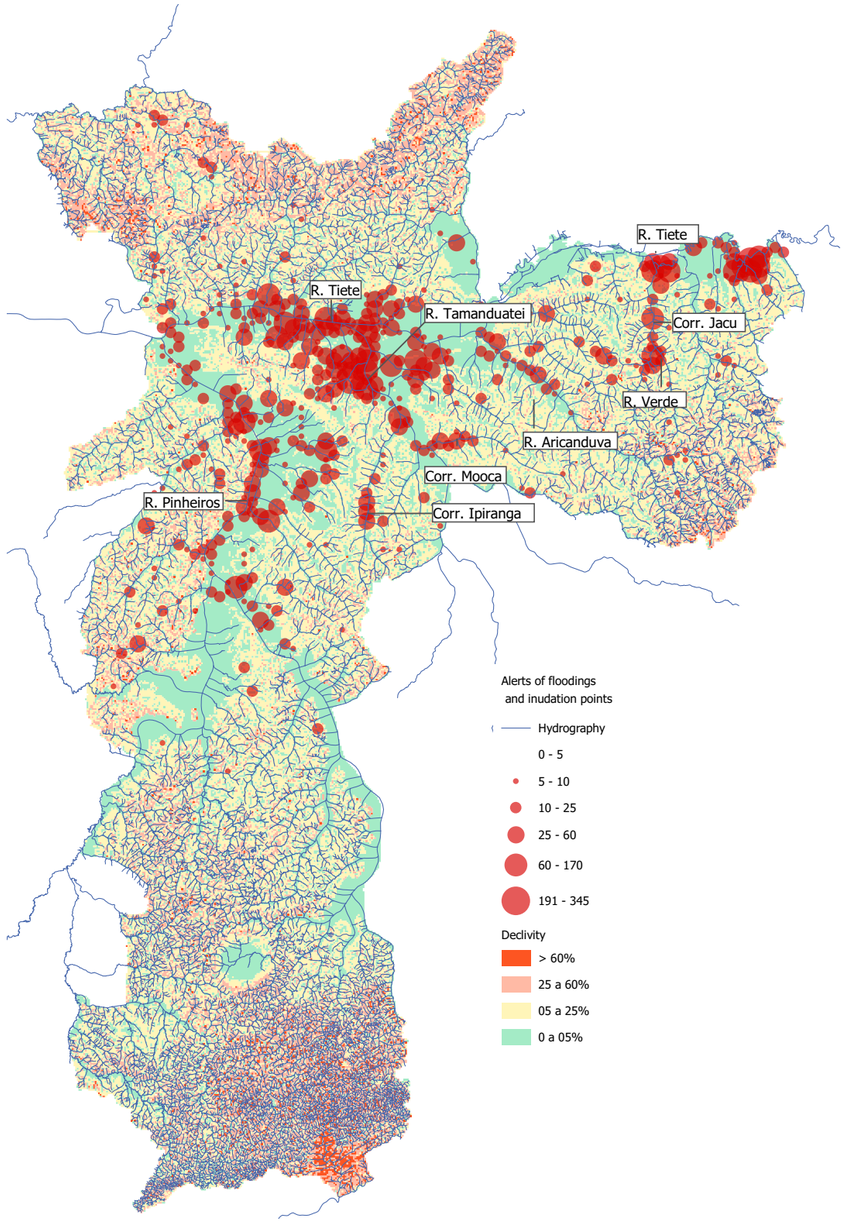


Figure 24: Reports of Flooding Points in the Municipality of São Paulo Since January 2013 (Source: Urano System)

Since 2017, the Municipal Public Administration has not only carried out interventions in 264 areas dedicated to the recovery, improvement, and expansion of the drainage system, rivers, and streams of the Municipality (Figure 25), but has also significantly increased this type of investment in recent years (Chart 14).

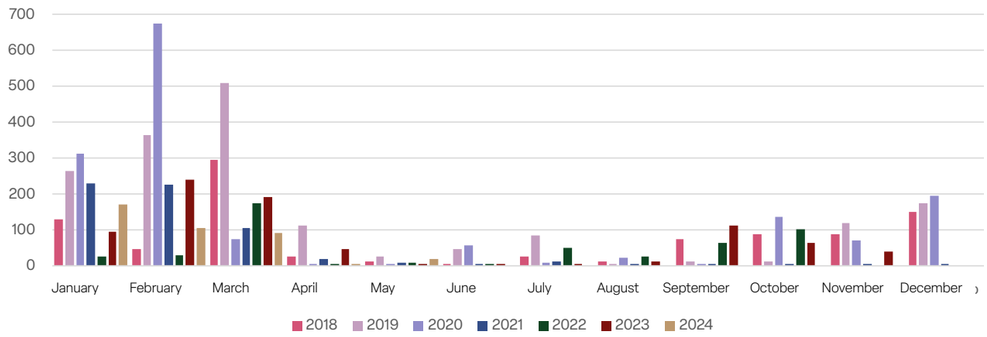


Chart 13: Reports of Inundation Points in the Municipality of São Paulo Since 2018 (Source: Urano System)

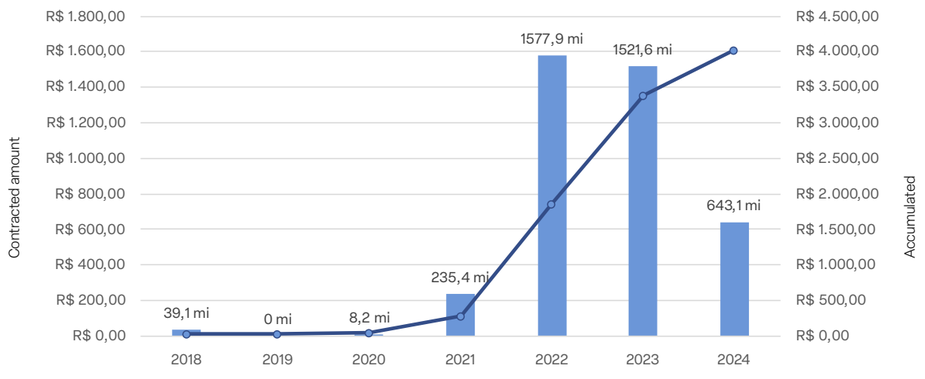


Chart 14: Annual and Cumulative Evolution of Contracted Values for Drainage Works (Source: Siurbdigital System)

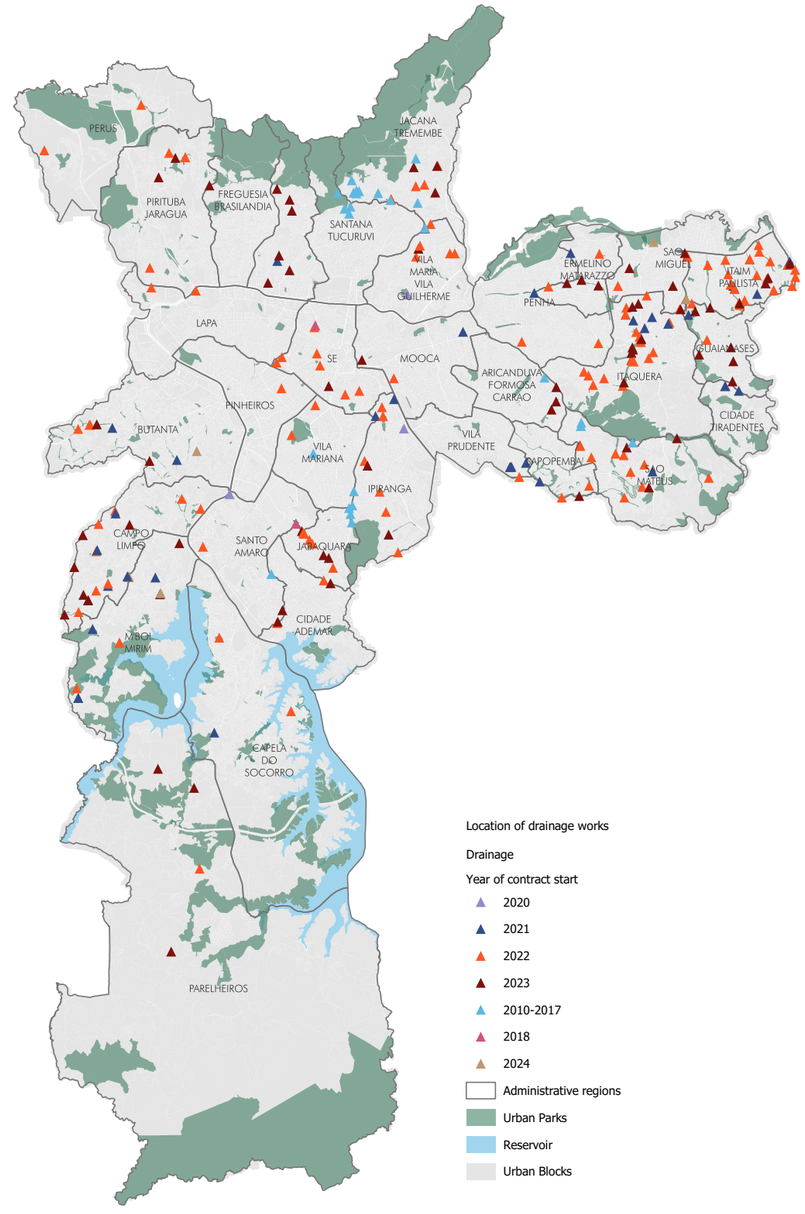


Figure 25: Location of Drainage Works Implemented (Source: Siurbdigital System)

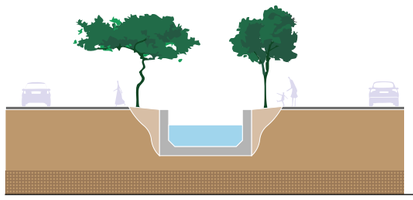
These interventions aim to:

1. Execute drainage works to expand the collection infrastructure (storm drains and catch basins), surface water transport systems (curbs, gutters, and channels), and stormwater transport networks;

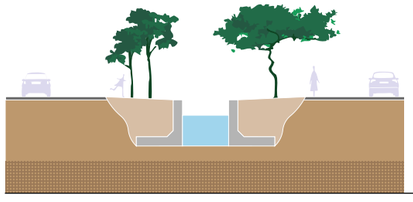
2. Carry out containment and channeling works along stream banks to increase flow capacity and reduce the risk of bank collapse and sedimentation;

3. Implement energy dissipation structures that reduce kinetic energy potential, such as ramps, impact devices, and steps, among others, to decrease water flow velocity;

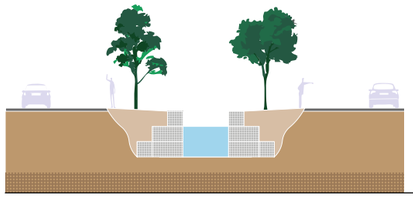
4. Restore drainage systems that show defects (ruptures).



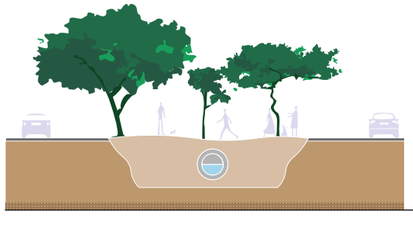
Channeling using pre-molded components, keeping them open and promoting landscape reconstruction and diversified use along their banks.



Containment of stream banks using pre-molded components, keeping them open and promoting landscape reconstruction and diversified use along their banks.



Containment of stream banks using gabions, keeping them open and promoting landscape reconstruction and diversified use along their banks.



Implementation of stormwater conveyance galleries.

This project alternative is less frequent and is only employed when the watercourse is already partially covered.

The Municipal Public Administration has prioritized solutions that avoid covering water bodies and straightening stream walls with concrete elements, since gabions have shown higher operating costs due to the need for maintenance of their metal components and cleaning caused by waste adherence.

Two important structural projects (interventionist and non-interventionist) have been implemented by the Municipal Public Administration. The first line of action is led by SIURB and focuses on urban drainage planning, mainly through the development of the *Watershed Booklets*, which assess the existing drainage system and prepare a plan of prioritized works based on their functionality, impact on reducing flood-prone areas, and affected population, including structural measures such as flood attenuation reservoirs, channeling, linear parks, and sustainable drainage measures. These activities make up the *Drainage Master Plan (PDD)*.

Each PDD booklet, referring to the respective watershed or group of watersheds studied, is developed according to three main stages: diagnosis of the current situation, proposal of alternatives, and complementary actions. The final objective is for the booklets to serve as decision-support tools for the Municipal Secretariat of Urban Infrastructure and Works (SIURB).

The diagnostic stage's main outputs are the mapping of flood-prone areas and critical areas of the watershed. The flood-prone area mapping results from applying a hydraulic-hydrological model calibrated with precipitation events monitored by the SAISP weather radar and water levels measured at telemetric network stations. The *flood-prone area map* is generated, composed of *flood spots*, which are graphical representations of areas that may be flooded considering design storms with return periods of 2, 5, 10, 25, and 100 years.

The critical area mapping stage results from crossing flood-prone areas with social vulnerability, population density – risk map –, the most vulnerable buildings (such as schools, hospitals, and slums), and the most important roads for citywide mobility. This stage aims to guide the prioritization of works within the watershed so that regions most frequently affected by severe inundations (higher flood risk) are addressed in the first stage of flood control interventions.

The alternatives presented in each Booklet consist of a set of interventions that, as a whole, aim to protect the basin against events with a return period of up to 100 years. For the sizing of the alternatives, the maximum land-use densification allowed by the Land Subdivision, Use, and Occupation Law (LPUOS) is considered, in order to include, in a future scenario, the possibility of increased soil impermeabilization — a precursor to the increase in maximum direct surface runoff rates, with higher flow velocities and shorter basin concentration times.

Each alternative is divided into up to four stages of works, considering the need to distribute investments in the short, medium, and long term and the objective of addressing critical regions affected by the most recurrent floods. The composition of the alternatives differs between basins, in order to account for the particularities and patterns of land occupation in each region of the municipality. For their development, the implementation of structural measures such as reservoirs, channeling, reinforcement galleries, polders, linear parks, sustainable drainage measures (infiltration wells, rain gardens, among others), bridge elevation, crossing adaptation, channel and gallery lining, channel openings, and watercourse revitalization is considered — as well as non-structural measures such as flood coexistence associated with alerts issued by the Flood Warning System (SAISP). Based on the proposed alternatives and SIURB's cost table, a preliminary estimate is presented of the investments required for the implementation of each alternative, in each of its stages, considering a project horizon of 40 years.

Finally, the Booklet proposes complementary zoning actions for land use in flood-prone areas, with adaptations of land use and buildings in high-risk locations, and source control measures that mitigate the impacts of urbanization on direct surface runoff, promote harmonious integration with the urban landscape, and treat diffuse pollution, improving the quality of the water that flows into the channels and reducing the overload on the stormwater drainage network.

The map below presents the basins whose booklets had been published by 2023, as well as those under development and soon to be published.

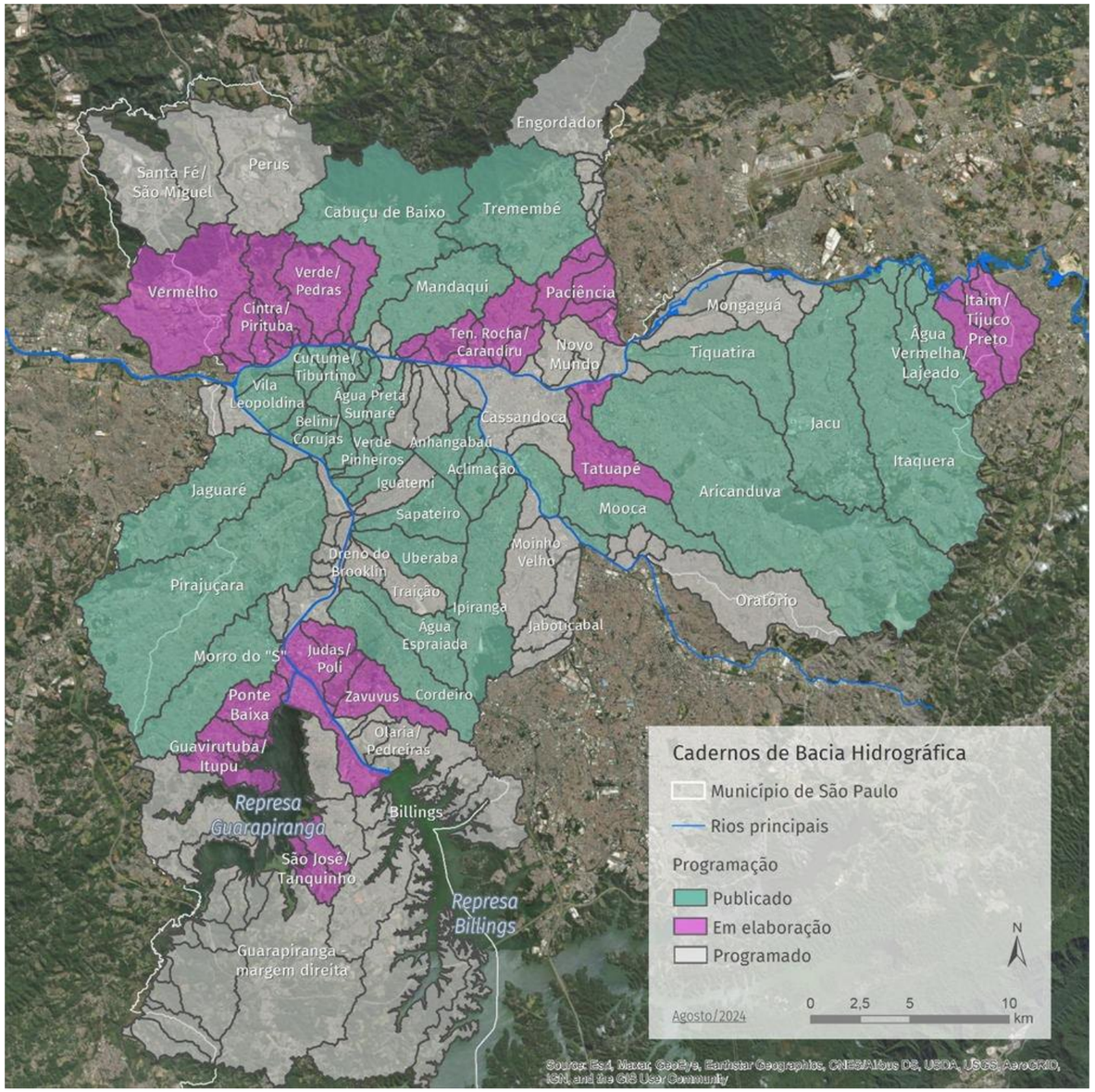


Figure 26: Schedule of Watershed Basin Reports (Source: FCTH)

Given the complexity of managing a territory with such diverse occupation characteristics, flood control planning in the Municipality of São Paulo faces several challenges. This reality is mainly addressed by the *Watershed Booklets (CBHs)* and the *Priority Action Plan*, which are part of the *Drainage Master Plan (PDD)* and together form the strategic basis to increase the municipality's resilience against flooding and inundations.

The CBHs focus primarily on regional-scale flood control, with an emphasis on macro-drainage, considering the watershed as the territorial unit of study. The drainage booklets are technical documents that analyze the dynamics of hydrological events, identify critical areas, and propose measures aimed at reducing the accumulated impact of large volumes of water, mitigating inundations in densely urbanized areas.

Currently, 29 (twenty-nine) of the 50 (fifty) planned booklets have been published, covering 63% of the total area of the Municipality of São Paulo.

However, due to their strategic and broad approach focused on macro-drainage and flood mitigation, the CBHs operate on a larger scale and do not directly address localized problems, such as the insufficiency of the micro-drainage network. Hence arises the importance of integrating the *Watershed Booklets* with the *Municipal Risk Reduction Plan*, as this will serve as a complementary instrument to the CBHs' approach, allowing for additional and localized studies to mitigate problems such as flooding in regions that require specific and locally adapted solutions.

The studies carried out for the development of the CBHs are related to hydrological risk areas, which are territories prone to inundations. These areas, also assessed by the *Municipal Risk Reduction Plan*, are periodically mapped and classified by the Municipal Civil Defense according to their degree of risk. Currently, around 269 (two hundred and sixty-nine) hydrological risk areas are mapped.

In addition to hydrological risk areas, there are also areas associated with geological risks, among which *bank collapses* may also be related to the *Watershed Booklets*, since such collapses are associated with the instability of riverbanks, slopes, and coastal areas caused by accelerated erosion, excessive water infiltration, or changes in the soil's hydrological regime. This phenomenon occurs when there is a gradual or sudden loss of soil material, compromising the structural integrity of inhabited areas or nearby infrastructure.

By comparing the mapping of these hydrological risk areas in the municipality with the studies and interventions proposed in the CBHs, it is possible to observe both the advances and the boundary conditions of the current planning methodology. Although the CBHs cover a significant portion of these areas, with structural proposals aimed at flood control, detailed analysis reveals that many areas still lack specific localized solutions or await the development of their respective *Watershed Booklets*.

The table below presents data on CBH coverage and the different intervention demands identified.

Results of the comparison between risk areas and the studies and technical solutions presented in the Watershed Booklets (CBH):

No CBH	92
Has CBH	177
Requires Localized Intervention	80
Intervention to be carried out by the State Government	1
Micro-drainage Problem	12
Solution Proposed in CBH	84

As can be seen, of the approximately 269 (two hundred and sixty-nine) risk areas, 177 (one hundred and seventy-seven) are located in watersheds that already have published CBHs, while 92 (ninety-two) are not yet covered by studies. Among the areas covered by the CBHs, 80 (eighty) lack detailed proposals for localized interventions, 12 have micro-drainage problems, and 84 (eighty-four) already have proposed solutions in the CBHs. In addition, one specific area (HCL-10 – Jardim Ângela) requires state intervention due to its location on the municipal border near the Pirajuçara Stream.

As previously presented, the *Watershed Booklets* are essential instruments for planning stormwater management in the Municipality, integrating with the *Drainage Master Plan (PDD)* to promote the mitigation of flooding and inundations in urban areas. Developed based on detailed watershed characterization, the CBHs assess aspects such as hydrography, relief, land use, impermeabilization, and the impacts of urbanization on the drainage system. From these analyses, they identify critical areas and propose structural interventions that prioritize sustainability and urban resilience. In addition, the CBHs provide guidelines for non-structural actions and the implementation of sustainable drainage systems, including *Nature-Based Solutions (NbS)*.

One of the methodologies used in these studies is advanced hydrological and hydraulic modeling, which assesses watershed behavior by simulating different rainfall scenarios, including extreme events with a *Return Period (TR)* of up to 100 years, to predict areas subject to severe inundations. From these analyses, *flood maps* are generated to indicate the most vulnerable locations, considering factors such as peak flows, capacity of stormwater galleries, and the cumulative impact of urbanization.

The 84 (eighty-four) areas that already have proposed solutions in the CBHs were included in these flood maps for the 100-year TR, which justifies their prioritization for planned interventions. These areas showed high flood risk and significant impacts on urban infrastructure and local communities. The modeling allowed for precise identification of critical points, ensuring that the proposed solutions — such as detention reservoirs, channeling, reinforcement galleries, linear parks, and sustainable drainage systems — were directed toward these areas with greater vulnerability.

Subsequently, the 80 (eighty) areas that require localized interventions reflect specific and localized urban drainage problems not directly related to the main channel dynamics of the watersheds. Many of these areas are located in small tributaries or in higher regions of the basins, where the local hydrological impact is limited, and therefore were not included in the *Watershed Booklets (CBHs).* Over the years, the CBH methodology has been improved, and currently, the polygons of the hydrological risk areas mapped by Civil Defense are integrated into the flood diagnostic maps — which was not the case in the earlier booklet prototypes. This is one of the reasons why the initially published booklets are now being revised.

The CBHs, by nature, define large-scale structural interventions with regional impact, such as major retention structures (reservoirs) or alternatives such as linear parks, whose implementation proposals affect the watershed's overall hydrological behavior. In contrast, areas requiring localized interventions demand specific solutions, such as targeted channeling and resizing of existing drainage systems — actions that, although essential for solving local problems, do not align with the strategic and regional scope of the CBHs.

To address the needs of these 80 areas, a risk reduction and mitigation-oriented approach is necessary, as it combines broader planning with targeted interventions based on specific studies along with larger-scale structural actions. This ensures a balanced approach that reduces localized impacts and promotes safety and well-being within communities.

The 12 (twelve) areas identified with micro-drainage problems are located away from watercourses and face specific challenges related to insufficient or nonexistent localized micro-drainage systems. The local topography, often unfavorable, hampers natural water flow, resulting in accumulation in flat and depressed areas that rely heavily on artificial drainage solutions. In these regions, the drainage infrastructure — often undersized due to increased soil impermeabilization over time or blocked — is responsible for managing stormwater, leading to localized flooding, mobility problems, and degradation of urban infrastructure.

As previously mentioned, since CBHs focus on flood control and macro-drainage solutions, they generally do not cover these areas due to their limited impact on the overall watershed dynamics. As a result, specific and targeted approaches are necessary to address these local demands. Solutions such as gallery expansion and the implementation of other drainage devices adapted to the terrain characteristics are essential to mitigate micro-drainage issues.

Finally, the HCL-10 area – *Jardim Ângela*, located near the *Pirajuçara Stream*, exemplifies the complexity of water resource management along municipal borders, as this action requires coordinated interventions under the responsibility of the State Government. The *Pirajuçara Stream* marks part of the boundary between São Paulo and *Taboão da Serra*, and the population living along its banks faces problems such as flooding, erosion, and insufficient drainage infrastructure, which demand integrated and comprehensive solutions. The assignment of these actions to the State Government stems from the need for inter-municipal planning that balances the interests of all municipalities involved, enabling structural works such as channeling, reservoirs, and flow-control systems to mitigate regional impacts.

In addition to the *Pirajuçara Stream*, other water bodies along São Paulo's borders with neighboring municipalities present similar characteristics, such as the *Tietê, Pinheiros,* and *Tamanduateí* rivers, *Cabuçu de Cima*, and streams such as *Ribeirão dos Meninos* and *Embu-Mirim.* These watercourses are strategic for urban drainage and flood control, and their management falls under the State Government's responsibility as mediator and executor of actions that optimize resources and ensure intervention efficiency. This integrated approach is essential to guarantee hydrological risk mitigation and promote solutions that benefit the population on both sides of municipal borders.

The second line of action, in turn, is led by *SMSUB* and focuses on improving the cleaning of micro-drainage networks, characterized by increased frequency of cleaning and unclogging, more accurate identification of points to be cleaned, and reduced intervals between maintenance (Figure 29 and Chart 15). The actions were established to prevent situations where drainage pipes become obstructed, compromising the entire performance of the drainage system.

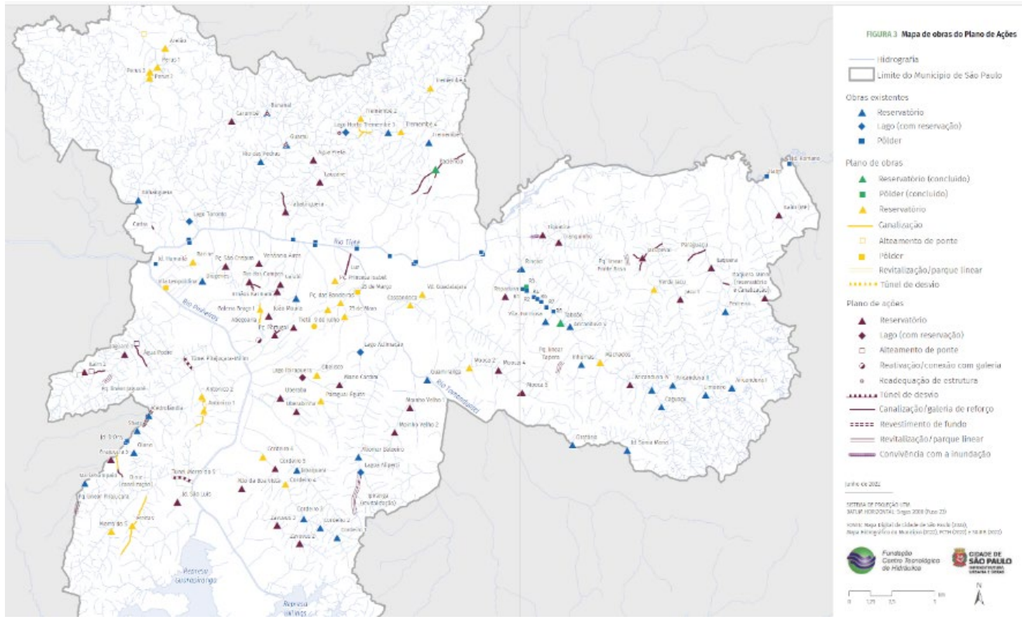


Figure 27: Interventions Proposed by the Drainage Master Plan (Source: Plano Diretor de Drenagem)

The map (Figure 28) presents the overlap of interventions listed in the *PDD*, where it is possible to visualize the hydrological and geological risk areas of the Municipality of São Paulo and the projects included in this *Municipal Risk Reduction Plan (PMRR).*

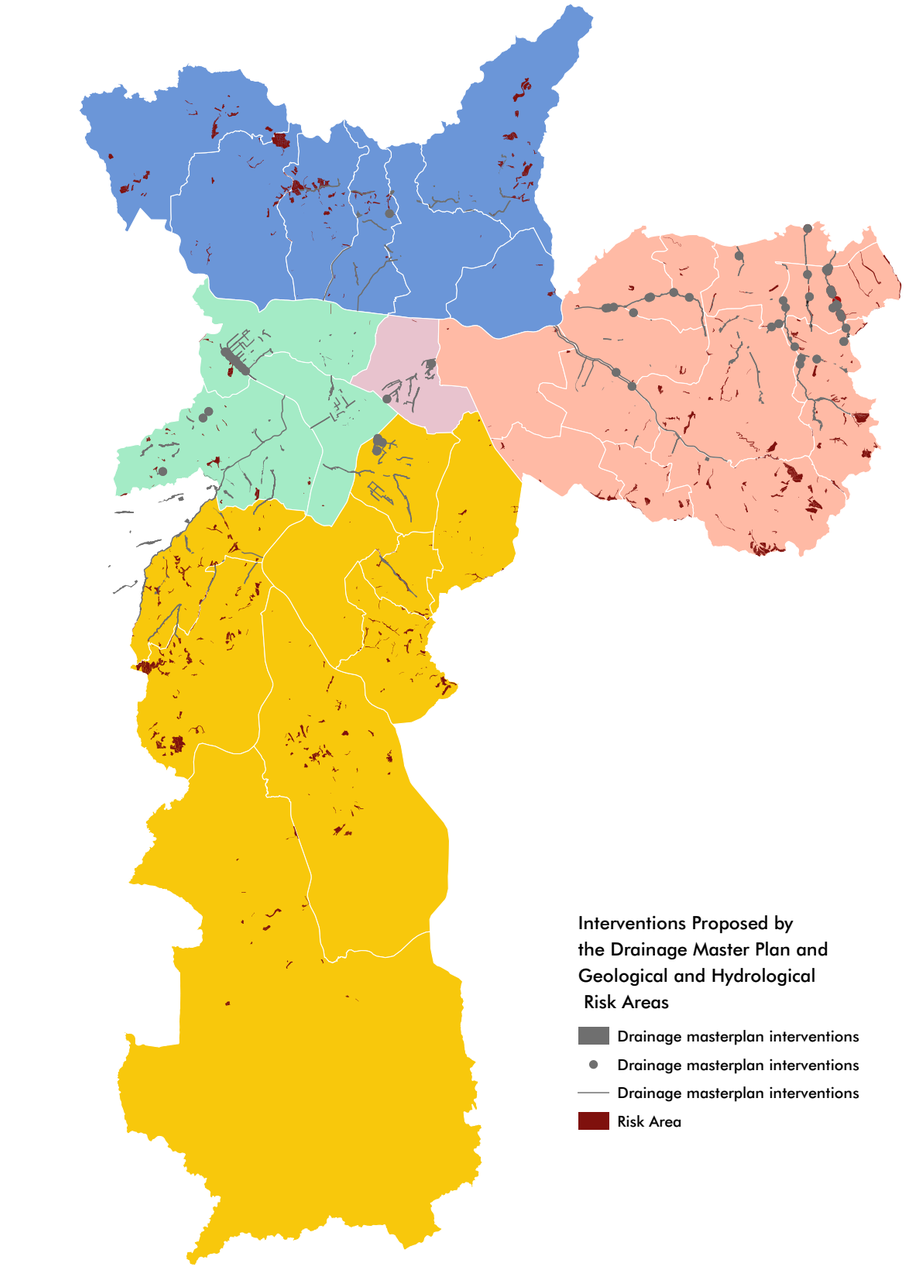


Figure 28: Overlap Between Interventions Proposed by the Drainage Master Plan and Geological and Hydrological Risk Areas

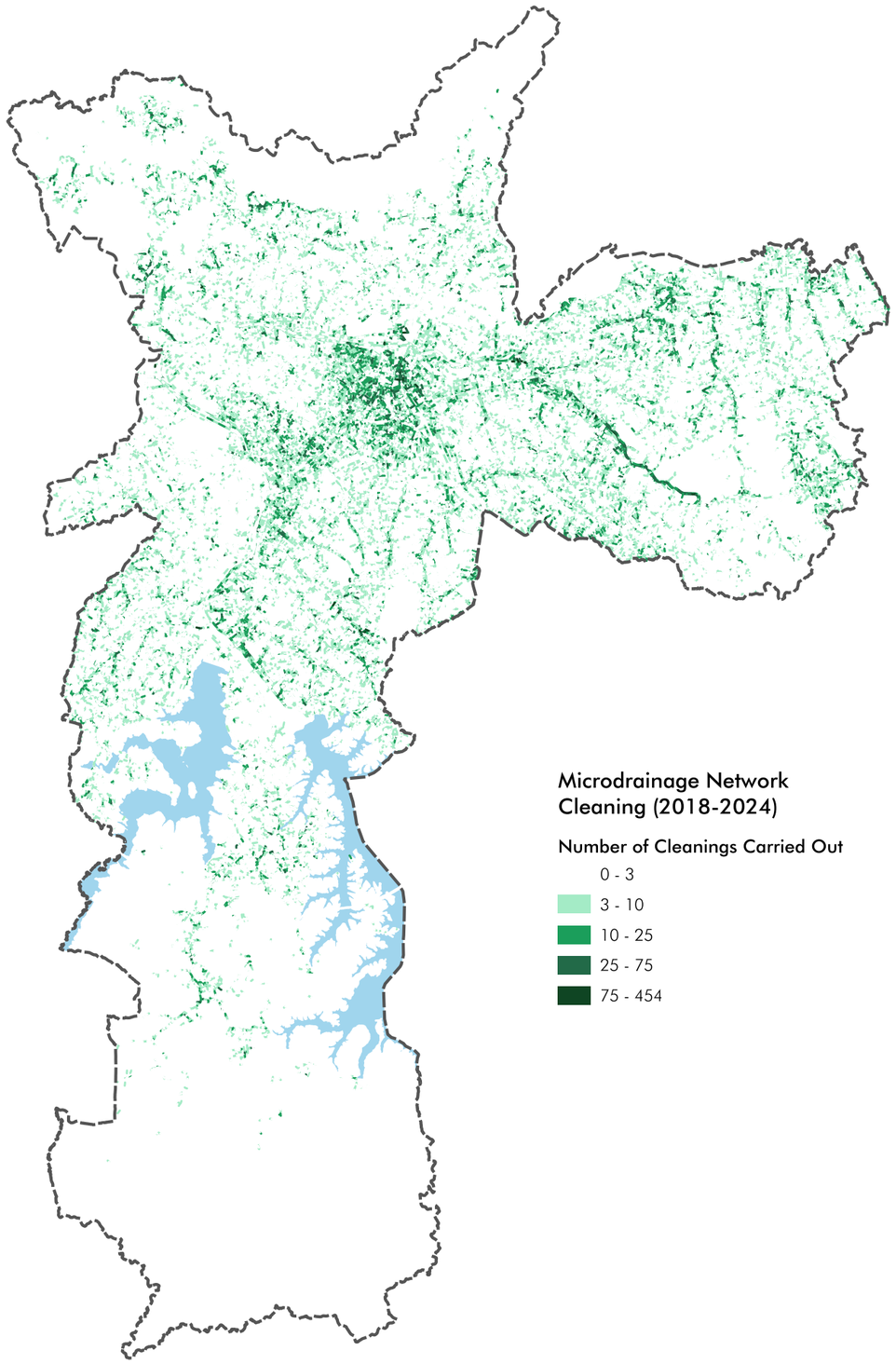


Figure 29: History of Microdrainage Network Cleaning in the Municipality (Source: Urano System)

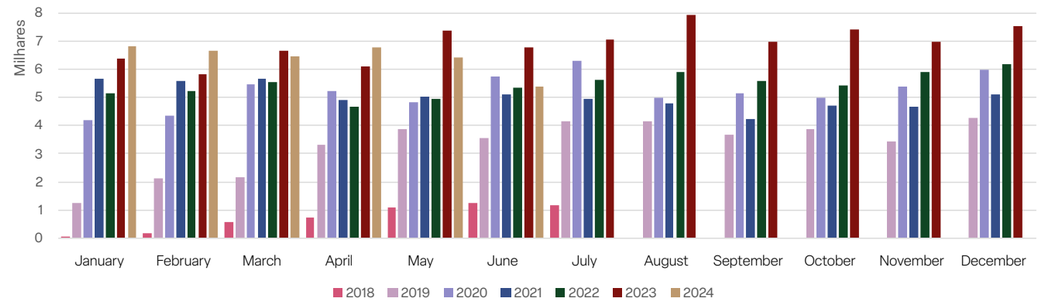


Chart 15: History of Microdrainage Network Cleaning in the Municipality (Source: Urano System)

As a consequence of these two lines of action, a significant reduction in the number of measured flood events in the city has already been observed. Graph 16 shows the relationship between the number of flood notifications and the accumulated rainfall during each rainy season, starting from 2017–2018. The data indicate that, after 2021, the trend line shifted, showing a reduction of over 50% in the number of flood occurrences for the same rainfall index.

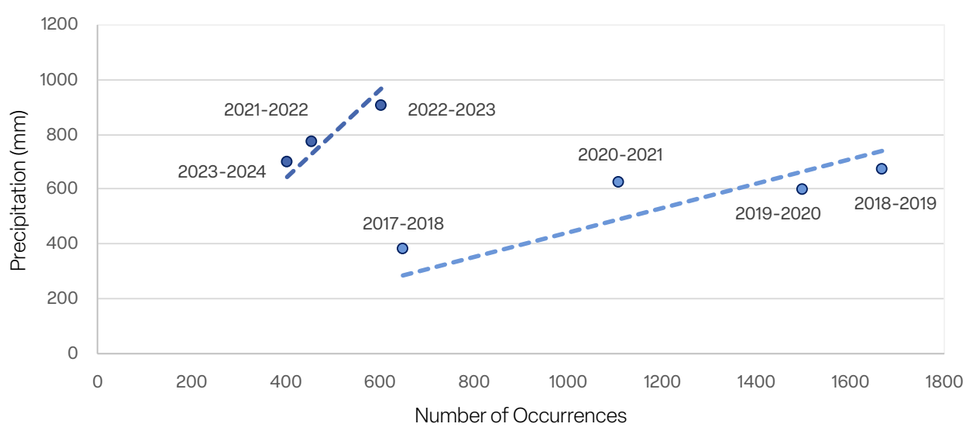


Chart 16: Relationship Between Flooding and Inundation Occurrences and Rainfall Levels in Different Rainy Seasons

There are different ways to classify the hydrological risk of an area. The Civil Defense of the Municipality of São Paulo uses the methodology described in the section **Methodology for the Registration, Characterization, and Evaluation of Risk Areas in the Municipality of São Paulo.**

Table 8: Criteria for Classification of the Degree of Hydrological Risk in an Area (Suggested by the Geological Survey of Brazil)

Risk Level	Description of Hydrological Risk
R1 – Low	The drainage structures or drainage compartments are subject to processes with low potential to cause damage and low frequency of occurrence (no recorded events in the last five years). Under current conditions, the occurrence of destructive events is not expected. Corresponds to regions that may be affected by flooding if the water level rises more than 3 m above the normal flow level.
R2 – Medium	Under current conditions, there is a reduced possibility of destructive events during episodes of intense and prolonged rainfall. The drainage structures or compartments are subject to processes with moderate potential to cause damage and medium frequency of occurrence (record of one significant event in the last five years). Corresponds to regions that may be affected by flooding if the water level rises more than 2 m above the normal flow level.
R3- High	Under current conditions, the occurrence of destructive events during intense and prolonged rainfall is quite possible. The drainage structures or compartments are subject to processes with high potential to cause damage, with medium frequency of occurrence (at least one significant event in the last five years), involving highly vulnerable dwellings. Corresponds to regions that may be affected by flooding if the water level rises between 1 m and 2 m above the normal flow level.
R4 – Very High	Under current conditions, the occurrence of destructive natural events during intense and prolonged rainfall is highly probable, particularly during the rainy season. The drainage structures or compartments are subject to processes with high potential to cause damage, with high frequency of occurrence (at least three significant events within five years) and involving highly vulnerable dwellings. Corresponds to regions that may be affected by flooding if the water level rises up to 1 m above the normal flow level.

METHODOLOGY FOR MAPPING, CHARACTERIZATION, AND ASSESSMENT OF RISK AREAS IN THE MUNICIPALITY OF SÃO PAULO

The Civil Defense of the Municipality of São Paulo is responsible for mapping, characterizing, and assessing risk areas. It is also tasked with distinguishing between geological, hydrological, and geological-hydrological risks, as well as defining these areas by sector.

This methodology includes the following stages:

Stage 1: Occupational Description of the Sectors

This stage consists of a general description of each sector's location (latitude and longitude), identifying streets, specific reference points, and the history of occurrences.

It includes observations on the types of constructions present (e.g., masonry houses or more precarious structures) and evaluates the availability and condition of essential services, such as sanitation. It also describes the conditions of access roads, noting whether they are paved streets or dirt paths.

For each sector, maps and photographs are prepared to document existing conditions and track changes over time — essential for comparing conditions before and after interventions, or for recording the evolution of risk situations.

Specifically, for areas subject to flooding, detailed information is provided on precarious settlements along watercourses, which are typically the most critical risk situations.

Increasingly, drones are used to facilitate visualization in sectors with difficult access and to count rooftops, allowing for an estimate of the number of households affected in each sector. This is crucial for planning evacuations and other safety measures.

Lastly, property registration data are obtained from the GeoSampa portal to complement the mapping.

Stage 2.a: Geotechnical and Geological Characterization of the Sectors

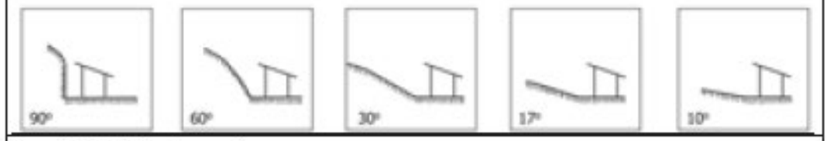
The assessment of geological risk areas is based on technical inspections conducted by Civil Defense.

Among the most widely used methods in Brazil, the Ministry of Cities[44] provides a checklist (reproduced below) designed to characterize the terrain and occupancy conditions.

a. Conditions of the terrain type and distances to the dwellings:

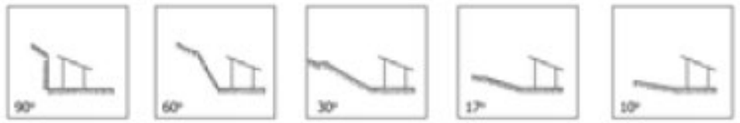
( ) **Encosta Natural**

altura _____ m
Inclinação (marque com "x" o desenho que apresenta a condição mais parecida com a situação)



( ) **Talude de corte**

altura _____ m
Inclinação (marque com "x" o desenho que apresenta a condição mais parecida com a situação)



Dist. da moradia:____ m da base da encosta/talude

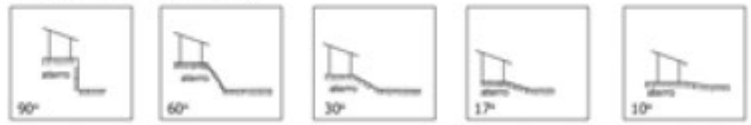


OU_____ m do topo da encosta/talude

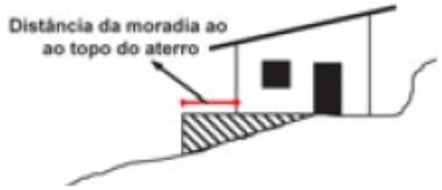


( ) **Aterro Lançado**

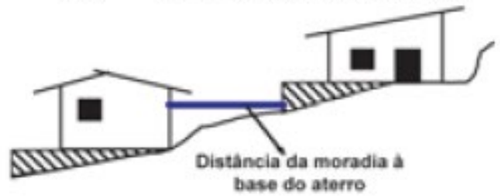
altura _____ m
Inclinação (marque com "x" o desenho que apresenta a condição mais parecida com a situação)



( ) **Dist. Da moradia:** _____ m do topo do aterro



OU _____ m da base do aterro



( ) **Presença de parede rochosa**

altura _____ m
Inclinação (marque com "x" o desenho que apresenta a condição mais parecida com a situação)



( ) **Presença de blocos de rocha e matacões**
( ) **Presença de lixo/entulho**

44 44. Brazil. Ministry of Cities / Institute for Technological Research. Mapping of Risks on Slopes and Riverbanks. 2007.

b. Conditions of Rainwater and Sewage Drainage:

( ) **Concentração** de água de chuva em superfície (enxurrada)	( ) **Lançamento** de água servida em superfície (a céu aberto ou no quintal).
Sistema de drenagem superficial ( ) inexistente ( ) precário ( ) satisfatório	
Para onde vai o esgoto? ( ) fossa ( ) canalizado ( ) lançamento em superfície (céu aberto)	
De onde vem a água para uso na moradia? ( ) Prefeitura ( ) mangueira	
Existe vazamento na tubulação? ( ) SIM ( ) esgoto ( ) água ( ) NÃO	
Minas d'água no barranco (talude) ( ) no pé ( ) no meio ( ) topo do talude ou aterro	

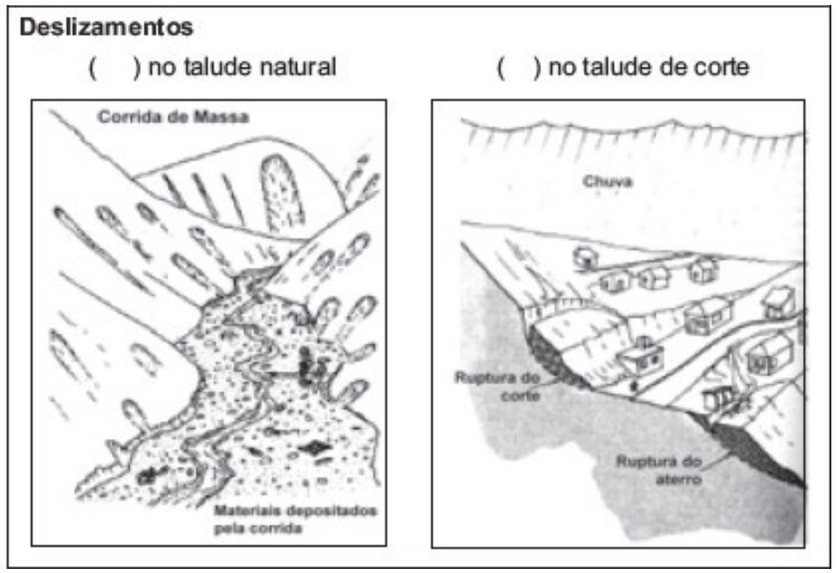
c. Presence and Density of Vegetation: Special attention should be given to the presence of banana trees, as this species is detrimental to slope stability. Their shallow and water-heavy root systems can contribute to the weakening of slopes and trigger landslides.

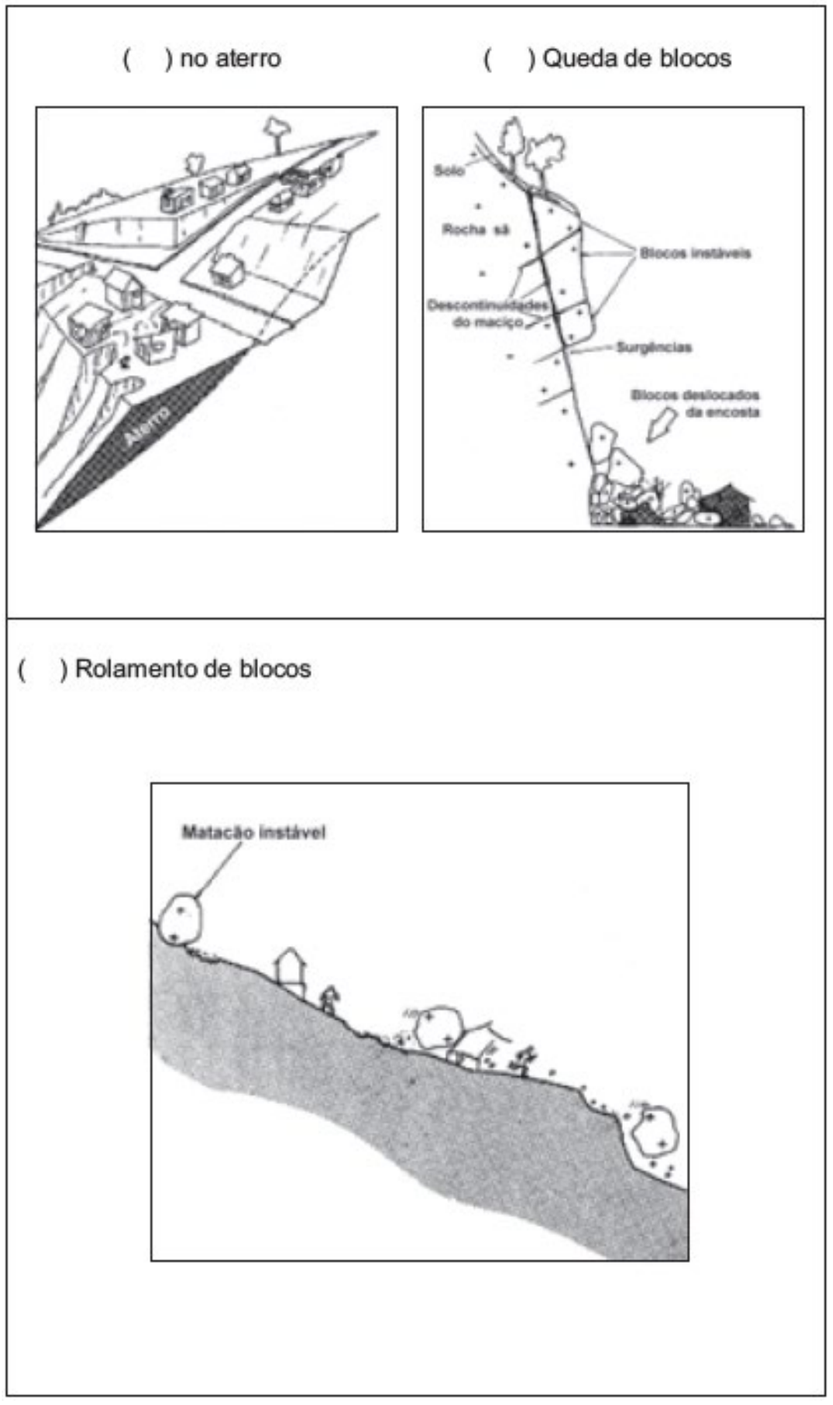
( ) **Presença de árvores**	( ) **Vegetação rasteira (arbustos, capim, etc)**
( ) **Área desmatada**	( ) **Área de cultivo de** _____

d. Presence of Signs or Evidence of Ground Movement: This involves identifying features of instability, such as cracks, settlement steps, tilting of rigid structures (trees, poles, or walls), and bulging of walls or retaining structures. For trees, when the trunk is straight but tilted, it indicates movement occurred after the tree's growth; whereas a crooked and tilted trunk suggests that growth occurred simultaneously with ground movement.

5º Passo – Sinais de movimentação (Feições de instabilidade) **Instruções:** Lembre-se que antes de ocorrer um deslizamento, a encosta dá sinais que está se movimentando. A observação desses sinais é muito importante para a classificação do risco, a retirada preventiva de moradores e a execução de obras de contenção.	
Trincas ( ) no terreno ( ) na moradia	( ) **Degraus** de abatimento
Inclinação ( ) árvores ( ) postes ( ) muros	( ) Muros/paredes **"embarrigados"**
( ) **Cicatriz de deslizamento próxima à moradia**	

e. Characterization of Instabilization Processes: The evaluator must identify the process most likely to occur, including landslides on natural slopes, cuts, or embankments; falling or rolling of rock blocks; other forms of mass movement that pose risks to the built environment.





Step 2.b: Hydrological Characterization of the Sectors

The assessment of hydrological risk areas is based on comparing the flood level records (historical flood and inundation events) of a given region with a simplified computational model of the flood surfaces in the area of interest.

i. Historical Records in the Sector

Numerical information is obtained through field visits and interviews with residents, aiming to identify the causal events and the water level reached during floods.

ii. Characterization of the Watershed

The hydrodynamic modeling of the area of interest is carried out using a simplified simulation based on the HAND model (Height Above the Nearest Drainage) of the watershed where the sector is located. The following georeferenced data, available on GeoSampa, are used:

- Hydrographic network at a 1:2000 scale;
- Watersheds at a 1:5000 scale;
- Informal settlements (favelas) at a 1:2000 scale;
- Flood occurrences at a 1:5000 scale;
- Aerial imagery – orthophoto at a 1:1000 scale.

The HAND model is calculated using the Digital Terrain Model (DTM) with a 0.5 m resolution, derived from LiDAR (Light Detection and Ranging) data.

iii. Generation of the Flood Surface

The flood surface is generated using the TerraView software (version 0.4.4), developed by INPE, integrated with the TerraHidro extension (version 4.2.2), which processes the data required for the simplified hydrodynamic modeling based on the HAND model.

The flood surface is obtained by calculating the height differences between the terrain and the thalweg (lowest point) of the surface drainage networks. In practice, each cell represents the “height above the nearest drainage”, and regions with lower elevation values tend to be more susceptible to flooding.

Step 3: Analysis of the Sector's Occupational Vulnerability

To determine the vulnerability of each sector, the following aspects are considered:

Occupational Density (AO): distance between dwellings and the degree of land occupation, relating to the number of people living in the area. The higher the density, the greater the sector's vulnerability;

Construction Standard (PC): quality of the existing housing, considering its ability to resist impacts related to hydrological processes. The lower the construction quality, the higher the vulnerability;

Basic Sanitation (SB): presence of a sewage collection network and evidence of waste being dumped on streets or in watercourses;

Surface Drainage (DS): condition and functionality of structures designed to channel stormwater;

Accessibility (AC): access conditions for response and rescue teams to reach the area during emergency situations.

For each of these elements, values ranging from 1 to 4 are assigned, where lower values correspond to lower vulnerability degrees, and higher values correspond to greater vulnerability.

The overall vulnerability is defined by the arithmetic mean of all results.

Table 9 presents the criteria used by the São Paulo Civil Defense to characterize the occupational vulnerability of risk areas.

Table 9: Criteria Used in the Assessment of Vulnerability in Informal Settlements

VULNERABILITY (V)				
DO Densification of Occupation	Occupation < 30%	Occupation between 30% and 80% and predominantly horizontal	Occupation between 30% and 80% and predominantly vertical	Occupation > 80% and predominantly vertical
Classification	LOW	MEDIUM	HIGH	VERY HIGH
Value	1	2	3	4
CS Construction Standard	Masonry dwellings without evident pathological features	Masonry dwellings predominantly without coating, with incipient pathological features (dampness, small cracks, etc.)	Predominantly masonry dwellings with advanced pathological features (cracks, fissures, exposed reinforcement, exposed foundation, signs of settlement, etc.)	Predominantly timber/plywood/scrap dwellings OR masonry with evident signs of imminent collapse (many cracks, fissures, strong wall inclinations)
Classification	LOW	MEDIUM	HIGH	VERY HIGH
Value	1	2	3	4
SB Basic Sanitation	Has sewage network and no garbage	No sewage network and no garbage	Has sewage network and garbage present	No sewage network and garbage present
Classification	Adequate	Deficient	Precarious	Nonexistent
Value	1	2	3	4
SD Surface Drainage	Surface drainage structures in good condition	Surface drainage structures without maintenance (e.g., obstruction, damaged elements)	Surface drainage structures nonexistent (e.g., missing elements, undersized elements)	Surface drainage structures absent OR improvised by residents
Classification	Adequate	Deficient	Precarious	Nonexistent
Accessibility	Wide paved roads, easy access for vehicles and trucks	Predominantly wide roads with few narrow streets, paved and/or partially paved, access for medium-sized vehicles (pickup/ambulance)	Predominantly narrow roads with few paved and/or partiallyv paved alleys, access for small vehicles (car)	Narrow alleys, unpaved or paved by residents, vehicles cannot access (pedestrian access only)
Classification	LOW	MEDIUM	HIGH	VERY HIGH
Value	1	2	3	4

The sector's vulnerability is then calculated by the arithmetic mean of each of the criteria, as shown in Equation 3.

Equation 3: Equation for defining the vulnerability of a sector

$$V = \frac{AO + PC + SB + DR + AC}{5}$$

Where:
V = Vulnerability
AO = Occupation Density
PC = Construction Standard
SB = Basic Sanitation
DR = Surface Drainage
AC = Accessibility

Stage 4: Analysis of Hydrological Hazards

It is carried out based on elements that influence the potential for damage.

These elements are: flow energy and transport capacity, level of process reach, channel interferences, event recurrence, occurrence of processes associated with the events, and the site's susceptibility to hydrological processes.

Kinetic Energy and Transport Capacity (ECT): This is qualitative information obtained from residents who have previously experienced the occurrence of events in the area.

Level of Reach (NAT): Numerical information obtained from interviews with residents or field evidence, such as water marks on the wall:

Reach Interval	Value
NAT < 0,40 m	1
0,4 m < NAT < 0,80 m	2
0,80 m < NAT < 1,2 m	3
NAT ≥ 1,2 m	4

1. **Interferences in the Channel (IC)**: presence of some structure or intervention in the watercourse that may interfere with the flow of water in the drainage channel, whether construction debris or the presence of dwellings built over the channel. The greater the interference, the greater the danger;

2. **Recurrence (RC):** information obtained from local residents, generally referring to 10 years. This information assesses the frequency with which the hydrological event occurs. The greater the recurrence, the greater the danger;

3. **Associated Processes (AP**): occurrence or possibility of occurrence of channel silting processes and/or undermining of stream banks. It is considered that these processes contribute directly to the danger, as they increase the chance of floods and inundations occurring;

4. **Susceptibility (SU)**: is obtained from the susceptibility map, observing in which susceptibility class the location is found, and can be adjusted according to the NAT reported by residents and observation during inspection.

These criteria also have values ranging from 1 to 4, linked to low and very high dangers, respectively. The danger is defined by the arithmetic mean of these results.

Equation 4: Equation for danger definition

$$P = \frac{ECT + NAT + IC + RC + PA + SU}{6}$$

Where: P = Danger, ECT = Energy and Transport Capacity, NAT = Achievement Level, IC = Channel Interferences, RC = Recurrence, PA = Associated Processes, SU = Susceptibility

Table 10 presents the criteria used by the Civil Defense of São Paulo for characterizing the vulnerability of occupation in risk areas.

Table 10: Criteria Considered in the Hazard Assessment of Informal Settlements

VULNERABILITY (V)		
ETC– Energy and Transport Capacity	Low kinetic energy, slow flooding of floodplain	Medium kinetic energy, capable of transporting light objects
Classification	LOW	MEDIUM
Value	1	2
Water Level	Less than 0.4 m	Greater than or equal to 0.4 m and less than 0.8 m
Classification	LOW	MEDIUM
Value	1	2
CI – Channel Interference	No interference	Interference in the channel due to construction debris
Classification	Nonexistent	Slightly significant
Value	1	2
RC – Recurrence	There is a risk of occurrence	Does not occur every year
Classification	Low	Medium
Value	1	2
PA – Associated Processes	No associated process	Possible occurrence of undercutting or siltation of the channel
Classification	Nonexistent	Possible
Value	1	2
SU – Susceptibility	Low susceptibility (above 3 m)	Medium susceptibility (above 2 m and up to 3 m)
Classification	LOW	MEDIUM
Value	1	2

	High kinetic energy, capable of transporting objects and people	Very high kinetic energy, capable of transporting heavy objects
	HIGH	VERY HIGH
	3	4
0.4	Greater than or equal to 0.8 m and less than 1.2 m	Greater than or equal to 1.2 m
	HIGH	VERY HIGH
	3	4
nel	Presence of undersized and/or damaged interventions in the channel and/or the stream partially blocked by irregular interventions (slab, bridge, dwellings)	Presence of undersized and/or damaged interventions in the channel and/or the stream partially blocked by irregular interventions (slab, bridge, dwellings)
	Significant	Very significant
	3	4
ear	Occurs at least once a year	Occurs several times a year
	High	Very High
	3	4
of	Observed occurrence of undercutting OR siltation of the channel	Observed occurrence of undercutting AND siltation of the channel
	Significant	Very Significant
	3	4
m)	High susceptibility (above 1 m and up to 2 m)	Very high susceptibility (up to 1 m)
	HIGH	VERY HIGH
	3	4

Step 5: Determination of the Sector Risk Level

The determination of the risk level for each sector is carried out through a comparison between field investigations and simulation results, considering the occupational characteristics of the sector. For both Hydrological and Geological risks, a classification with four levels is applied, with R1 representing low risk and R4 representing high risk.

For geological risks, the following criteria are used:

Table 11: Parameters Used by the Civil Defense of São Paulo and the Geological Survey of Brazil to Determine the Geological Risk Degree of an Area

Geological Risk Degree	Geological Risk Degree
R1 – Low	1. The predisposing geological–geotechnical conditions (slope, soil type, etc.) and the level of intervention in the area present low or no potential for the development of landslide or undercutting processes. 2. No signs, features, or evidence of instability are observed. No indications of slope or drainage margin instability. 3. Under existing conditions, the occurrence of destructive events during a normal rainy season is not expected.
R2 – Medium	1. The predisposing geological–geotechnical conditions (slope, soil type, etc.) and the level of intervention in the area present medium potential for the development of landslide or undercutting processes. 2. Some incipient signs, features, or evidence of instability (on slopes or drainage margins) are observed. The destabilization process is at an early stage. 3. Under existing conditions, the probability of destructive events during episodes of intense and prolonged rainfall is low within a normal rainy season.
R3- High	1. The predisposing geological–geotechnical conditions (slope, soil type, etc.) and the level of intervention in the area present high potential for the development of landslide or undercutting processes. 2. Significant signs, features, or evidence of instability (e.g., soil cracks, settlement steps on slopes, etc.) are observed. The destabilization process is active but can still be monitored. 3. Under existing conditions, destructive events are likely to occur during intense and prolonged rainfall within a normal rainy season.
R4 – Very High	1. The predisposing geological–geotechnical conditions (slope, soil type, etc.) and the level of intervention in the area present very high potential for the development of landslide or undercutting processes. 2. Numerous and severe signs, features, or evidence of instability (e.g., soil cracks, slope settlement steps, cracks in houses or retaining walls, leaning trees or poles, landslide scars, erosive features, or proximity of dwellings to stream margins) are present. The destabilization process is in an advanced stage—the most critical condition—making monitoring unfeasible. 3. Under existing conditions, destructive events are highly likely during intense and prolonged rainfall within a normal rainy season.

For hydrological risks, the determination of the risk level is performed by multiplying the vulnerability and hazard values of each sector, resulting in the correlation matrix presented in Equation 4.

Equation 5: Hydrological Risk Correlation Matrix

$$R = VxP$$

Where: R = Risk, V = Vulnerability, P = Hazard.
The ranges of the risk classes were empirically adjusted, allowing for the classification of risks.

Table 12: A) Correlation matrix of vulnerability and hazard, where colors represent the degree of risk (Green: R1; Yellow: R2; Orange: R3; Red: R4).
B) Intervals for the classification of hydrological risk in precarious settlements: R1: Low Risk; R2: Medium Risk; R3: High Risk; R4: Very High Risk.

a.

Risk (R=PxV)		V			
		1	2	3	4
P	1	1	2	3	4
	2	2	4	6	8
	3	3	6	9	12
	4	4	8	12	16

b.

	Class	Intervals
Risco	R1	1≤ R <4
	R2	4 ≤ R < 8
	R3	8 ≤ R < 12
	R4	12 ≤ R < 16

Step 6: Preparation of the Detailed Report

Each report begins with clear details about the location, including the Subprefecture, the specific area, and the streets involved. This ensures the geographical accuracy necessary for interventions and monitoring.

This form also lists the members of the team who carried out the inspection and the specific date on which it took place, providing an official record and assigning responsibility to those involved in the assessment. Figure 30 illustrates the cover of one of these reports prepared in 2023 for the risk area known as *Canto da Noite*.

Each sector is identified by a code, for example, “AD-22-01 (R3)”, in which AD represents the Subprefecture in which the risk area is located—in this case, the Cidade Ademar Subprefecture—followed by a sequential number assigned to each risk area as it is mapped, then the sector within the risk perimeter, and finally its respective risk classification, such as R4 (Very High), R3 (High Risk), R2 (Medium Risk), or R1 (Low Risk).

CIDADE DE SÃO PAULO
DEFESA CIVIL

Mapeamento de risco de enchente e inundação em assentamentos precários

Relatório HAD-20 Canto da Noite – 04/05/2023

Subprefeitura: Cidade Ademar
Bacia: Córrego Apucas
Curso d’água: Córrego sem denominação afluente do Córrego Apucas
Área: Canto da Noite
Localização: Rua Guaicuri e Rua Aurora Livida
Equipe:
Data da vistoria: 04/05/2023

Área	Risco Hidrológico	Risco Geológico
	HAD-20	AD-06 Ladainha do Mar

Figure 30: Ilustration of Initial Information from a Report Prepared by Civil Defense for the Assessment of a Hydrological and Geological Risk Area (Source: Civil Defense)

For areas already monitored by COMDEC, the report includes a summary table highlighting the changes observed between different assessment periods. This table is structured to show the evolution or stability of landslide and erosion risks, typically organized as follows:

- Columns for each compared assessment period, such as “Sector PMSP XXXX” and “Sector PMSP YYYY,” representing the current and previous risk classifications for each evaluated sector.

- Each row in the table corresponds to a specific sector within the mapped area.

- Comparison Data: the last column highlights any changes that occurred between periods. This field may state “No change in the sector,” meaning that conditions and risk level remained stable, or it may detail specific changes, such as “Sector reduced and risk classification readjusted,” indicating an alteration in conditions or in the effectiveness of implemented mitigation measures.

Figure 31 illustrates the beginning of a report comparing two evaluations.

Mapeamento de risco de escorregamento e solapamento em assentamentos precários

CIDADE DE SÃO PAULO
DEFESA CIVIL

Relatório AD-22 – 26/04/2023

Subprefeitura: Cidade Ademar
Área: AD-22 Jardim Martini
Localização: Rua Hermenegildo Martini, Rua Estanislau Moniusko e Rua João da Veiga Bueno
Equipe:

Data da vistoria: 26/04/2023

Setor PMSP 2023	Setor PMSP 2021	Comparação dos Setores
AD-22-01 (R3)	AD-22-01 (R3)	Não houve alteração no setor

Figure 31: Example of a Report Comparing Two Geological Risk Assessments (Source: Civil Defense)

CONTINGENCY PLANS FOR RISK AREAS IN THE MUNICIPALITY OF SÃO PAULO

It is the responsibility of the Civil Defense to develop Protection and Civil Defense Contingency Plans (PLANCON) specific to each risk area, with the objective of providing municipal technical teams with action tools to reduce the possibility of loss of human life resulting from adverse climatic events.

These PLANCONs describe the procedures to be taken after the occurrence or imminent occurrence of an event, identifying the agencies to be notified in each of the predetermined stages: monitoring stage, attention stage, alert stage, and maximum alert stage.

The plans also describe the necessary rescue, humanitarian aid, and rehabilitation actions to reduce resulting damage and losses. Once the risk attributed to an area has been eliminated, the plan is no longer required.

The preparation of PLANCONs seeks to answer the following questions:

1. What is the problem, and how does it occur?
2. Where does the problem occur?
3. When does the problem occur?
4. What should be done?
5. Who will do it?

Activation Criteria for PLANCONs Used by COMDEC for areas with geological risk:

- When accumulated rainfall over 72 hours (according to CGE) exceeds 50 mm;

- When a mass movement on a slope or stream bank is detected by DDEC.

For areas with hydrological risk:

- When flooding or inundation is recorded;

- When CGE declares a state of imminent stream overflow, based on the telemetric network and SAISP;

- When stream overflow is identified by NUDEC or DDEC.

The contingency plan, also developed by the Civil Defense, corresponds to a risk coexistence action, meaning that it **does not reduce the risk itself**, but rather provides a structured response when activation parameters are reached.

Geological risk activation criteria established by COMDEC are:

- When accumulated rainfall over 72 hours, monitored by the São Paulo Municipal Emergency Management Center (CGE), is equal to or greater than 50 mm;

- When a mass movement on a slope or stream bank is detected by DDEC.

For hydrological risk:

- When flooding or inundation is recorded;

- When CGE declares a state of imminent stream overflow;

- When stream overflow is identified by NUDEC or DDEC.

OPERATIONAL PROCEDURE IN SITUATIONS OF IMMINENT RISK AND EMERGENCY

Beyond the legal framework that underpins the preparation of this Plan, special attention must be given to the current regulations directly related to the topic, whose purpose is to provide a set of guidelines that enable the adoption of logical, technical, and administrative procedures structured to be quickly triggered in emergency situations, minimizing impacts on the population and reducing the spread or extent of damage.

Among the relevant provisions are Municipal Decree No. 59,135, of December 12, 2019, which regulates, at the municipal level, the contracting of emergency works and services through Subprefectures, as provided for in item IV of Article 24 of Federal Law No. 8,666, of June 21, 1993 (previously mentioned in the section “Responsibilities of Municipal Administration Bodies”), and Internal Order PREF No. 1, of January 9, 2013, directed to the Subprefectures and Municipal Secretariats, establishing guidelines for procedures regarding preventive relocation of residents in geological risk areas in the Municipality of São Paulo.

A common feature of these regulations is the cross-sectoral nature of the issue, the clear interdependence among Municipal Administration bodies, and the need to clearly define the roles and responsibilities of those involved to achieve their intended purpose—safeguarding human life.

Focusing on Internal Order No. 01/2013, it is established (specifically in item 1 of its determinations) that the instrument applies both to preventive relocations due to geological risk and to emergency response following disasters. For this purpose, a series of procedures must be followed, establishing distinct responsibilities for the involved agencies (Municipal Secretariats and Subprefectures), as described below:

The process begins with the Civil Defense, which must analyze the situation and issue a reasoned opinion on the probability of a disaster occurring, according to the classification defined by the Municipal Risk Mapping, evaluating the possibility of restoring safety conditions at the site and suggesting necessary actions to achieve this.

If it is determined that it is not possible to promptly restore safe conditions, the opinion must indicate which dwellings should be preventively evacuated.

The Subprefecture responsible for the territory must then interdict the dwellings indicated in the report, notify residents to leave[45] immediately, and isolate and signal the area with tape and warning signs indicating accident risk. An Interdiction Notice must be issued for each dwelling at imminent risk, and all actions must be documented with photographs that allow identification of the interdicted residences.

The Subprefecture must also collect data on affected residents and open an administrative process, properly documented with: a description of the occurrence with photographs; the report/opinion issued by the Civil Defense; Interdiction Notices; sketches or maps showing the exact location of interdicted dwellings; a list with resident information cross-referenced with the corresponding Interdiction Notice and housing location (which can be numbered on the sketch/map); an intervention plan for eliminating the local risk; and, if applicable, a police report.

This process must then be forwarded to the Municipal Secretariat of Subprefectures (SMSUB), which will verify whether the process is properly documented and evaluate the proposed Intervention Plan, requesting additional or revised documentation if necessary. Once all documents are confirmed and the Intervention Plan deemed viable, SMSUB forwards the process to SEHAB.

SEHAB is then responsible for providing housing assistance to displaced families, considering the Intervention Plan for risk elimination (which may include the possibility of returning to the site), family profiles, available resources, and legal requirements.

In this regulatory context, SEHAB's assistance to families removed due to imminent risk or displaced by disasters (emergencies), after appropriate classification, may include both temporary housing assistance (Rent Assistance, Housing Support Grant, Moving Assistance) and permanent solutions (allocation of new housing or compensation for improvements).

Another benefit available in such cases is the Emergency Card, granted to the head of the household affected by the event, in prepaid[46] format.

The granting of each of these benefits is governed by specific regulations and procedures. In general, once the administrative process is received, SEHAB reviews all documentation, especially the Intervention Plan, and conducts a socioeconomic survey of the families to determine which benefit(s) will be provided.

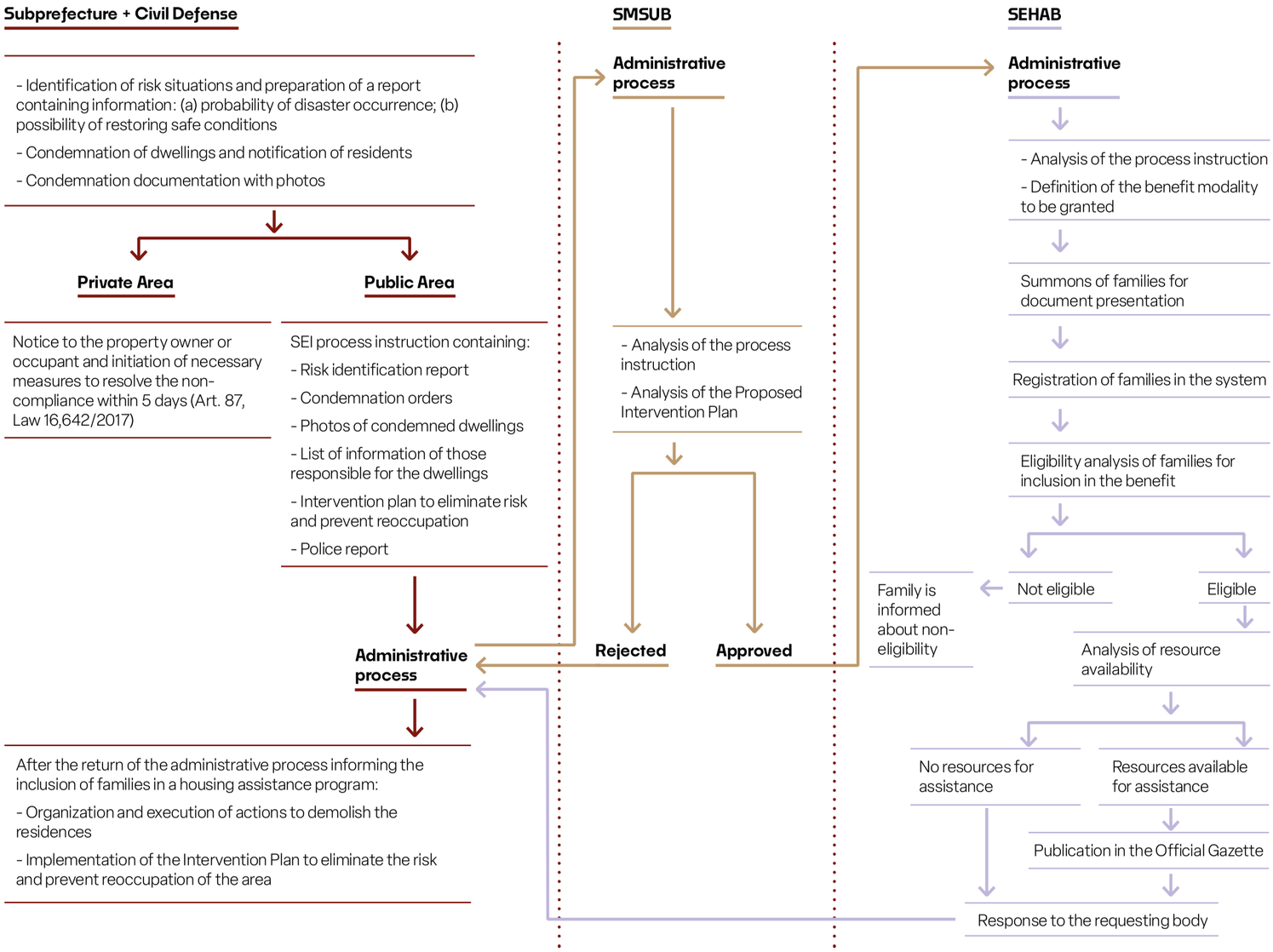
The process is then supplemented with information on whether or not assistance can be provided to the families and returned to the Subprefecture, so that it can implement the Intervention Plan.

To illustrate this framework, a flowchart is presented below, showing the main actions triggered in cases of preventive relocation due to geological risk or emergency response following disasters, as outlined in Internal Order 01/2013.

Finally, it is noted that, since this is the only regulatory instrument establishing procedures for municipal action in imminent risk situations, it is frequently applied to other types of risks as well.

45 The Subprefect may, when applicable, request assistance from the Metropolitan Civil Guard (GCM) and the Military Police (PM) to enforce the interdiction order, considering the non-negotiable right to life and the need to protect the physical integrity of residents.

46 The creation of the Emergency Card is established in Article 43 of Law No. 17,719 of November 26, 2021, regulated by Decree No. 61,031 of February 4, 2022, with guidelines set by Joint Ordinance SEHAB/SMSUB No. 09/2023. It governs the payment of emergency aid in situations of imminent risk, disaster, or public calamity, preferably executed through the Emergency Card.



Source: SEHAB

“We have all the Secretariats involved; all the data are being used for the preparation of this Municipal Risk Reduction Plan.”

Joel Malta – Civil Defense

Foto: Jardim Eucaliptos

CURRENT SITUATION OF RISK AREAS

CURRENT SITUATION OF RISK AREAS

A study conducted by the Municipal Secretariat of Urbanism and Licensing (SMUL), which analyzed the evolution of geological risk areas in São Paulo between 2010 and 2022, shows that, in 2022, out of 1,325 risk sectors (R1, R2, R3, and R4), 1,120 were located totally or partially within Special Zones of Social Interest (ZEIS), of which 1,070 were risk sectors within ZEIS 1[47].

Regarding R3 and R4 risks, from the total of 561 risk sectors mapped in 2022, 473 were located totally or partially in ZEIS, with 448 of these R3 and R4 sectors situated in ZEIS 1.

This study, published in *Informes Urbanos*, reveals that geological risk is closely linked to ZEIS 1, more specifically to favelas and irregular subdivisions, areas characterized by precarious housing and urban conditions.

The level of urban precariousness, including the presence of environmental risk in its various degrees—such as contamination or fire risk—allows for classifying settlements as consolidated, consolidable, or non-consolidable.

The risk areas discussed here are present not only in consolidable precarious settlements, which require the execution of works to mitigate geological and hydrological risks, but also in non-consolidable settlements, where the physical and environmental characteristics of the land do not allow for residential occupation, in which case the total removal of dwellings located there is recommended.

In the municipality of São Paulo, Civil Defense has approximately 785 areas[48] registered, with 66% related to geological risks and 34% to hydrological risks.

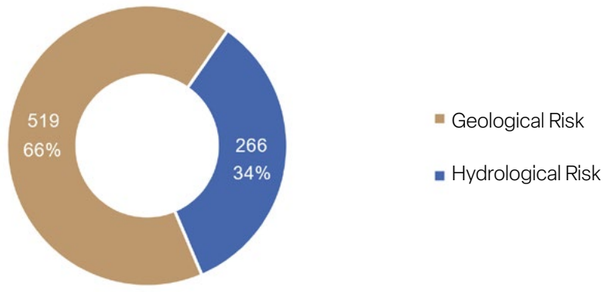


Chart 17: Distribution of Risk Type by Risk Type[49]

47 Areas characterized by the presence of favelas and irregular settlements, social housing developments, low-income housing clusters, and communities predominantly inhabited by low-income populations.

48 05/01/2024.

49 Chart prepared using data from GeoSampa, available at: https://metadados.geosampa.prefeitura.sp.gov.br/geonetwork/srv/por/catalog.search; last accessed May 15, 2024.

At a finer level of detail, there are 1,954 sectors, of which 16% are classified as low risk, 34% as high risk, and 10% as medium risk

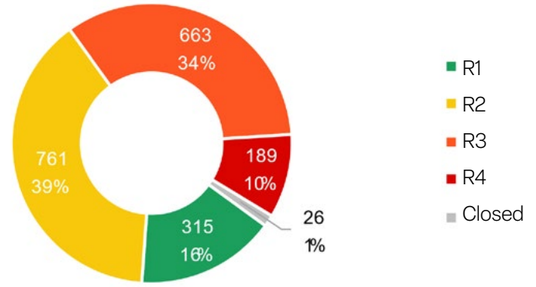


Chart 18: Distribution of Risk Type by Sector Risk Class[50]

The risk areas total 20.2 km² in the municipality, representing 1.2% of its total surface area (1,520 km²), of which 17.2 km² (90%) are related to geological risks and 2.0 km² (10%) to hydrological risks.

This represents a significant increase compared to previous[51] surveys, since in 2006 the measured area was 5.6 km², and in 2010, 13.5 km².

These areas are located on just over 21.000 lots, with 19.926 classified as private in the official municipal systems (FISCAL terminology used in GeoSampa), while 786 are on public land owned by the municipality. The remaining 305 lots are classified as rural.

This information is highly significant, as any intervention plan by the administration requires a Declaration of Public Utility (DUP), with corresponding compensation to the property owner.

At a more detailed analytical level (*Graph 19*), it is observed that publicly owned lots have a higher proportion of very high-risk areas (approximately 21% are R4) compared to private ones. Meanwhile, for high and medium risk areas (R2 and R3), this percentage is around 10%.

50 Chart prepared using data from GeoSampa, available at: https://metadados.geosampa.prefeitura.sp.gov.br/geonetwork/srv/por/catalog.search; last accessed May 15, 2024.

51 https://www.prefeitura.sp.gov.br/cidade/secretarias/upload/desenvolvimento_urbano/arquivos/apresentacao_final_31-10-2011.pdf

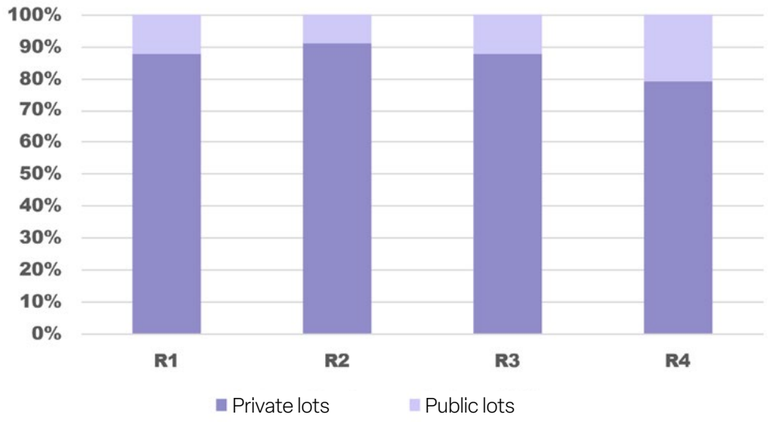


Chart 19: Change in Lot Property Profiles According to Sector Risk Classification[52]

The cross-analysis of land ownership status and sector classification indicates that occupations on public land tend to be larger and characterized by higher risk levels for the population. Conversely, private areas tend to be smaller, with a greater proportion of medium and low-risk areas.

Each risk area comprises multiple lots in public registries. Most have more than 20 lots in the land database, with about 20% containing more than 50. *Figures 32* and *33* illustrate the land tenure situation for the areas known as Joaquim Meira de Siqueira (IQ-08) and Vila Clara (JA-02).

52 Chart prepared using data from GeoSampa, available at: https://metadados.geosampa.prefeitura.sp.gov.br/geonetwork/srv/por/catalog.search; last accessed May 15, 2024.

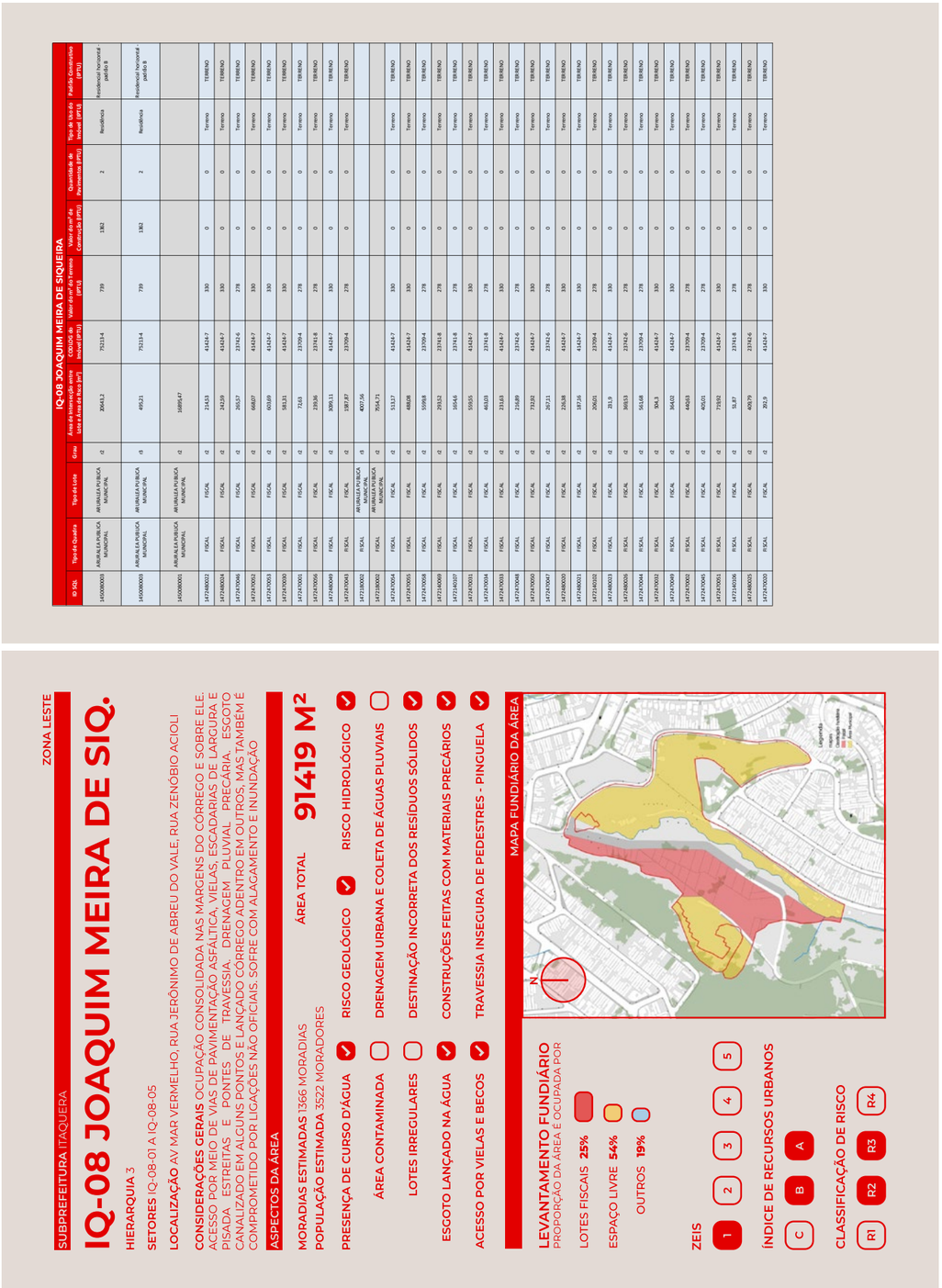
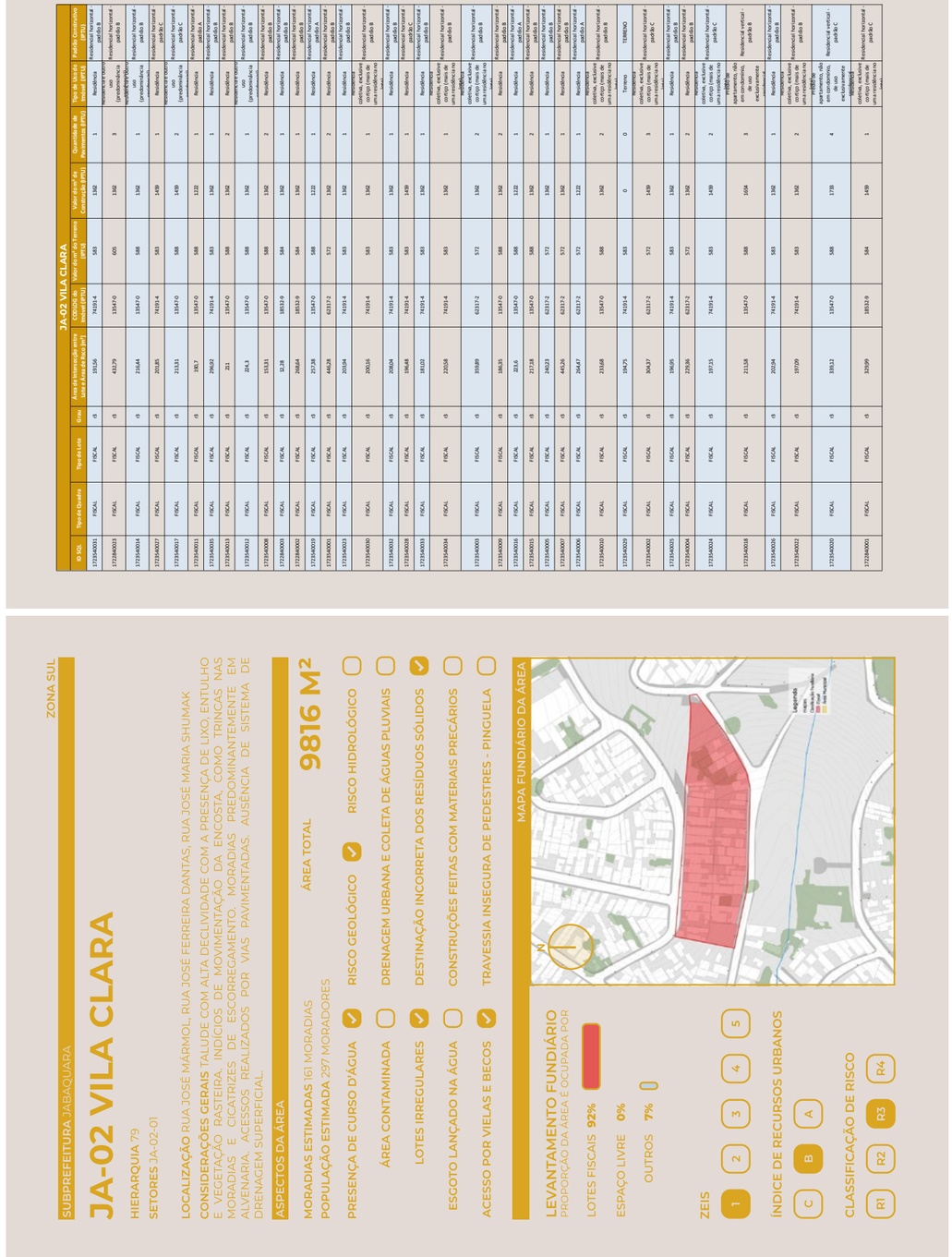


Figure 32: Example of Land Registry Form for Area IQ-08 (Source: PMRR)



JA-02 VILA CLARA												
ID SQL	Tipo de Quadra	Tipo de Lote	Geo	Área de intervenção em um raio de 1 km de 1 km (m²)	CÓDIGO DE NOME (m²)	Valor do m² de terreno (m²)	Valor do m² de Construção (m²)	Quantidade de Pavimentos (m²)	Tipo de Unidade Imobiliária	Padrão Construtivo
1721640031	FISCAL	FISCAL	0	19156	743914	583	1382	1	Residência	Residencial horizontal padrão B
1721840023	FISCAL	FISCAL	0	43179	119470	605	1382	3	Residência uso (predominância)	Residencial horizontal padrão B
1721640014	FISCAL	FISCAL	0	21644	119470	588	1382	1	Residência uso (predominância)	Residencial horizontal padrão A
1721640027	FISCAL	FISCAL	0	20185	743914	583	1439	1	Residência	Residencial horizontal padrão C
1721640017	FISCAL	FISCAL	0	21331	119470	588	1439	2	Residência uso (predominância)	Residencial horizontal padrão B
1721640011	FISCAL	FISCAL	0	3817	119470	588	1132	1	Residência	Residencial horizontal padrão A
1721640035	FISCAL	FISCAL	0	29692	743914	583	1382	1	Residência	Residencial horizontal padrão B
1721640013	FISCAL	FISCAL	0	211	119470	588	1382	2	Residência	Residencial horizontal padrão B
1721640012	FISCAL	FISCAL	0	2413	119470	588	1382	1	Residência uso (predominância)	Residencial horizontal padrão B
1721640008	FISCAL	FISCAL	0	13321	119470	588	1382	2	Residência	Residencial horizontal padrão B
1721840003	FISCAL	FISCAL	0	3128	183329	584	1382	1	Residência	Residencial horizontal padrão A
1721840002	FISCAL	FISCAL	0	26864	183329	584	1382	1	Residência	Residencial horizontal padrão A
1721640039	FISCAL	FISCAL	0	25738	119470	588	1132	1	Residência	Residencial horizontal padrão A
1721640001	FISCAL	FISCAL	0	44628	631372	572	1382	2	Residência	Residencial horizontal padrão B
1721640023	FISCAL	FISCAL	0	20304	743914	583	1382	1	Residência	Residencial horizontal padrão B
1721640060	FISCAL	FISCAL	0	20016	743914	583	1382	1	comércio, exclusivo ou misto (predominância uso)	Residencial horizontal padrão B
1721640032	FISCAL	FISCAL	0	28604	743914	583	1382	1	Residência	Residencial horizontal padrão B
1721640028	FISCAL	FISCAL	0	19648	743914	583	1439	1	Residência	Residencial horizontal padrão C
1721640033	FISCAL	FISCAL	0	18102	743914	583	1382	1	Residência	Residencial horizontal padrão B
1721640034	FISCAL	FISCAL	0	22028	743914	583	1382	1	comércio, exclusivo ou misto (predominância uso)	Residencial horizontal padrão B
1721640003	FISCAL	FISCAL	0	35989	631372	572	1382	2	comércio, exclusivo ou misto (predominância uso)	Residencial horizontal padrão B
1721640039	FISCAL	FISCAL	0	38135	119470	588	1382	2	Residência	Residencial horizontal padrão A
1721640016	FISCAL	FISCAL	0	2216	119470	588	1122	1	Residência	Residencial horizontal padrão A
1721640015	FISCAL	FISCAL	0	31718	119470	588	1382	2	Residência	Residencial horizontal padrão B
1721640005	FISCAL	FISCAL	0	24023	631372	572	1382	1	Residência	Residencial horizontal padrão B
1721640007	FISCAL	FISCAL	0	44526	631372	572	1382	1	Residência	Residencial horizontal padrão B
1721640066	FISCAL	FISCAL	0	26447	631372	572	1122	1	Residência	Residencial horizontal padrão A
1721640010	FISCAL	FISCAL	0	23168	119470	588	1382	2	comércio, exclusivo ou misto (predominância uso)	Residencial horizontal padrão B
1721640029	FISCAL	FISCAL	0	19475	743914	583	0	0	TERRENO	TERRENO
1721640002	FISCAL	FISCAL	0	30437	631372	572	1439	3	comércio, exclusivo ou misto (predominância uso)	Residencial horizontal padrão C
1721640035	FISCAL	FISCAL	0	19695	743914	583	1382	1	Residência	Residencial horizontal padrão B
1721640064	FISCAL	FISCAL	0	22636	631372	572	1382	2	Residência	Residencial horizontal padrão B
1721640024	FISCAL	FISCAL	0	19715	743914	583	1439	2	comércio, exclusivo ou misto (predominância uso)	Residencial horizontal padrão C
1721640018	FISCAL	FISCAL	0	21138	119470	588	1654	3	apartamentos, não em condomínio, exclusivamente	Residencial vertical padrão A
1721640026	FISCAL	FISCAL	0	20234	743914	583	1382	1	Residência	Residencial horizontal padrão B
1721640022	FISCAL	FISCAL	0	19709	743914	583	1382	2	comércio, exclusivo ou misto (predominância uso)	Residencial horizontal padrão B
1721640020	FISCAL	FISCAL	0	19812	119470	588	1778	4	apartamentos, não em condomínio, exclusivamente residencial	Residencial vertical padrão C
1721840001	FISCAL	FISCAL	0	32599	183329	584	1439	1	comércio, exclusivo ou misto (predominância uso)	Residencial horizontal padrão C

Figure 33: Example of Land Registry Form for Area JA-02 (Source: PMRR)

Across these 200 risk areas, there are 206,000 dwellings mapped (*Graph 20*), of which 73% are located in areas classified as low and medium risk (R1 and R2), and 5.4% in very high-risk areas (R4).



Chart 20: Distribution of Housing Units by Risk Type[53]

When focusing on the sectors classified as high and very high risk (R3 and R4), it is found that 59% are exposed to geological risks (41,300 dwellings), 36% to hydrological risks (25,700 dwellings), and 5% to both (3,500 dwellings). *Graph 21* illustrates this comparison.

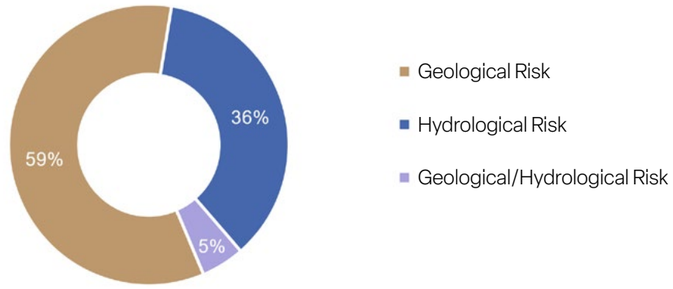


Chart 21: Distribution of Housing Units by Risk Type and Number of Areas[54]

The Subprefectures of Campo Limpo, M'Boi Mirim, Capela do Socorro, Cidade Ademar, and Freguesia do Ó / Brasilândia are those with the largest number of mapped risk areas (*Table 13*).

53 Chart prepared using data from GeoSampa, available at: https://metadados.geosampa.prefeitura.sp.gov.br/geonetwork/srv/por/catalog.search; last accessed May 15, 2024.

54 Chart prepared using data from GeoSampa, available at: https://metadados.geosampa.prefeitura.sp.gov.br/geonetwork/srv/por/catalog.search; last accessed May 15, 2024.

Table 13: Risk Areas by Subprefecture and Type of Risk[55]

SUBPREFECTURES			
NAME	**CODE**	**GEOLOGICAL RISK**	**HYDROLOGICAL RISK**
Aricanduva-Formosa-Carrão	AF	6	7
Butantã	BT	26	13
Campo Limpo	CL	39	33
Capela Do Socorro	CS	42	18
Casa Verde-Cachoeirinha	CV	22	11
Cidade Ademar	AD	26	25
Cidade Tiradentes	CT	12	3
Ermelino Matarazzo	EM	6	6
Freguesia-Brasilandia	FO	36	18
Guaianases	GU	21	0
Ipiranga	IP	5	19
Itaim Paulista	IT	13	0
Itaquera	IQ	22	15
Jabaquara	JA	13	16
Jaçanã -Tremembé	JT	24	0
Lapa	LA	7	5
M'Boi Mirim	MB	65	0
Mooca	MO	1	4
Parelheiros	PA	12	7
Penha	PE	6	0
Perus	PR	27	5
Pinheiros	PI	0	1
Pirituba-Jaraguá	PJ	22	18
Santana-Tucuruvi	ST	1	0
Santo Amaro	SA	3	7
São Mateus	SM	36	12
São Miguel	MP	7	0
Sapopemba	SB	12	8
Se	SE	0	1
Vila Mariana	VM	0	4
Vila Maria-Vila Guilherme	MG	3	0
Vila Prudente	VP	4	10
	Total	**519**	**266**

55 Developed using data from GeoSampa, available at: https://metadados.geosampa.prefeitura.sp.gov.br/geonetwork/srv/por/catalog.search; last accessed May 15, 2024.

Table 14: Population of Subprefectures and Associated Risk Areas

SUBPREFECTURES	785 AREAS			
NAME	**CODE**	**Population (2022)**	**Risk Area (2022)**	**Percentage**
Aricanduva – Formosa - Carrão	AF	268.218	1.838	0,7%
Butantã	BT	466.719	36.635	7,8%
Campo Limpo	CL	675.370	61.294	9,1%
Capela do Socorro	CS	605.595	32.505	5,4%
Casa Verde - Cachoeirinha	CV	308.008	12.848	4,2%
Cidade Ademar	AD	414.809	26.291	6,3%
Cidade Tiradentes	CT	194.280	7.744	4,0%
Ermelino Matarazzo	EM	202.374	6.972	3,4%
Freguesia - Brasilândia	FO	379.493	25.867	6,8%
Guaianases	GU	273.044	7.643	2,8%
Ipiranga	IP	480.385	9.860	2,1%
Itaim Paulista	IT	345.447	10.139	2,9%
Itaquera	IQ	549.323	27.318	5,0%
Jabaquara	JA	214.700	10.500	4,9%
Jaçanã - Tremembé	JT	284.229	25.106	8,8%
Lapa	LA	339.243	12.512	3,7%
M'Boi Mirim	MB	576.311	62.961	10,9%
Mooca	MO	377.484	1.488	0,4%
Parelheiros	PA	164.872	5.609	3,4%
Penha	PE	471.637	7.315	1,6%
Perus	PR	163.359	22.547	13,8%
Pinheiros	PI	285.391	25	0,0%
Pirituba - Jaraguá	PJ	478.808	28.915	6,0%
Santana - Tucuruvi	ST	319.320	117	0,0%
Santo Amaro	SA	271.757	611	0,2%
São Mateus	SM	453.971	23.148	5,1%
São Miguel	MP	345.769	3.886	1,1%
Sapopemba	SB	266.611	11.079	4,2%
Sé	SE	424.153	-	0,0%
Vila Mariana	VM	337.944	258	0,1%
Vila Maria-Vila Guilherme	MG	276.141	1.482	0,5%
Vila Prudente	VP	243.534	6.483	0,7%

In total, the city has 4.3% of its population living in areas subject to flood and landslide risks. Based on data from the 2022[56] IBGE census, it is possible to infer that the municipality of São Paulo had 490 thousand residents in the risk areas delimited by Civil Defense. The Subprefectures with the largest number of people living in risk areas are Campo Limpo and M'Boi Mirim (more than 60 thousand each). Comparing the number of residents in these risk areas with the total population of each Subprefecture, it is possible to see that the Subprefectures of Perus and M'Boi Mirim have more than 10% of their population living in risk areas, predominantly geological (Graph 22).

It is important to note that the data provided by the Census present a weakness when it comes to risk areas, especially in hydrological risk areas, where dwellings are located on or adjacent to water bodies. This underreporting of dwellings and residents became evident when the demographic survey for this PMRR was carried out, as detailed below.

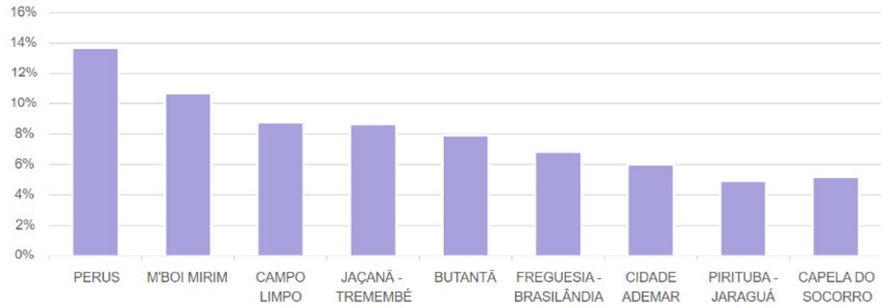


Chart 22: Population Proportion in Risk Areas (by Subprefecture) (Source: PMRR)

The deepening of knowledge about each area took place through a multidisciplinary approach (social, civil construction, geotechnics, hydrology, geology, architecture, and urban planning). Visits were made to 200 areas, 100 of which received intervention projects for risk mitigation.

The criteria for prioritizing the areas to be visited took into account the number of people in areas classified as R3 and R4 (criterion A – 50% of the score), the São Paulo Social Vulnerability Index (criterion B – 15% of the score), the existence of legal action (criterion C – 30% of the score), and the existence of mitigation works (criterion D – 5% of the score).

Figure 34 presents the distribution of risk areas based on the weighting results used for the prioritization of the areas that underwent field visits and the development of intervention projects. The list below shows an excerpt from the spreadsheet with the scores of each area for each of the criteria.

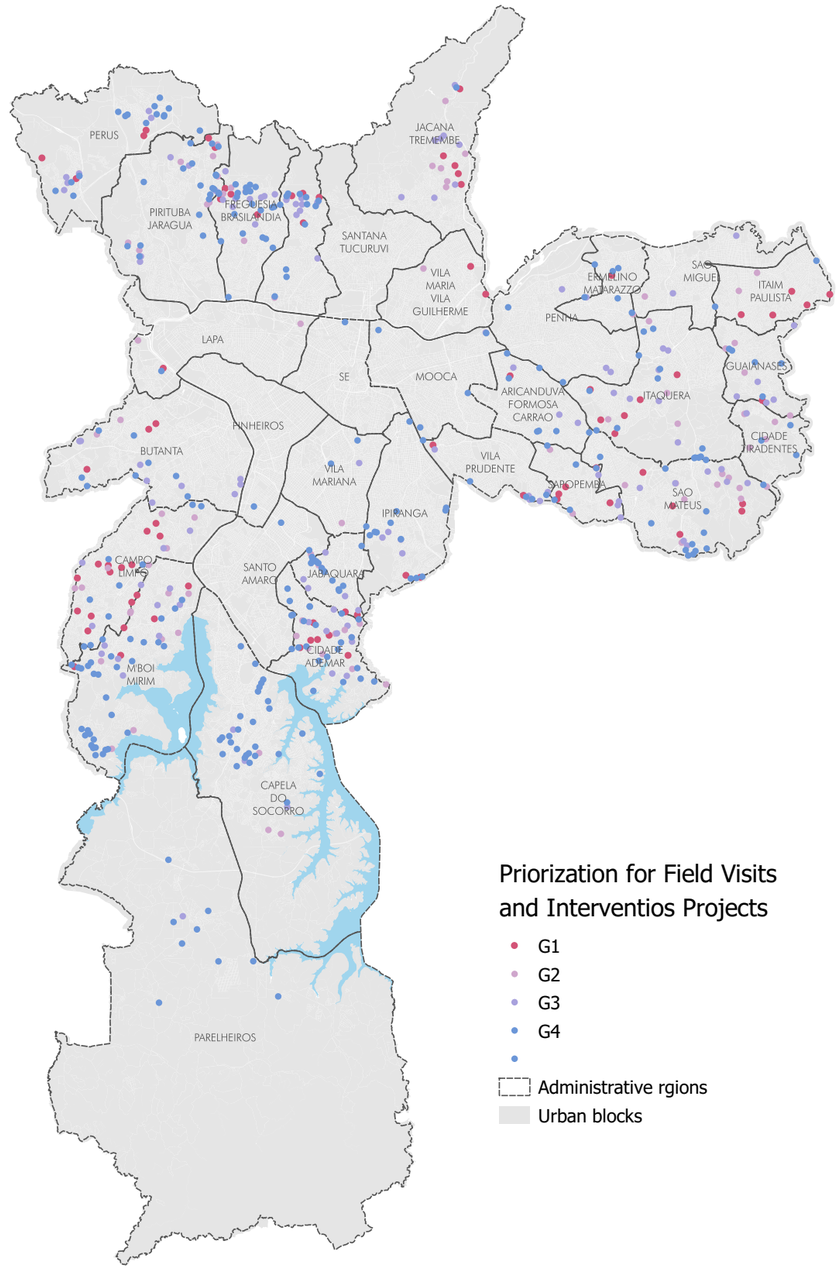


Figure 34: Prioritization of Areas for Field Visits and Development of Intervention Projects

56 BRAZILIAN INSTITUTE OF GEOGRAPHY AND STATISTICS (IBGE). Brazilian Census 2022. Rio de Janeiro: IBGE, 2024.

Figure 35 presents the activity flowchart for the areas that underwent field inspection and the development of intervention projects.

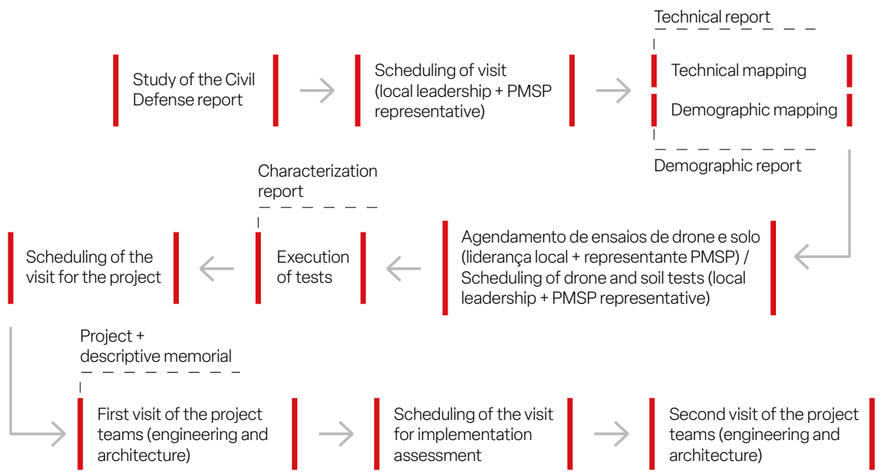


Figure 35: Workflow of Activities for Each of the Risk Areas Ranked Between 1 and 100 (Source: PMRR)

All field incursions were carried out with scheduled accompaniment by the Subprefecture, Civil Defense, or local leadership, with the presentation of the Project team and the activities to be conducted in the region. All field records were made using an application developed specifically for the PMRR, in which forms were filled out and photographic records were taken, already georeferenced for the demographic survey. The application received improvements during the field data collection to incorporate necessary features such as offline operation. This was necessary because in many areas, mobile internet signal is weak or non-existent.

DEMOGRAPHIC MAPPING

The demographic mapping was carried out in 200 (two hundred) risk areas, where social workers aimed to obtain detailed information about all dwellings. In addition to data about the housing units, information about the residents was also collected.

To infer values for the areas that were not surveyed and/or where it was not possible for the social workers to collect data *in loco*, data imputation was applied through a statistical similarity methodology — the "K-Nearest Neighbors Method" (kNN or *k-Nearest Neighbors*)[57]. This was done by considering, as variables, the different characteristics present in the dataset — in this case, the study area.

The kNN is a similarity algorithm that defines the value of an observation based on existing data. It works by identifying the "k" nearest neighbors of each data point and returning the average of these "k" neighbors as the most representative value for that data. The definition of the number "k" of nearest neighbors was made through cross-validation, a robust and intensive machine learning process that tests various parameters in search of the optimization of a metric.

For the cross-validation, the value of $k = 20$ nearest neighbors was adopted, as this k value presented the best relationship between the number of neighbors, the mean RMSE[58] (the estimator used in the validation), and the standard deviation of the RMSE. In the process of choosing the number k, attention must be paid to the fact that a high "k" can lead to results with more global aspects and, therefore, more general (and not local) outcomes. Furthermore, increasing "k" naturally produces lower average RMSE values, since the variability of the results also decreases. For this reason, the choice of "k" should not only consider the mean and standard deviation of RMSE, as this could give a "false impression" of improvement in the model as "k" increases.

57 Annex 2 presents a methodological breakdown of the k-Nearest Neighbors (kNN) algorithm.

58 The Root Mean Square Error (RMSE) is the square root of the mean squared difference between observed and predicted values. The smaller the RMSE value, the better the model's performance, as it indicates that predictions are closer to the actual values.

The table below shows some *k* values tested for applying the metric:

k	Metric	Mean	Standard deviation
2	RMSE	2.158338	0.02133973
8	RMSE	1.842161	0.018755926
14	RMSE	1.765532	0.015982613
20	RMSE	1.731072	0.016687388
26	RMSE	1.721101	0.017340139
32	RMSE	1.710381	0.016357024
57	RMSE	1.69271	0.017603044
69	RMSE	1.689102	0.017208784
75	RMSE	1.686916	0.016642691
81	RMSE	1.685189	0.016890243
87	RMSE	1.68418	0.01744233
93	RMSE	1.683187	0.017262295
100	RMSE	1.682625	0.017582213

In the case of the PMRR, the following variables were chosen to represent the profile of each sector:

- Total population of the sector (IBGE 2022)[59]
- Average number of residents per household in the sector (IBGE 2022)[60]
- Subprefecture
- Risk level (R1, R2, R3, R4)
- Type of risk (flooding, undercutting, landslide, etc.)

The use of the kNN method is justified because it is a well-established method in the scientific literature when it comes to imputing missing values. It operates under the premise that missing data behave similarly to the nearest collected data. It is used when the sample is not necessarily spatially systematic, as the method can provide a "local" estimate by considering the various adopted factors.

59 BRAZILIAN INSTITUTE OF GEOGRAPHY AND STATISTICS (IBGE). Brazilian Census 2022.

60 BRAZILIAN INSTITUTE OF GEOGRAPHY AND STATISTICS (IBGE). Brazilian Census 2022.

The robustness and consistency of the kNN are evaluated by the model's ability to provide stable estimates that are coherent with the patterns observed in the collected data. The cross-validation used in selecting the "k" value was fundamental to ensuring that the selection was rigorous, maximizing the model's predictive capacity. In this way, an optimized imputation process was ensured, taking into account the data distribution as well as the mean and variability of the results.

The performance of the kNN is reinforced by the quality and quantity of data available, ensuring that the imputation is based on observations sufficiently representative of the studied population. Thus, even in situations where sampling is not systematic or presents spatial irregularities, the method can provide consistent and reliable estimates by incorporating the similarity between sectors and adjusting to the data distribution, which reduces imputation error, especially in areas with higher data density.

Therefore, in the context of the PMRR, the use of the kNN proved to be a robust and consistent approach, as it effectively incorporates the similarity between sectors and adapts to the data distribution, resulting in a reduction of imputation error in areas with higher information density and providing more reliable estimates.

The reliability of the imputations increases as the data density within the sector grows, and the presence of sectors with similar characteristics reinforces the accuracy of the estimates. Consequently, the applied methodology provided results aligned with the demographic reality and the data distribution of the analyzed sector.

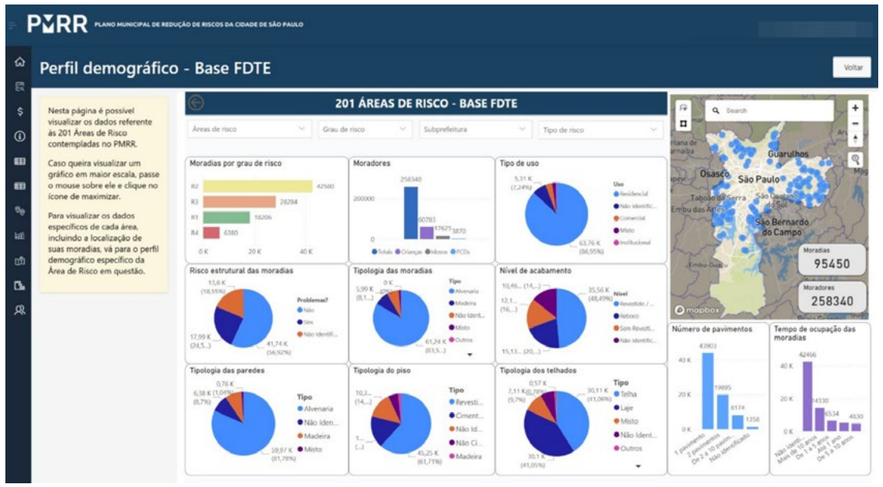


Figure 36: Application Interface Developed Specifically for PMRR Showing Demographic Survey Results (Source: PMRR System)

The information collected in summarized form was as follows:

- Residents: number of residents, families, children, elderly people, and persons with disabilities (PWD);

- Housing: number of dwellings, location, occupancy status of the house, type of use, length of occupancy, construction typology, number of floors, type of wall, type of flooring, finishing standard, type of roof, state of conservation, existence of structural problems or risks that threaten the dwelling, and occurrences of deaths on site (resulting from geological or hydrological issues).

All the forms fed into a database in which it is possible to view all the recorded information (Figure 37) and perform filters (Figure 38) and totals (Figure 39).



Figure 37: Application Interface Developed Specifically for PMRR – Pedra Sobre Pedra Area (Source: PMRR System)

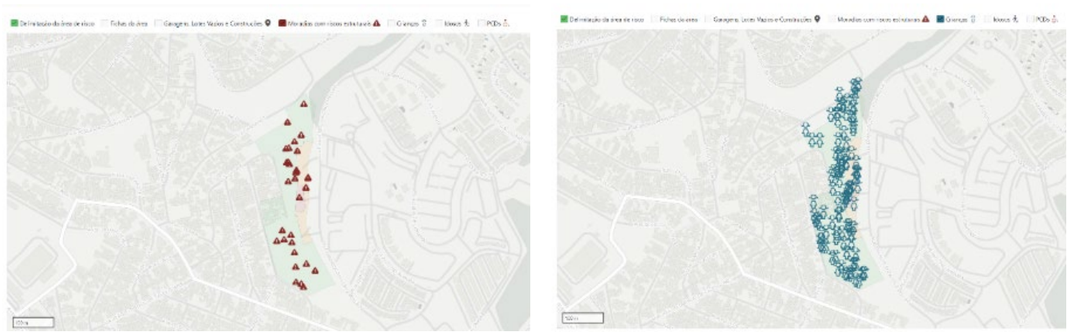


Figure 38: Application Interface Developed Specifically for PMRR – Vale das Virtudes I Area. Right: Filter Displaying Only Houses with Structural Risk; Left: Houses with Children (Source: PMRR System)

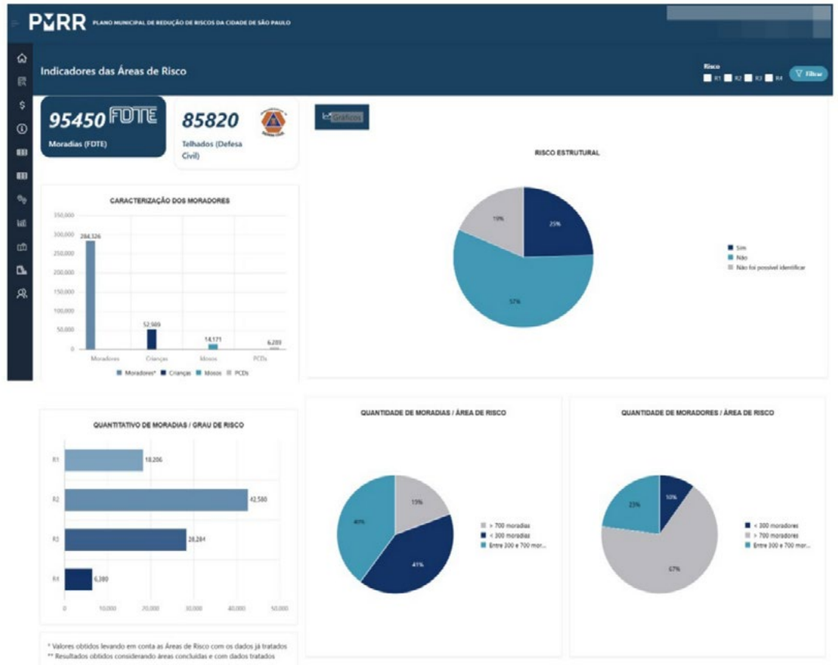


Figure 39: Indicators – Filter for R4 Areas (Source: PMRR System)

TOPOGRAPHIC MAPPING

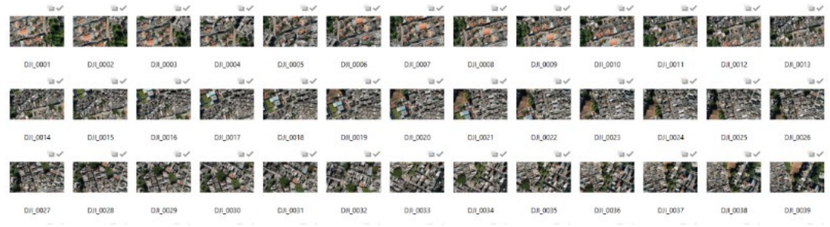
For the topographic mapping of the risk areas, a methodology combining 3D modeling and conventional topography was applied. The integration of both datasets ensured the reliability of the results obtained in the processing (Figure 40).

The 3D model generated through drone surveys enabled the traceability of information in areas with difficult access—a crucial characteristic of risk areas—along with the generation of DTM (Digital Terrain Model) and DSM (Digital Surface Model) data.

The topographic survey validated key interference data essential for developing hydrological risk mitigation solutions, such as the depth of stormwater drainage networks and the streambed elevation, as illustrated in Figure 41.

As a result, the integrated topographic mapping produced georeferenced data, providing the necessary foundation for implementing solutions aimed at mitigating and/or eliminating hydrological and/or geological risks.

A



B

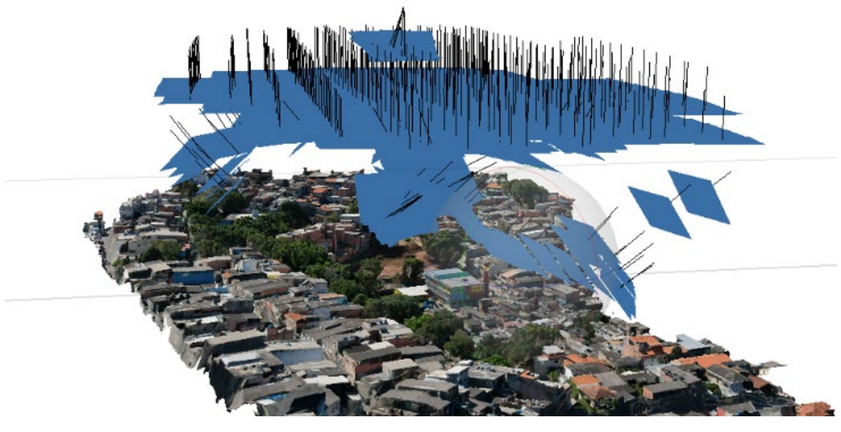


Figure 40: Image Processing and 3D Model Development. a) Field Images Imported into the Processing System. b) Arrangement of Collected Images, Positions, and Angles for Greater 3D Model Detail (Source: PMRR)

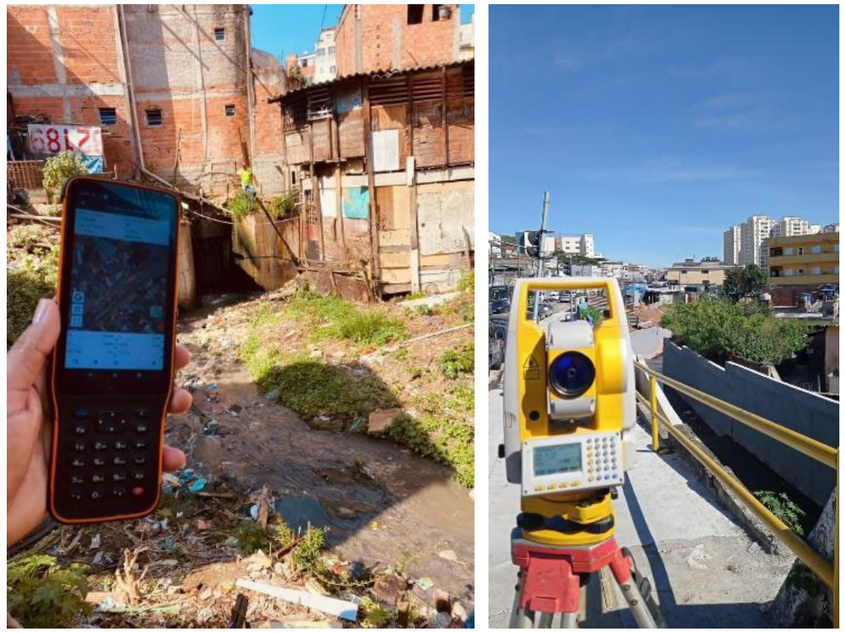


Figure 41: Complementary Topographic Survey (PMRR)



Figure 42: Measurement of Drainage Network Elevation



Figure 43: Validation of Measurements and Georeferenced Alignment

TECHNICAL GEOLOGICAL–GEOTECHNICAL MAPPING

The geological and geotechnical mapping aims to characterize soil, rocks, water sources, vegetation morphology typology, and patterns of land occupation, as well as to identify signs of instability in slopes.

Figure 44 illustrates the types of evidence collected during field visits and used for the technical characterization of risk areas.





Figure 44: Illustrative Images Collected During Field Visits for Geological-Geotechnical Mapping of Risk Areas. First: Nova União Area Showing Ground Cracks and Landslide Features; Second: Vila Cais Area Showing Soil Delamination (Source: PMRR)

After mapping, the investigation of soil layers begins, following these steps:

- Field visit to recognize the risk area and the affected community, and to assess equipment accessibility;

- Definition of criteria for determining the need for geotechnical testing in risk areas;

- Execution of drilling and geophysical tests;

- Identification of layers of interest for collecting undisturbed samples; Laboratory testing for characterization and strength (grain size distribution, physical indices, and shear strength of undisturbed samples);

- Geological–geotechnical profile modeling and stability analysis.

The drilling points were located as close as possible to sectors classified as very high risk (R4) or with a history of incidents. At least one investigation was conducted near the crest (top) of the slope, one in the middle, and another at the lowest section (see figure below).

In geological risk areas, more boreholes and greater depths were carried out than in hydrological risk areas.
In total, 850 percussion drilling holes were executed, totaling 4,500 meters. Figure 45 illustrates the execution of a percussion drilling.

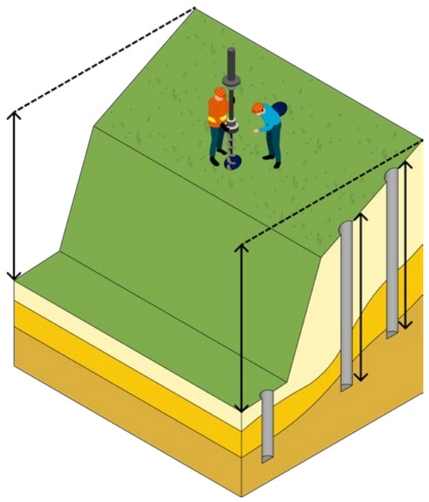


Figure 45: Schematic Sketch of Preferred Borehole Locations Relative to the Slope Profile and Target Depth (Source: PMRR)



Figure 46: SPT Drilling (Source: PMRR)

For stability analysis, a computational model of the slope was developed, incorporating all field and laboratory data.

Figure 47 illustrates the stability analysis of a slope that presented a safety factor below the acceptable limit, indicating the need for a retaining structure. This type of analysis was repeated every 20 meters (distance between sections) in all geological risk areas with intervention projects.
The detailed development of these solutions is carried out during the design phase.

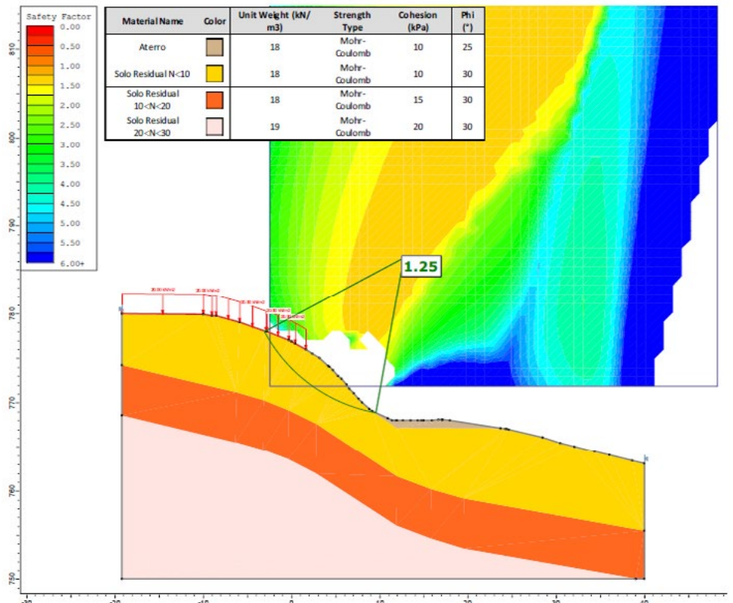


Figure 47: Stability Analysis (Source: PMRR)

TECHNICAL HYDROLOGICAL MAPPING

The hydrological survey follows these steps:
a. Hydrological characterization of the area
b. Hydrological study
c. Hydraulic design
d. Drainage area characterization
e. Evaluation of existing infrastructure
f. Diagnosis and intervention proposals

The hydrological characterization of the region involves assessing the basin and sub-basins where the area is located, the land use, and the vegetation cover associated with it. Figure 48 shows an example of basin identification for one of the study areas.

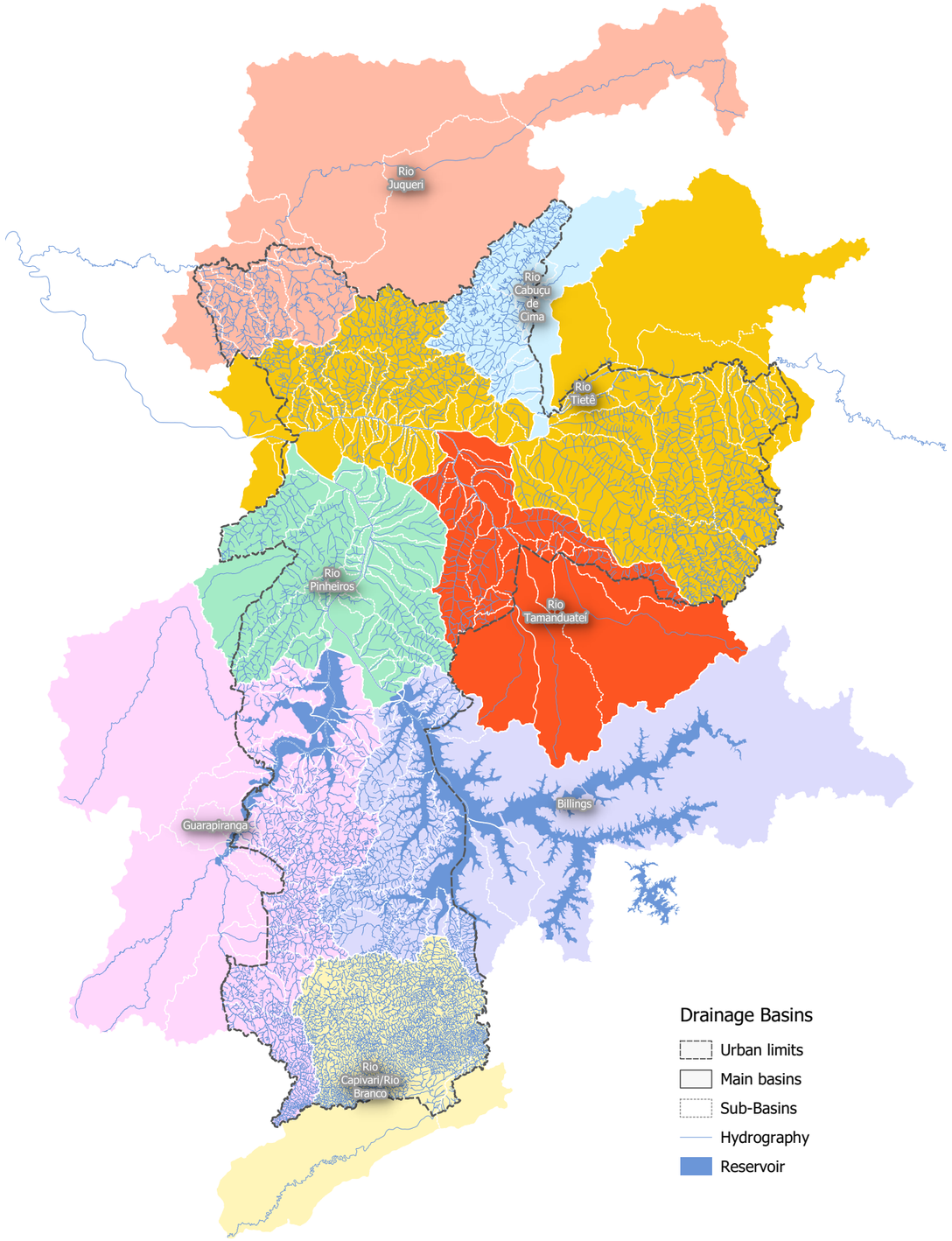


Figure 48: Hydrological Map of the Municipality of São Paulo (Source: PMRR)

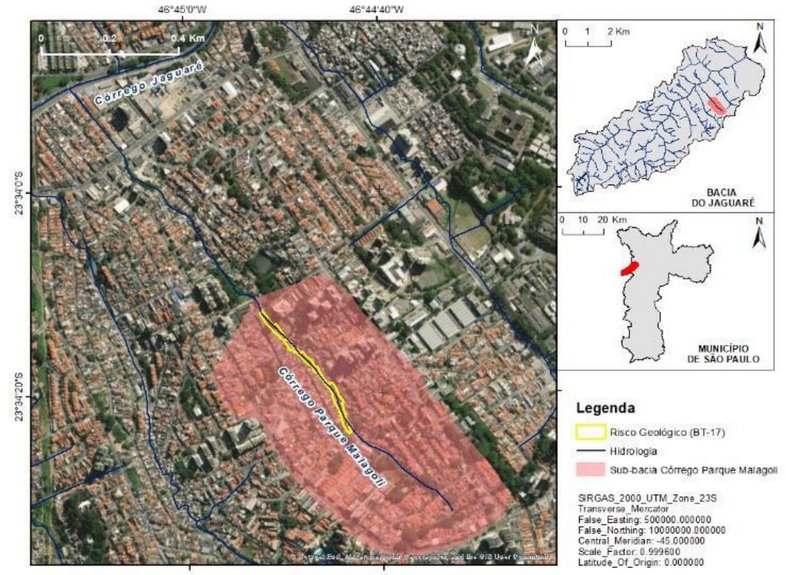


Figure 49: Drainage Area Highlighting the Location of the Risk Zone (Source: PMRR)

Land use and occupation are determined based on field surveys and drone imagery analysis, as described in the topographic survey. Figure 50 exemplifies one of the study areas, showing horizontal settlements of medium and low income (brown and yellow polygons, respectively), vertical settlements of medium and high income (pink polygons), and green areas corresponding to parks and vacant lots (green polygons).

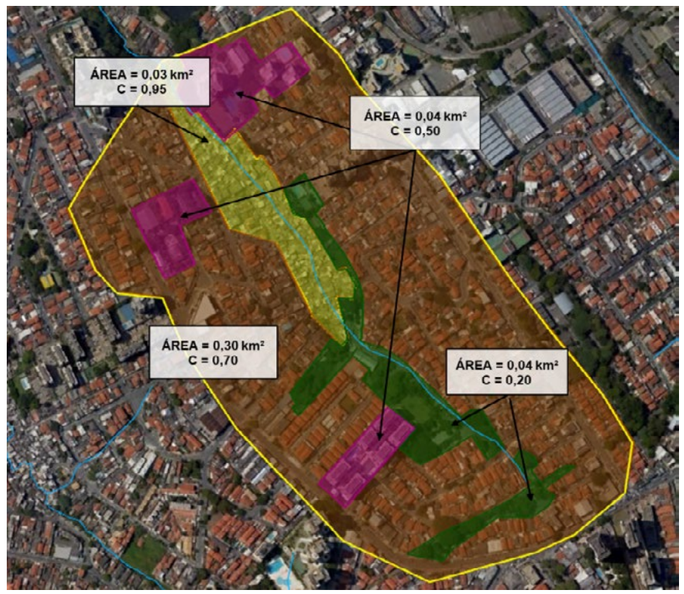


Figure 50: Land Use and Occupation in the Sub-basin with Corresponding Runoff Coefficient (C) Adopted for Each Area (Source: PMRR)

The impermeabilization rate is calculated based on the estimated existing permeable surface area. Permeable areas are defined according to vegetation cover, street trees, and exposed soil zones.

The infrastructure assessment seeks to identify the presence of macro- and microdrainage works, as well as the existence of a sanitary sewage system in the area.

Finally, the volume of water reaching the watercourse is quantified for a 100-year return period (TR100), and the need for intervention works to minimize risks is evaluated.
Below are photographs illustrating the conditions observed in the field.



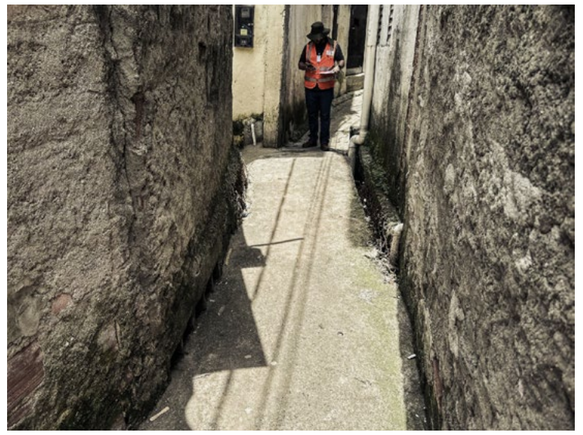
Figure 51: Field Visit Photo – IQ-07 “Maré Vermelha I” – Canal with Narrowed Section Due to Occupation; Note the Large Amount of Waste (Source: PMRR)



Figure 52: Field Visit Photo – FO-29 “Tribo.” Raw Sewage Discharge into the Stream; Note the Large Amount of Waste (Source: PMRR)



Figure 53: Field Visit Photo – BT-17 “Nossa Senhora da Assunção.” Channel in Its Original ConFigure tion Covered by Housing; Note the Large Amount of Waste (Source: PMRR)



Passagem sobre córrego tamponado do Setor HAD-02-02



Córrego tamponado com a presença de lançamento de esgoto, lixos e entulhos no Setor HAD-02-02



Dispositivo de drenagem das águas de chuva no Setor HAD-02-02



Dispositivo de drenagem das águas de chuva no Setor HAD-02-02

Figure 54: Field Visit Photos – HAD-02 “Sebastião Afonso” (Source: PMRR)

METHODOLOGY FOR THE DEVELOPMENT OF INTERVENTION PROJECTS

The study of intervention alternatives aimed at reducing geological and hydrological risk situations in specific areas takes into account a set of factors, including: relevant legislation (especially environmental licensing), technical suitability of the proposed solution to the site's characteristics, preservation of green areas, and minimization of expropriation needs.

The solutions evaluated vary widely — from the simplest and least invasive measures (for example, the implementation of a simple drainage system on slopes or the installation of a green soil-nailing system in specific points) to the most substantial and comprehensive interventions, which may require the partial or total relocation of residents due to the need for increasing the cross--section of watercourses.

In addition to containment and stream-channeling solutions, urban design interventions were also developed for certain areas. These not only help prevent reoccupation but also reflect a structured and holistic process, aiming to ensure integrated access for the population to urban infrastructure and city services.

After the technical solution is proposed, the project team conducts a field visit to validate the proposed alternative and make any necessary adjustments. The document referred to as the "project" reaches a level of detail that enables the preparation of a preliminary budget, in accordance with the standards required for immediate tendering.

For slopes, the impacts on slope stability are evaluated at 20-meter intervals, comparing the conditions before and after the proposed intervention. Figure 55 presents the new safety factor of an area after the proposed intervention, which in this case consists of a combination of conventional soil nailing with a concrete facing and green soil nailing, spaced every 2.0 meters (the safety factor increased from 1.25 to 1.53 after the proposed intervention).

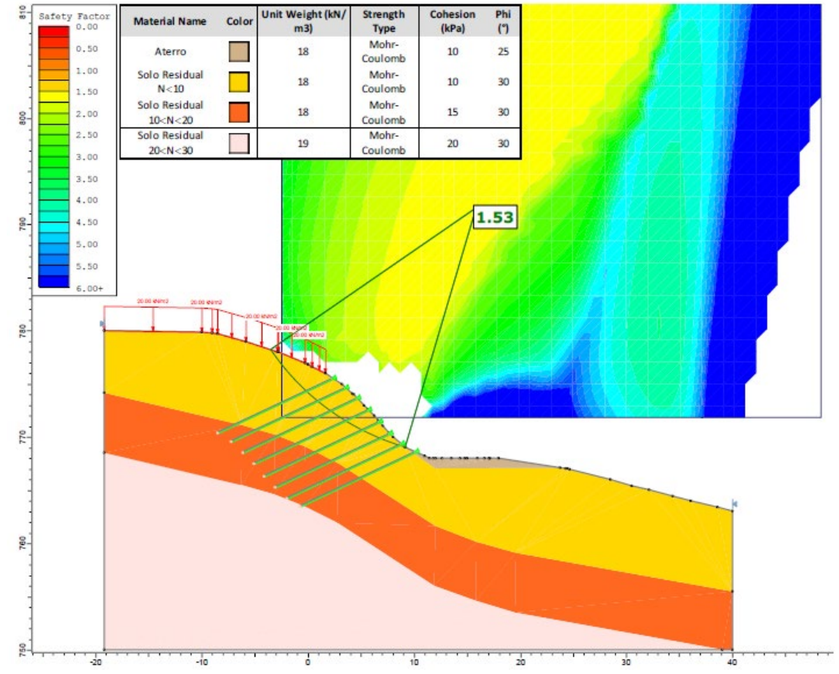


Figure 55: Proposed Solution Using Soil Nailing – Combination of Conventional Soil Nailing with Concrete Facing and Green Soil Nailing (Source: PMRR)

For streams, interventions were designed to ensure a freeboard of 0.40 meters in the watercourse during peak flow for a 100-year return period (TR100).
The channeling alternatives considered include the use of precast elements and gabion structures, as shown in Figures 56 and 57, respectively.

It is important to emphasize that the evaluated alternatives were not limited to simple stream channeling. The need for reinforcement of the existing micro-drainage network and the construction of on-site and off-site reservoirs, such as in the HAD-16 Zavuvus area, were also assessed.

After defining the most appropriate technological solution for each location, the quantities required for budget preparation were determined.
As the final stage, the cost estimation of the proposed interventions was carried out, using as the main reference the SIURB unit price table and applying a BDI (Indirect Expense Benefit) rate of 24.31%.

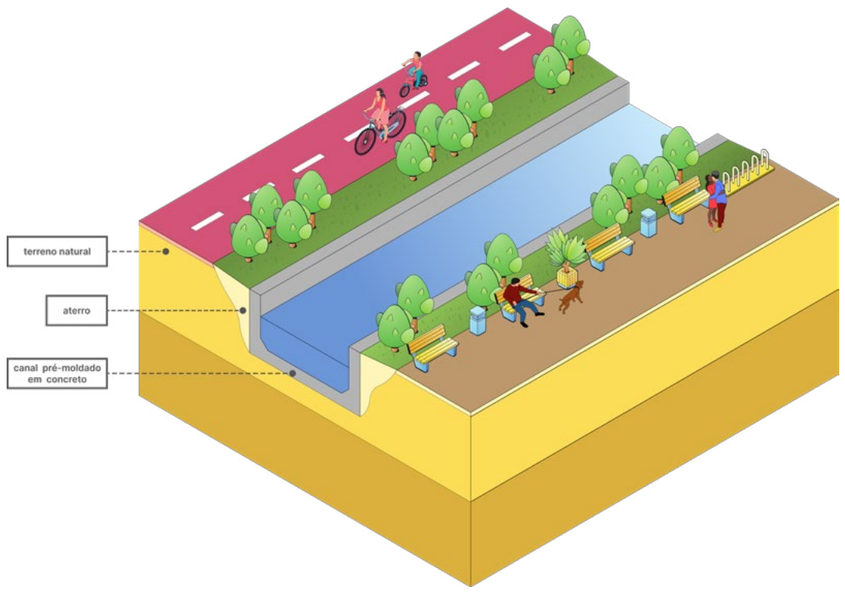


Figure 56: Schematic of Prefabricated Channeling (Source: PMRR)

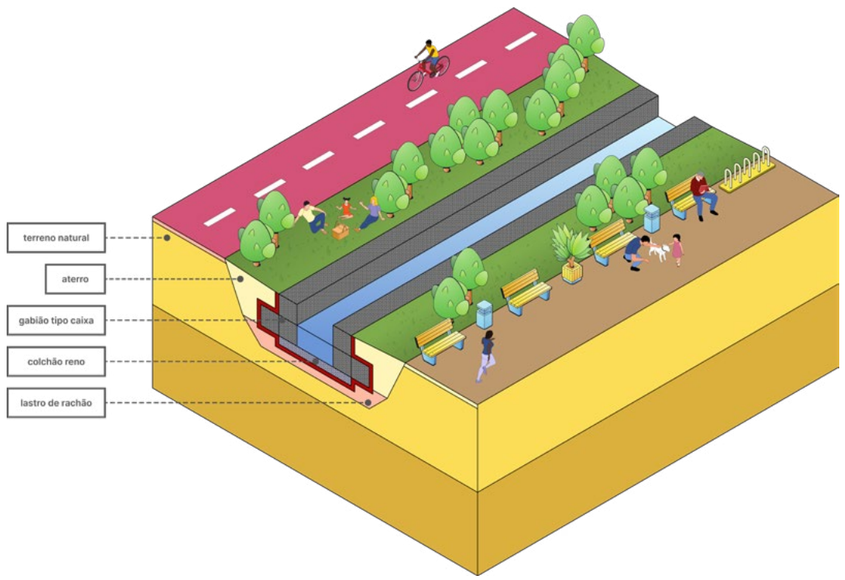


Figure 57: Schematic of Gabion Channeling (Source: PMRR)

MAIN RESULTS OF THE FIELD STAGE

All results in this section refer to the two hundred surveyed areas.

The field data show that, in 2024, the risk areas in the municipality of São Paulo are predominantly small (with fewer than 300 housing units). Only 11% have more than 700 dwellings and can therefore be considered large (Figure 23).

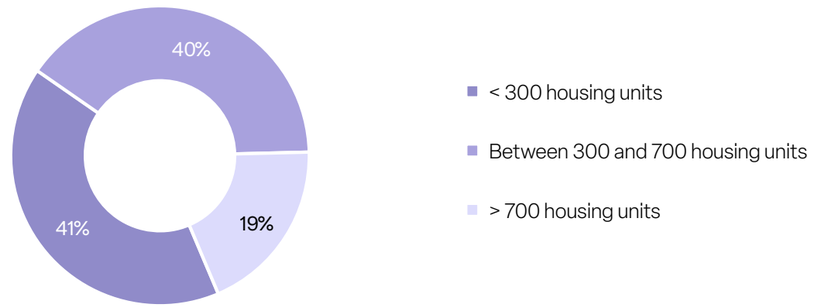


Chart 23: Typology of Risk Areas According to the Number of Existing Housing Units (Source: PMRR)

In total, over 95,000 dwellings were registered (Figure 24), of which approximately 7% are located in areas classified as very high risk for natural disasters (R4), 40% as high risk (R3), 37% as medium risk (R2), and 16% as low risk (R1).

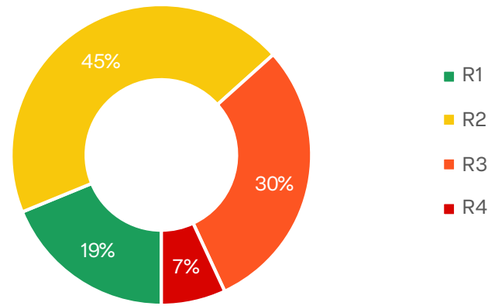


Chart 24: Percentage of Housing Units by Risk Class (Source: PMRR)

The average number of residents per dwelling measured in this sample is 2.71, which is very similar to the value measured in the latest IBGE Census (2.75).
The residents are primarily adults (Figure 24), with 16% being children, 4% elderly, and 1% persons with disabilities (PWDs).

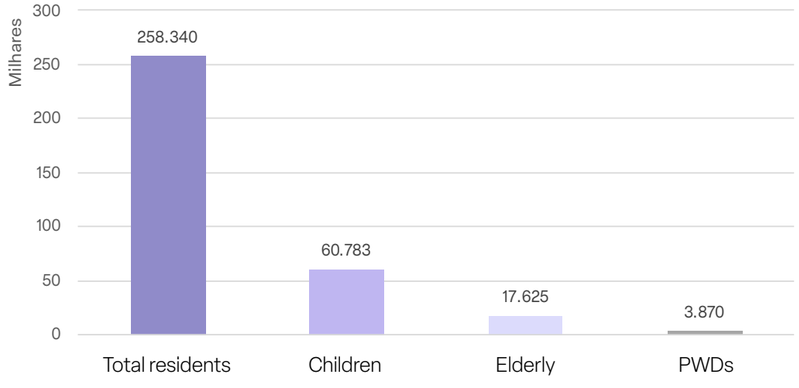


Chart 25: Population Characterization in Risk Areas (Source: PMRR)

Figure 26 presents a segmentation of residents by risk level. The table below provides the corresponding description by Subprefecture.

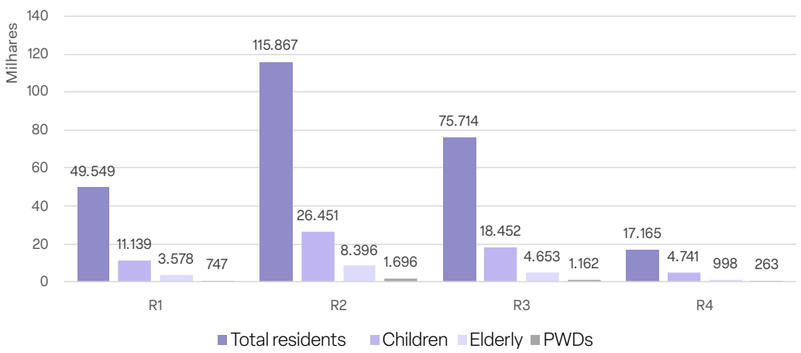


Chart 26: Segmentation of Residents by Risk Level (Source: PMRR)

Table 16: Description of Housing Units and Residents by Subprefecture

SUBPREFECTURE	Housing Units	Residents
Aricanduva – Formosa - Carrão	170	533
Butantã	2803	7408
Campo Limpo	14406	37928
Capela do Socorro	2588	7364
Casa Verde - Cachoeirinha	1889	5495
Cidade Ademar	7210	18149
Cidade Tiradentes	3725	11015
Ermelino Matarazzo	820	2408
Freguesia – Brasilândia	6847	19208
Guaianases	2091	5769
Ipiranga	905	2293
Itaim Paulista	408	1028
Itaquera	6165	16757
Jabaquara	2341	6088
Jaçanã – Tremembé	7778	21024
Lapa	775	1956
M’Boi Mirim	12981	33238
Penha	509	1576
Perus	974	2835
Pirituba – Jaraguá	1293	3737
Santo Amaro	130	265
Sapopemba	5493	15148
São Mateus	9208	25170
São Miguel	681	1877
Vila Maria – Vila Guilherme	1039	3358
Vila Mariana	78	264
Vila Prudente	2143	6449

Comparing these results with those provided by the latest IBGE Census, it was found that the number of residents identified in risk areas during fieldwork is, on average, 45% higher (median of 50%). In seven Subprefectures—Ermelino Matarazzo, Itaim Paulista, Lapa, Penha, Perus, Pirituba-Jaraguá, and São Miguel Paulista—the IBGE data were considerably higher.
In all other Subprefectures, the specific survey conducted for this study indicated a population between 15% and 41% higher (median of 68%).

Each risk area has, on average, 1,200 inhabitants, with 24 areas having fewer than 300 residents and 38 areas with more than 2,000.
The risk area with the largest population is Jova Rural II (JT-01), with over 8,000 inhabitants, followed by Felicidade, Jardim Colonial, and Recanto Verde II, each with more than 4,400 residents.

The buildings present in the surveyed risk areas were predominantly residential (87%), which, together with commercial and mixed-use buildings, account for a total of 92% (Figure 27).

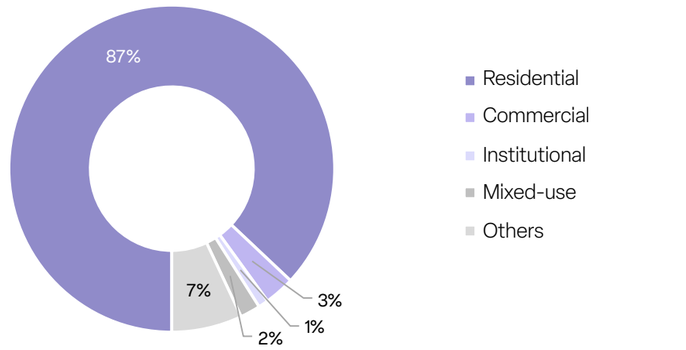


Chart 27: Type of Building Use in Risk Areas (Source: PMRR)

Most of the constructions are masonry buildings (90%), followed by wooden structures (9%) (Figure 28).

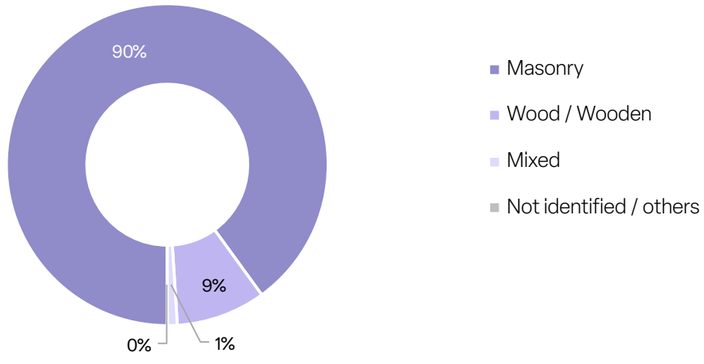


Chart 28: Predominant Building Material in Risk Areas (Source: PMRR)



Figure 58: Example of a Mixed Masonry and Wood Building Over the Stream, Sector HCV-05-01 – R3 (Source: PMRR)

It is important to note that, when segmentation is performed only for areas classified as R4, there is a very significant decline in construction quality, with more than 27% of the dwellings built in wood. Many of these have stilt-house characteristics, extending over water bodies (Figure 29).

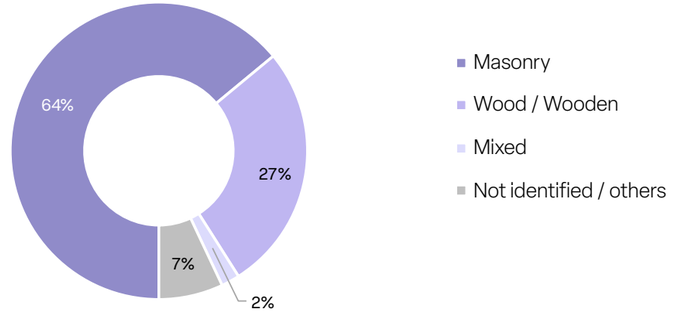


Chart 29: Construction Typology for Areas Classified as R4 (Source: PMRR)



Figure 59: Example of a Precarious Wooden Building in Area CL-31 – R4 (Source: PMRR)

Regarding structural risk, 25% of the buildings show some type of visible structural damage (such as major cracks, uneven floors, or a history of structural movement). In 57% of the cases, no signs were observed, as shown in Figure 30. In absolute terms, this means that 196,000 residents live in homes presenting some level of structural risk.

When the analysis is restricted to very high-risk areas (R4), approximately 99% of the houses present some form of structural risk.

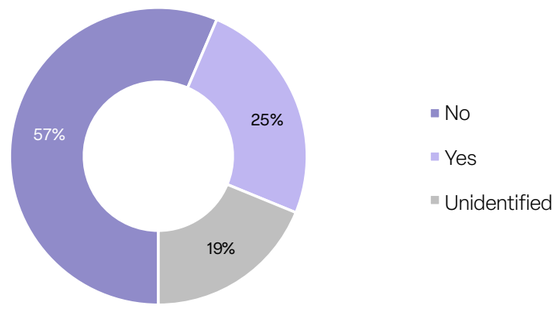


Chart 30: Housing Units with Structural Risk (Source: PMRR)

As for the number of floors, single-story buildings predominate (61%), followed by two-story (28%) and three-story (10%) buildings (Figure 31).

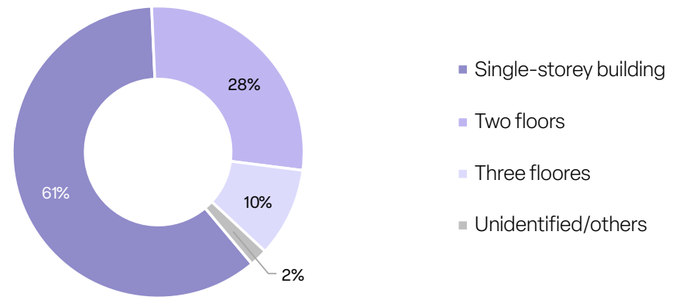


Chart 31: Number of Floors in Housing Units Located in Risk Areas (Source: PMRR)

A global analysis of the finishing conditions of dwellings in risk areas shows that 48% have wall cladding and 62% have floor finishing. More detailed data on the aesthetic finishes of the houses are presented in Figures 32 and 33.

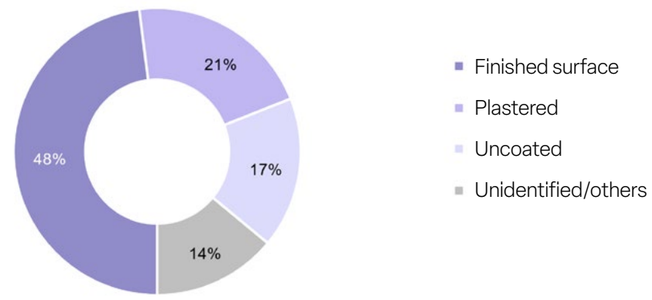


Chart 32: Predominant Wall Finishing in Risk Areas (Source: PMRR)

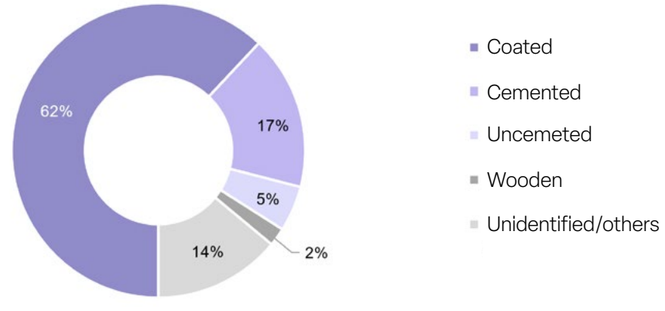


Chart 33: Predominant Floor Finishing in Risk Areas (Source: PMRR)

It is observed that, even though the dwellings are located in risk areas, there is a clear concern with their aesthetic finish on the part of the residents. It can also be noted that, as the area's risk level decreases, homes tend to show greater investment of time and resources by their occupants.

MAIN RESULTS OF THE PROJECTS STAGE

The development of the area projects throughout the PMRR followed the primary guideline of eliminating risks to the directly affected population while minimizing the need for population relocation. Thus, the adopted approach prioritized targeted interventions that reduced displacements and expropriations.

In general, slope containment projects proved more effective in meeting this main guideline, since the proposed interventions could be more localized, focusing on regions that presented safety factors below 1.5, according to the NBR 11682:2009 standard. An example is shown in Figure 60, referring to the Nova Jaguaré III area (LA-03). However, there were cases such as Barrocada III (JT-21), also shown in Figure 60, where it was necessary to propose interventions in multiple sectors to mitigate geological risks, leading to an increase in removals and expropriations.

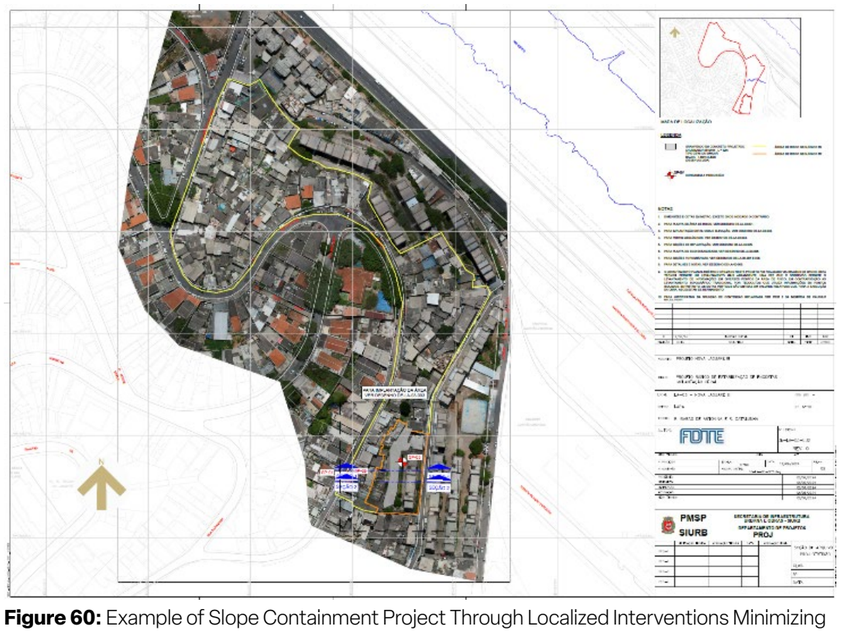


Figure 60: Example of Slope Containment Project Through Localized Interventions Minimizing the Need for Relocation in Area LA-03 – Nova Jaguaré III (Source: PMRR)

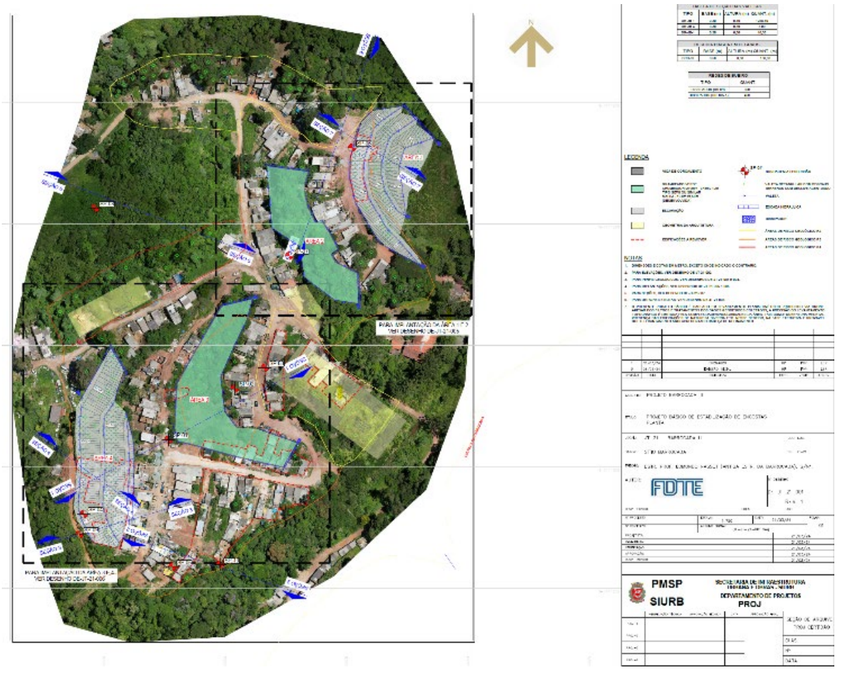


Figure 61: Example of Slope Containment Project Requiring Large-Scale Population Relocation in Area JT-21 – Barrocada III (Source: PMRR)

For geological risk areas, six solution typologies were specified, with the soil nailing technique, combined with projected concrete or vegetated surfaces, being applied in over 83% of cases (Figure 34).

Soil-nailing solutions are precisely those that require fewer removals, with the green nailed-soil technique offering the major advantage of maintaining soil permeability. Both approaches, however, require special attention to the hydraulic devices placed at the crest of the slope, which control water infiltration.

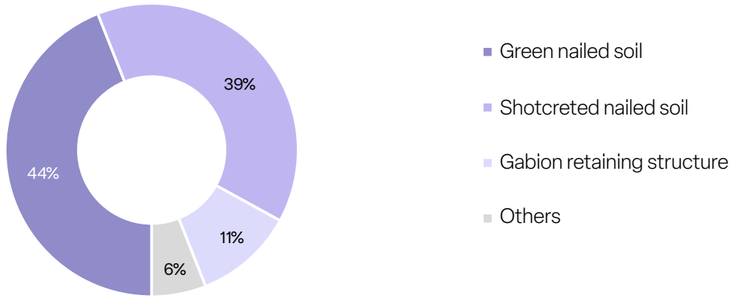


Chart 34: Distribution of Construction Typologies Specified for Geological Risk Mitigation (Source: PMRR)

In contrast, for hydrological risk areas, the population is directly impacted, and the need for removals or expropriations to carry out the works was considerably greater. An example is shown at Córrego do Bispo (Figure 62), where it was necessary to remove nearly the entire occupied perimeter and the tributaries within the area of interest.

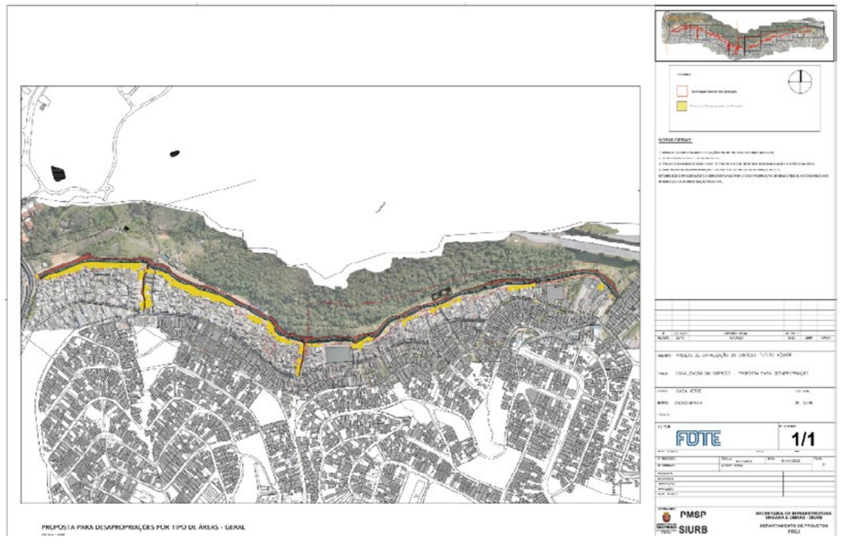


Figure 62: Example of Significant Population Relocation/Expropriation Required for Implementation of the Proposed Intervention to Mitigate Hydrological Risk (Source: PMRR)

This stems from two main reasons:

The increase in channel cross-section, needed to accommodate flow from a 100-year return period rainfall event; and the large number of houses improperly built over the watercourse, which must be removed for project execution (Figure 63).

An example of an area where the channel was enlarged to meet the TR=100 condition is shown in Figure 64 (Papaterra area). The channel had to be widened from 2.5 m to 4.0 m, and its depth increased from 1.5 m to 2.0 m.



Figure 63: Illustration of Houses Built Over Water Bodies in Hydrological Risk Areas Requiring Relocation – Area MG-03 “Vila do Sapo” (Source: PMRR)

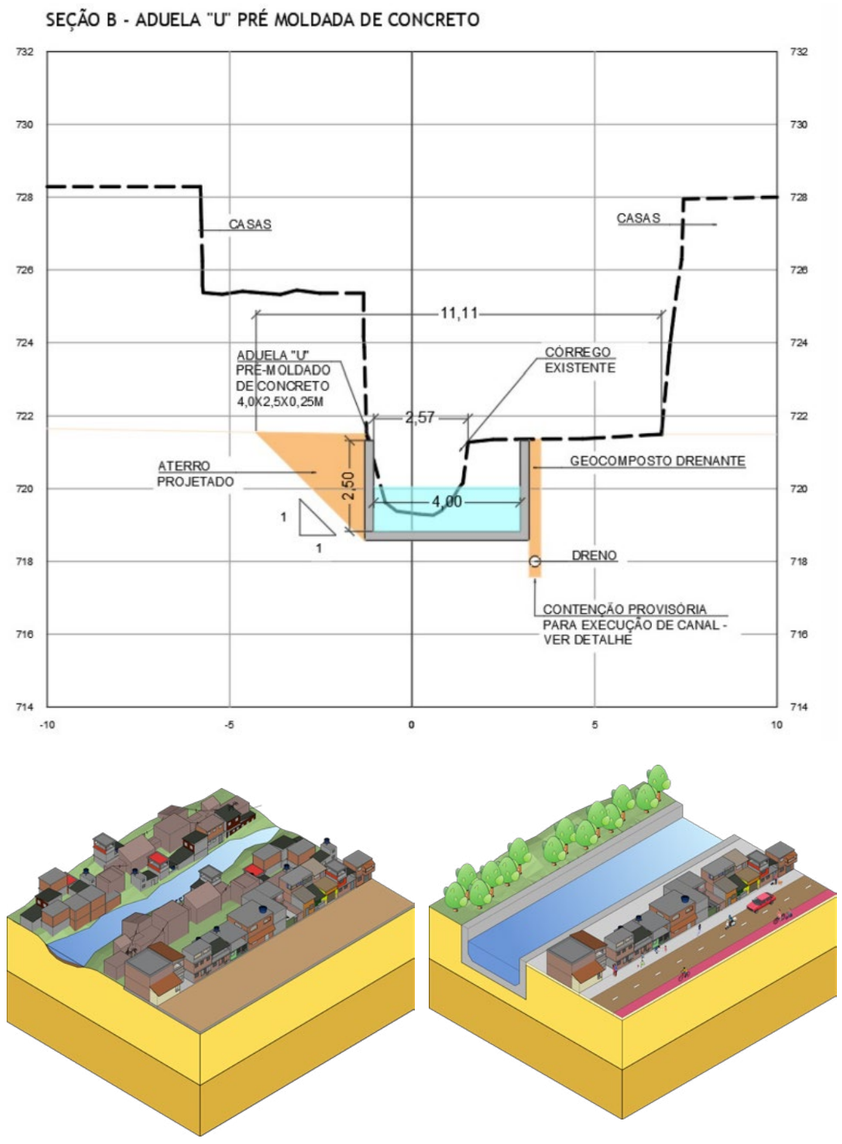


Figure 64: Example of Channel Widening as a Result of TR100 – Papaterra Area (Source: PMRR)

For hydrological risk areas, four typologies of solutions were defined. Among these, stream channeling works accounted for 95% of all proposed interventions, with only three construction types specified: Precast concrete box culverts, Cast-in-place concrete, and Gabion structures.

Concrete-based solutions were specified in 96% of the 126 km of planned channeling works (see Chart 35), in response to a requirement from the Municipal Public Administration.

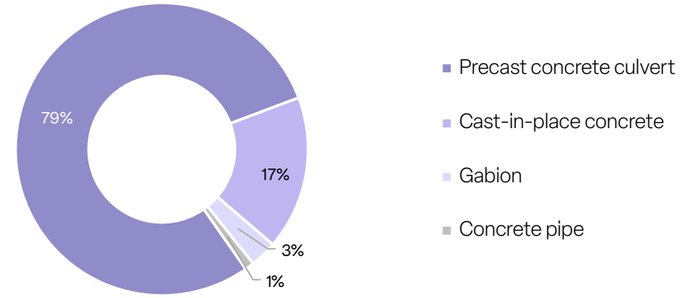


Chart 35: Percentage of Length for Hydrological Risk Mitigation According to the Specified Construction Typology (Source: PMRR)

The analysis of hydrological risk area projects allows for the following conclusions:

- In headwater areas, channels had smaller cross-sections, but were often associated with geological risks, mainly bank erosion (e.g., Jardim Eliane and Fazenda da Juta);

- In lower-basin areas, channels were larger and had greater impacts, due to the higher population density directly affected (e.g., Córrego do Bispo and Jardim Mitsutani);
In mid-basin areas, the solutions were more complex to specify, as they required greater coordination with existing drainage infrastructure (both micro and macrodrainage), as seen in Camarazal and Francisco Munhoz;

- Extensive coordination with the PDD team was required, since stream channeling generates downstream impacts beyond the immediate risk areas. This coordination proved highly effective in developing more rational solutions for the city.

The estimated budget for the interventions of the projects developed used January 2024 as the base date and totaled R$ 1.062 billion. More than half of the budgets were below R$ 10 million, and only 11 projects exceeded R$ 20 million. Figure 36 illustrates the distribution of the project area budgets.

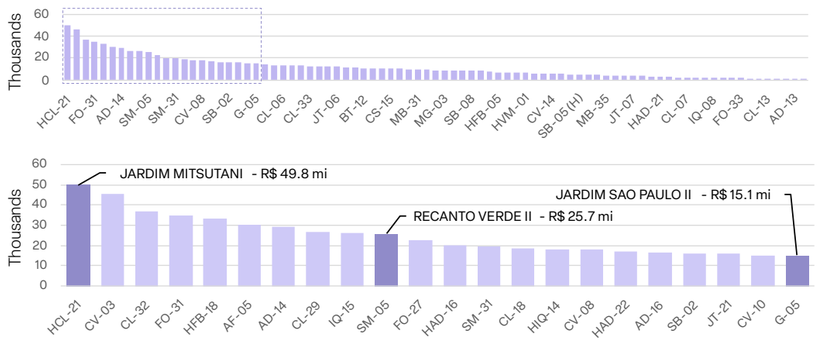


Chart 36: Budgets from Projects Developed Throughout the PMRR, Highlighting Areas with Budgets Above R$15 Million (Source: PMRR)

The budgets for areas with geological risks total R$ 515 million, those with only hydrological risks amount to R$ 77 million, and the remainder covers areas with both hydrological and geological risks.

GLOBAL INVESTMENT PLAN ARISING FROM INTERVENTIONS

The high presence of risk areas in the Municipality brings the need for a large volume of investments to address this problem. In this document, the issue is approached from two perspectives, as follows.

The first is aimed at carrying out interventions in areas involving slope containment works and stream rectification. The second concerns the construction and provision of new housing units for families that will need to be relocated, either to prevent accidents or to enable the execution of the planned works.

In the first part, a set of indicators was developed based on the projects carried out during the development of this PMRR and already described previously. Table 17 below presents the indicator that proved to be the most promising for each risk level (R1, R2, R3, and R4), disregarding expropriation costs. This is the indicator that will be used to measure the investment requirements.

Table 17: Unit Values Used in Projects Developed for Mitigation According to the Sector Risk Level

Unit Values (Base Date: November/2024)	R1	R2	R3	R4
BRL/m²	R$ 138,12	R$ 204,29	R$ 584,69	R$ 747,85
BRL/household	R$ 9.392,5	R$ 14.691,94	R$ 45.496,67	R$ 70.404,96

The data show that the unit values for the requalification of areas assessed as high risk by the Civil Defense (R3 and R4) are considerably higher than those classified as medium and low risk (R2 and R1). This was observed for both hydrological and geological risks.

The main explanations are related both to the need for larger and more complex interventions, and to the smaller number of housing units and residents in the R3 and R4 areas.

In addition to the values directly related to the implementation of the interventions, it was established that the development of projects and the soil investigations required for their preparation amount to 5% of the project cost.

The table below summarizes the quantities of risk areas, segmented by risk typology.

Table 18: Summary of Quantitative Data on Risk Areas (Source: PMRR)

Quantities	R1	R2	R3	R4
Area (m²)	3.570.995,00	9.613.479,00	4.592.197,00	1.426.533,00
Housing Units (units)	44.451	106.935	45.574	11.244

Table 19: Values by risk level, area, and number of housing units

Global Investment	R1	R2	R3	Total
BRL/m²	R$ 493.225.829	R$ 1.963.937.625	R$ 2.685.011.664	R$ 6.209.007.822
BRL/housing unit	R$ 417.507.796	R$ 1.571.082.604	R$ 2.073.465.239	R$ 4.853.689.008
Projects	R$ 24.661.291	R$ 98.196.881	R$ 134.250.583	R$ 310.450.391

Based on this method, slightly more than R$ 6.2 billion will be required, adopting a conservative premise of using the highest calculated value and the R$/m² indicator (other results being disregarded). It is worth noting that all risk areas were considered for this calculation, except those that were deactivated by the Civil Defense. The costs for project development totaled approximately R$ 310 million, according to the previously mentioned premise.

In the second approach, the projects allow for the estimation that, in areas with geological risks, removals occur only in sectors classified as high and medium risk (R3 and R4). These removals affect 30% of the existing housing units in the sector. When geological and hydrological risks overlap, this percentage rises to 50%, while in areas with hydrological risk classified as R3 and R4, this percentage reaches 90% of the existing housing units. All these values were established by FDTE.

The number of housing units considered is presented in Table 20.

Table 20: Number of residents by risk level considered

RISK	R1	R2	R3	R4
Geological	41.287	87.961	32.525	8.820
Geological/Hydrological	978	5.215	3.058	487
Hydrological	2.186	13.759	9.991	1.937
Total	44.451	106.935	45.574	11.244

Table 21 summarizes these percentages and totals the number of housing units to be removed for each of the risk classes based on GeoSampa, dated May 1, 2024. Consequently, it is estimated that slightly more than 27.000 housing units will need to be provided for the population directly affected by interventions in risk areas.

Table 21: Summary of Relocations

Relocation Requirement	Geological	Hydrological	Geological/Hydrological
	R4/R3	R4/R3/R2	R4/R3
Existing Housing Units	41.345	25.687	3.545
Relocation Rate	30%/30%	90%/90%/20%	50%/50%
Required Relocations (units)	12.404	13.487	1.773

For the investment estimate, the following premises were adopted:

Housing unit value: R$ 210,000.00 (lowest value)61

Rental assistance value: R$ 600.00/month per housing unit62

Rental assistance period: 24 months63

Thus, an amount close to R$ 6.3 billion would be required to provide new housing units for the people whose homes will need to be expropriated during the interventions. Of this total, approximately R$ 266 million would be allocated solely for rental assistance payments.

Figure 37 presents the values according to the risk typology. For areas with geological risks, an estimated R$ 2.7 billion would be required for new housing. For hydrological risks, R$ 3 billion, and for combined geological and hydrological risks, slightly less than R$ 0.4 billion.

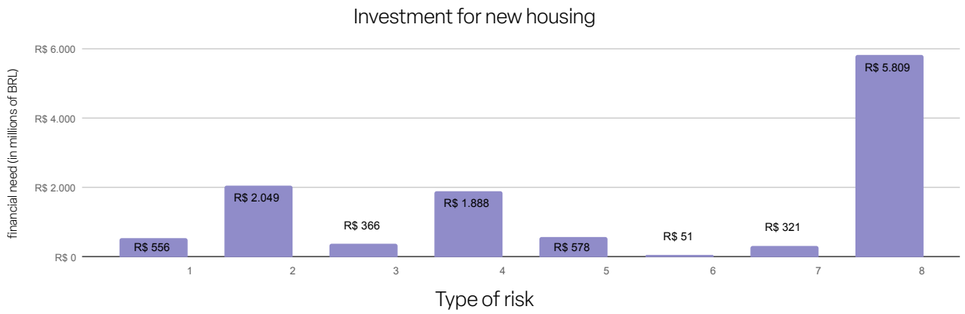


Chart 37: Investment Estimates by Risk Typology (Source: PMRR)

Resumindo, o total de investimento necessário para a questão de áreas de risco no município de São Paulo é da ordem de R$ 12 bilhões, sendo que 46% estão destinados para a disponibilização de novas habitações, 51% para as obras de intervenções e 3,1% para o pagamento do aluguel social (Chart 38).

61 Value provided by SEHAB.

62 In cases of relocation from risk areas due to public works, the rent assistance amount may reach up to 600 reais, according to Article 3 of SEHAB Ordinance 131/2015. "Single Paragraph – Provided there is budget availability, in cases requiring relocation from risk areas, geological accidents, landslides, floods, inundations, fires, chemical contaminations, and others duly characterized by the Civil Defense and Subprefectures, Rent Assistance of R$ 600.00 (six hundred reais) per month may be granted to families covered under items I or II of Article 2 of this Ordinance. (Included by SEHAB Ordinance No. 8/2022)."

63 In the event of relocation due to public works in risk areas, Rent Assistance must be granted until the families are permanently housed in Housing Units, in accordance with Article 9 of SEHAB Ordinance 131/2015. According to a provisional housing assistance report prepared by DEPLAN/PROG for June 2024, the average duration of Rent Assistance (AA) payments is 7.57 years.

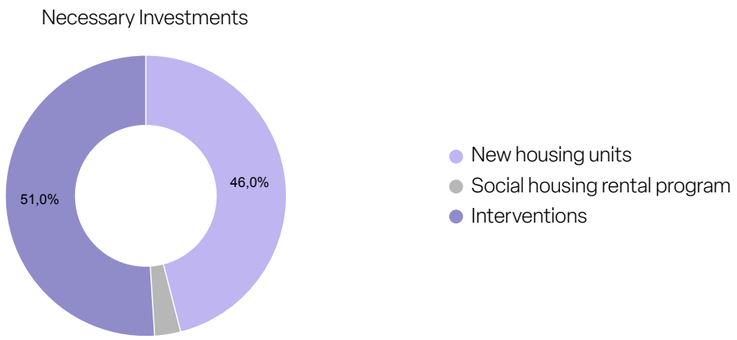


Chart 38: Distribution of Required Investments (Source: PMRR)

In summary, the total investment required to address risk areas in the municipality of São Paulo amounts to approximately R$ 12 billion, of which 46% is allocated for the provision of new housing, 51% for intervention works, and 3.1% for rental assistance payments (Figure 38).

It is important to note that this budget does not include the costs of expropriating the land required for the execution of the interventions and for the construction of new housing, considering in these cases that the property owner does not hold possession of the land, and that the costs related to any compensation for the land will be incurred for the effective vacating of the necessary areas.

MUNICIPAL BUDGET FRAMEWORK IN RISK MANAGEMENT

A simple comparison between the values described in the Investment Plan and those effectively disbursed by the Municipal Public Administration in recent years for interventions in risk areas shows that a coordinated and multiannual effort is necessary.

For this purpose, it is through the Multiannual Plan (PPA) that strategic guidelines are defined, priority programs are established, and management objectives are set—especially considering that the volume of demands in contrast to the municipality's execution capacity may exceed what can be addressed within one or two budget cycles.

The management of disaster risk within the municipal budget occurs in a cross-sectoral manner, as can be identified in the Annual Budget Law's Expenditure Demonstrative Chart. In addition to projects exclusively aimed at works and services in geological risk areas (preventive or emergency), there are also projects intended to improve living conditions, which contribute to better housing, habitation, and citizenship conditions.

Annex 4 describes the existing projects and activities in the Municipality of São Paulo's Budget related to Risk Areas.

The programs and activities directly or indirectly related to risk reduction have planned expenditures distributed across various agencies of the São Paulo Municipal Administration. Among these instruments, the following stand out:

Municipal Government Secretariat

Planning, Monitoring, and Evaluation of Public Policies

Municipal Subprefectures Secretariat

Implementation and Construction of Ecopoints

Collection, Transport, Treatment, and Final Disposal of Inert Solid Waste

Urban Cleaning Services – Sweeping and Washing of Public Areas

Works and Services in Geological Risk Areas – Preventive

Works and Services in Geological Risk Areas – Emergency

Municipal Housing Secretariat

Slum Upgrading

Urbanized Lot Program

Construction of Housing Units

Land Regularization

Implementation of the Reservoirs' Springs Area Program

Municipal Secretariat of Urban Infrastructure and Works

Interventions in the Drainage System

Municipal Secretariat for Green and Environment

Recovery of Degraded and/or Contaminated Areas

Environmental Inspection, Monitoring, and Control

Municipal Secretariat for Urbanism and Licensing

Expansion, Renovation, and Requalification of Public Areas

Slum Upgrading

Construction of Housing Units

Interventions in the Drainage System

Municipal Secretariat for Urban Security

Maintenance and Operation of Remote Monitoring Networks for Urban Security

Maintenance and Operation of Civil Defense

Regarding the origin of revenues, it is important to highlight the resources derived from specific funds aimed at supporting actions in risk areas:

Municipal Housing Fund (FMH): Centralizes resources intended for activities related to social housing policy, contributing to reducing the housing deficit and improving housing conditions in low-income settlements.

Municipal Social Assistance Fund (FMAS): Provides financial means for developing public policies in the area of social assistance, as well as for fulfilling the duties of the Municipal Council of Social Assistance (COMAS).

Special Fund for the Environment and Sustainable Development (FEMA): Supports direct or indirect actions promoted by the Municipal Secretariat for Green and Environment.

Urban Development Fund (FUNDURB): Supports and carries out investments aimed at implementing the objectives, guidelines, plans, programs, and urban and environmental projects included in or resulting from the Master Plan Law (PDE), in compliance with its established priorities.

Municipal Fund for Environmental Sanitation and Infrastructure (FMSAI): Supports and sustains actions related to basic and environmental sanitation and infrastructure in the municipality.

Municipal Fund for Social Development (FMD): Finances actions aimed at promoting the development of the Municipality of São Paulo.

Resources for municipal funds may come from different sources, such as transfers from the state and federal governments, collection of specific municipal taxes, donations, agreements, and other financing sources. The operation and management of these municipal funds are governed by specific legislation and are subject to accountability and oversight by internal and external control bodies.

Another possible source of resources derives from São Paulo's classification as a large-scale, high-capacity municipality in terms of its ability to allocate resources and efforts to improve risk and disaster management in priority areas. According to the criteria used by the Ministry of Integration and Regional Development to define the Municipal Capacity Indicator (ICM)—the main monitoring indicator for risk and disaster management linked to the Multiannual Plan—São Paulo meets the requirements for prioritized funding and program support.

“The goal of this joint effort with the other Secretariats is to carry out a humanized action in these communities located in risk areas.”

Secretary Marcos Monteiro

Foto: Papaterra

ABCDE

ACTION PLAN

ACTION PLAN

The Municipal Risk Reduction Plan (PMRR) of the City of São Paulo encompasses actions at various levels of the Municipal Public Administration, with some of them related to the improvement of management tools and others to the reformulation of roles and operational procedures. There is also a third category, related to the execution of investments for expropriation and intervention works.

Generally, these actions are grouped into **structural** and **non-structural measures**, depending on whether or not they involve intervention in the urban space. Structural actions are those linked to construction works, while non-structural actions comprise a set of measures related to urban policies, urban planning, legislation, contingency plans, and education.

The approach presented in this plan is complementary. It proposes new terminologies and definitions that are more aligned with best practices in public policy, providing greater importance to evidence-based planning. This is the well-known data-based decision making or data-driven decision making.

Therefore, four major, non-overlapping sets of definitions are suggested:

a. Structuring actions: a set of actions that, when properly coordinated by planning, are at a more advanced technical stage. They include the implementation of a slope monitoring program, river and stream telemetry, the creation of a municipal fund dedicated to risk areas, or even the strengthening of an integrated operations center.

b. Non-structuring actions: actions that need to be carried out even if they are not duly included in established plans. Emergency actions on unregistered slopes, cleaning of stormwater galleries, or routine garbage collection are typical of this group.

c. Intervention actions: those related to the execution of construction works that modify the morphology of urban space.

d. Non-intervention actions: those related to the development of projects, studies, program design, mobilization of external resources, among others.

Below, some key actions for the effective implementation of the PMRR are described. It is worth noting that, considering the proposed actions in the Action Plan and the dynamics of the city of São Paulo, its **update is recommended every two years.**

ACTION I: CREATION OF A GOVERNMENT GOAL

This action aims to increase transparency regarding risk areas. The strategic direction of efforts through the creation of a **Government Goal** significantly contributes to building safer, more resilient communities that are better prepared to face risk-related challenges.

Currently, there is no goal directly related to risk areas in the Municipal Administration's Goals Program — only correlated goals that contribute indirectly to addressing the issue, such as:

Goal 12: Promote social interest housing

Goal 13: Urbanization of precarious settlements

Goal 14: Land regularization

Goal 15: Licensing of affordable housing

Goal 32: Implementation of drainage works

Goal 33: Cleaning of streams, branches, and galleries

Goal 67: Increase in sanitary sewage collection

Therefore, it is proposed to create a **specific goal** within the Municipal Administration's Goals Program that consolidates, in a single indicator, the goals listed above. It should be emphasized that the goals must be addressed by the Secretariats that hold the competence over each specific topic.

Some possible **metrics for measurement** include:

Number of risk areas eliminated due to interventions (unit = number)

Reduction in the number of risk-related incidents (unit = percentage)

Reduction in the number of residents living in risk areas (unit = number)

Reduction in the number of residents living in high and very high-risk sectors (unit = percentage)

This action relates to items III and V of Article 300 of the Master Plan (PDE) and will contribute to adopting strategies with objective, technically recognized criteria for acting in risk areas, establishing priorities, deadlines, cost estimates, and required resources.

Main Agency Responsible for the Action: Municipal Secretariat of Government.

ACTION II: CREATION OF A BUDGETARY STRUCTURE FOR RESOURCE MOBILIZATION

Given the volume of resources required to mitigate the problems in the risk areas of the city of São Paulo, the following actions are proposed:

i. Creation of a Municipal Fund for Risk Areas: establish a specific municipal fund drawing from diverse sources such as community donations, external financing, and state and federal transfers, considering:

Resource Mobilization through Projects: prepare and submit projects to specific funding programs for civil protection and defense activities at both state and federal levels;

Technical Capacity Building: seek technical training to access available resources from governmental programs or civil society organizations specialized in risk and disaster management.

ii. Extra-budgetary Resources: several national and international funding lines can be used to develop actions in risk areas. Special attention should be given to preparing projects aimed at obtaining funds from the Ministry of Integration and Regional Development, since São Paulo is listed among the eligible municipalities for these resources.

iii. Structure for Mobilization of Extra-budgetary Resources: it is proposed to create a specialized team responsible for developing projects according to the requirements of each funding call.

iv. Creation of a Specific Budget Project entitled *"Actions for Risk Reduction"* within the agencies directly engaged in addressing this issue. This will promote better planning for actions in risk areas, ensure monitoring of interventions through performance indicators, and guarantee transparency in the disclosure of applied expenditures. The implementation of this Project will be linked to the actions of SEHAB, SIURB, SMSUB, and SVMA.

This action relates to items I, II, III, IV, V, and VI of Article 300 of the Master Plan (PDE).

It will support the coordination of PMH implementation, particularly regarding urbanistic, legal, land tenure, and environmental regularization of precarious and irregular settlements, as well as structural risk-reduction interventions, establishing priorities, timelines, and cost estimates.

Main Agency Responsible for the Action: Municipal Department of Finance.

ACTION III: CREATION OF A MANAGEMENT COUNCIL FOR PROJECTS AND WORKS IN RISK AREAS

This action seeks to enhance integration among society, municipal departments, and other public bodies in interventions within precarious settlements, introducing popular participation in public management to better meet community needs.

Intervention in precarious settlements for infrastructure implementation and risk mitigation is a shared responsibility among several municipal departments. However, they often pursue different objectives, and the project contracted — and consequently the construction work — by one department may render another department's project or work unfeasible, resulting in rework and loss of human and financial investment.

Thus, the objective of the Council is to promote visibility and joint action among society and the municipal public administration bodies involved in projects and works in risk areas.

Duties of the Management Council:
I. Analyze interrelated actions among various municipal bodies, aiming at the socioeconomic, cultural, and environmental development of risk areas;
II. Promote dialogue to improve public policy execution, optimizing resources and actions through knowledge exchange among municipal departments and entities;
III. Ensure that all contracts necessary for full project and construction development are executed efficiently and with quality;
IV. Prepare meeting agendas and corresponding minutes;
V. Supervise and guide the correct implementation of the council's decisions;
VI. Assess the effectiveness of structural interventions implemented to eliminate and/or mitigate risk areas.

Composition of the Management Council:

Members appointed by Mayoral Decree:

- SEPEP – Executive Secretariat for Planning and Priority Deliveries
- SEHAB – Municipal Housing Secretariat
- SIURB – Municipal Secretariat of Urban Infrastructure and Works
- SMSUB – Municipal Secretariat of Subprefectures
- Subprefectures – 32 Subprefectures, to be consulted based on the area of intervention
- SVMA – Municipal Secretariat for the Environment and Green Spaces
- SMUL – Municipal Secretariat for Urbanism and Licensing

Representatives of civil society entities:

- Representative of the business sector linked to the Municipal Council for Urban Policy (CMPU)

- Representative from the Municipal Housing Council (CMH), representing community and grassroots organizations

- Representative from the Municipal Council for Social Assistance (COMAS)

- Representative from the Municipal Participatory Council, being one representative from the Subprefecture where the risk area is located

- Representative of environmental NGOs

- Representative of professional, academic, or research entities related to urban and environmental issues within the perimeter of the risk area
Civil society representatives will be nominated by their respective councils in accordance with their internal regulations.

The regulation of the Management Council will occur through a Municipal Decree, which will detail its composition and operation. The Council will be coordinated by SEPEP (Executive Secretariat for Planning and Priority Deliveries) and secretaried by SIURB (Municipal Secretariat of Urban Infrastructure and Works), as outlined in Decree Draft – Annex 5.

This action relates to items I, II, III, IV, V, and VI of Article 300 of the PDE.

It will support the adoption of strategies with objective, technically recognized criteria for action in risk areas, establishing priorities, deadlines, cost estimates, and required resources.

Main Agency Responsible for the Action: Municipal Secretariat of Government.

ACTION IV: IMPROVEMENT OF THE RESPONSE FLOW FOR IMMINENT RISK AND EMERGENCY SITUATIONS

The Municipal Public Administration has already established an appropriate procedural flow for assisting residents in risk areas (detailed in the *Operational Procedure* section).

Nevertheless, in order to make the process more agile and dynamic, specific adjustments are deemed necessary to significantly improve the flow of actions, such as training Subprefecture teams to handle preventive removal processes, register residents, and prepare Intervention Plans.

It is also pertinent to **review SEHAB Internal Order No. 01/2013**, particularly regarding housing assistance for residents in risk areas located on private lots or exposed to risks other than geological. Below are the most relevant aspects to be considered:

Improvement of housing assistance in private areas (item 2.4 of SEHAB Internal Order No. 01/2013), not only through adjustments to its terms but also by establishing clear criteria/standards for classifying the various risk situations in private areas. The current regulation does not explicitly mention this type of action, making it difficult to include residents of private areas in SEHAB programs.

Expansion of SEHAB's role in situations triggered by other types of risk (hydrological, fire, contamination, structural, etc.), requiring the creation of new specific workflows and procedures for these risk types—especially intermittent risk cases where families may return home after the risk has been mitigated through localized drainage or streambank containment works.

Incorporation of digital tools by Subprefecture technical teams for resident registration (as required in Articles 2.5.1 and 25.2 of SEHAB Internal Order No. 01/2013). These records should form a ***simplified preliminary register*** with sufficient data to initiate housing assistance, since this is not an explicit SEHAB responsibility and current manual procedures are slow and inefficient.

Enhancement of the Intervention Plan developed by Subprefectures, requiring the inclusion of broader needs beyond localized risk-mitigation works. SEHAB and SIURB should then include such areas in their priority intervention planning.

Integrating all this data into a digital platform connected to the Municipal Administration's process flow systems will improve the quality and timeliness of Subprefecture Intervention Plans, providing the Administration with updated data consistent with SEHAB's normative guidelines.

This action relates to item VI of Article 300 of the PDE.

It will assist in defining strategies for preventive relocation of residents in risk areas based on objective, technically recognized criteria.

Main Agency Responsible for the Action: Municipal Secretariat of Government.

ACTION V: UPDATE OF DESIGN GUIDELINES FOR DRAINAGE AND SLOPE CONTAINMENT

This action aims to increase project efficiency and minimize the impact of decision-making in disaster situations.

The absence of clear guidelines hinders project development, making the process slow and burdensome for all parties involved. Current guidelines for hydraulic project development are outdated and inconsistent with best practices. It is necessary to standardize and complement certain technical parameters, particularly those related to freeboard, flow velocity, and roughness coefficients.

A clear example was the orientation toward prioritizing concrete elements in stream channelization projects, observed during PMRR development, established to minimize cleaning and maintenance costs over the lifespan of the structures.

Projects that incorporate nature-based solutions should also be encouraged, making use of local characteristics such as topography and permeability, while minimizing interventions.

It is necessary to update design rainfall equations (IDF curves) to accurately represent the municipality's rainfall regime, which is characterized by high-intensity, short-duration events, as demonstrated in this document.[64]

Additionally, guidelines should be created for slope containment projects in line with current standards, defining minimum parameters for drilling grids, the use of geophysical tests, necessary surcharge loads, and particularly the format for presenting the design solutions (drawings).

Furthermore, it is essential to overcome the 2D design paradigm, ensuring that solutions are developed and delivered using 3D, 4D, and even 5D modeling, following proper parameterization and acceptance protocols by the Municipal Engineering and Architecture teams.

Finally, it must be emphasized that this update is even more relevant given the influence of climate change, which has significantly altered historical rainfall patterns. The proposed actions must therefore genuinely enhance the resilience of municipal intervention areas.

This action relates to items III and V of Article 300 of the PDE

It will contribute to articulating strategies with other Municipal Programs through technical updates that increase efficiency in risk management.

Main Agency Responsible for the Action: Municipal Secretariat of Urban Infrastructure and Works.

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64 Chapter "Risks – Flooding and Inundations."

ACTION VI: CONTINUOUS MONITORING AND HIERARCHIZATION OF RISK AREAS

The dynamics observed over the past decade — characterized by a continuous increase in the number of areas, sectors, dwellings, and inhabitants located in risk zones — highlights the need to optimize the existing mechanisms and workflows for identification, registration, and classification.

In this regard, the routine currently in place within the municipality (Civil Defense and Subprefectures) should be enhanced by incorporating a system based on publicly available national and international satellite imagery (e.g., National Institute for Space Research – INPE; European Space Agency – ESA; DigitalGlobe; Planet Labs; Landsat). This system should enable biweekly monitoring of the presence of houses (roofs), people, and vehicles in areas previously registered by the municipality. In addition to the elements mentioned above, it is recommended that demographic data be continuously updated.

Within this preventive monitoring routine, there should be an image analysis stage employing neural networks capable of automatically identifying objects (Artificial Intelligence) and triggering alerts regarding morphological changes in the areas of interest.

To increase the reliability of results, the acquisition of higher-quality imagery (resolution better than 1 pixel per 40 m²) should be foreseen.

Furthermore, constant interventions modify the risk classifications of sectors and the number of dwellings and inhabitants within them. Therefore, it is necessary to maintain a continuous evaluation system for risk areas, whereby each new Civil Defense Preliminary Report for an existing area—or for each newly added area—undergoes processing according to the weighting criteria established in Action VII (Works and Projects for Risk Mitigation), resulting in updated hierarchizations.

This system should integrate the following entities: COI, Civil Defense, SIURB, SMSUB, SEHAB, and Subprefectures.

Action related to item VI, Article 300 of the Strategic Master Plan (PDE).

It will contribute to defining preventive relocation strategies for residents in risk areas, according to objective and technically recognized criteria.

Main Agency Responsible for Implementation: Municipal Secretariat for Urban Security – Civil Defense.

ACTION VII: UPDATE AND APPROVAL OF THE MUNICIPAL HOUSING PLAN (PMH)

The first PMH (Municipal Housing Plan) developed in São Paulo resulted in Bill No. 509/2011, which, however, was never enacted into law. In 2014, the São Paulo Strategic Master Plan (Municipal Law No. 16,050/2014, as amended by Municipal Law No. 17,975/2023) established several guidelines related to housing, dedicating Chapter VII to the Municipal Housing Policy and providing, in Article 294, for the revision of the PMH.

Completed in 2016, this revision resulted in Bill No. 619/2016, which once again was not approved by the Municipal Council. Consequently, despite the absence of an officially enacted PMH for the Municipality of São Paulo, a significant portion of the housing policy actions currently implemented by the Municipal Secretariat for Housing follow the guidelines proposed in the 2016 PMH revision.

Given that the PMRR (Municipal Risk Reduction Plan) is based on the principles of this last draft bill—aligned with already implemented programs and current municipal procedures—it becomes evident that both a new revision of the PMH and its enactment into law are necessary.

The PMH should provide for free technical and social assistance for developing improvement projects in dialogue with families, including strategy formulation, project implementation guidance, and supervision of construction activities, in accordance with Federal Law No. 11,888 of December 24, 2008, which guarantees low-income families the right to such services.

São Paulo Municipal Law No. 13,433 of September 27, 2002, establishes the Technical Advisory Service for Social Interest Housing and authorizes the Executive Branch to enter into agreements and partnerships. Free technical assistance requires proper structuring for implementation and must be accompanied by urbanization, land regularization, housing improvement, and housing provision actions (particularly through partnerships with organizations). These services should be delivered by multidisciplinary teams accredited by the Municipality, assisting individuals or organized groups.

The PMH update should also establish a Cadastral Database of Families in Precarious Settlements. Given that it is of public interest to make available and integrate existing data regarding families living in such settlements, this would allow for better quantification and characterization of populations potentially affected by risk mitigation measures. This update also provides an opportu-

nity to assess the feasibility of joint action among Civil Defense, SEHAB, and Subprefectures for registering families in risk areas to evaluate the most appropriate alternatives for inclusion in housing programs.

The database may include, among others:

- Number and location of water distribution points (provided by Sabesp);

- Number of families and family compositions recorded by community health agents of the Municipal Health Secretariat (SMS).

Additionally, in cases of disasters and emergencies—such as fires or landslides—where the materiality of housing may be lost, this data can help quantify the families affected in the impacted area, improving processes for temporary and permanent housing assistance.

In the PMH update, consistent with the 2016 PMH, it is important to include provisions for temporary assistance beyond those established by SEHAB Ordinance No. 131/2015—which regulates immediate shelter for families evacuated due to imminent risk or whose homes were destroyed by disasters—ensuring dignified conditions through oversight of property acquisition, habitability verification, and monitoring of assistance provided.

A deeper review, update, and subsequent regulation, structuring, and implementation are required.

Action related to items III and VI, Article 300 of the Strategic Master Plan (PDE).

It will contribute to the adoption of strategies with objective and technically recognized criteria to address risk areas, establishing priorities, timelines, cost estimates, and required resources.

Main Agency Responsible for Implementation: Municipal Secretariat for Housing.

ACTION VIII: WORKS FOR RISK MITIGATION

This action aims to eliminate situations of natural disaster risk.

In addition to projects already executed, it is necessary to establish a practice for contracting intervention projects in order to create a project database. This requirement has already been addressed in the section “Global Investment Plan for Previously Registered Areas.”

A fundamental stage of the PMRR seeks to answer the following question: What should be prioritized?

Therefore, establishing well-founded criteria is crucial for addressing the need--resource (intervention-budget) relationship and ensuring appropriate hierarchization. The proposed prioritization does not concern municipal government actions in cases of imminent risk but rather the planning of risk mitigation measures.

For this purpose, a Multicriteria Decision Analysis (MCDA) was employed, allowing for the integration of relevant factors in the evaluation process through criteria, weights, and classifications.

In MCDA, a criterion serves as a comparison axis among alternatives and can be expressed qualitatively or quantitatively, considering viewpoints, objectives, capacities, or constraints within the real-world context, thereby enabling the assessment of potential actions.

The criteria used for risk area hierarchization were:

- Dwellings classified as Risk Levels R3 and R4;

- Total number of dwellings in R3 and R4 according to the Civil Defense Circumstantial Report;

- IPVS – São Paulo State Social Vulnerability Index;

- Existence of Judicial Proceedings (information provided by the Municipal Attorney General’s Office – PGM);

- Existence of prior municipal interventions (data from SIURBDigital[65] and SMSUB);

- Existence of a developed project.

- Project base date criterion:

- Projects with base date less than 12 months old;

- Projects with base date greater than 12 months old;

No existing project.

- Intervention cost

Construction budget range, as presented in the corresponding table.

- Need for environmental licensing

65 SIURBDigital – MUNICIPAL SECRETARIAT OF URBAN INFRASTRUCTURE AND WORKS (SIURB) ORDINANCE No. 17 of May 29, 2023.

For hydrological risk areas (and areas with overlapping geological risk), as interventions are located within Permanent Preservation Areas (APPs), it is necessary to prepare a Preliminary Consultation Report (RCP) in accordance with Ordinance No. 004/SVMA.G/2021 and to obtain the Environmental Compensation Term (TCA) as per Ordinance No. 130/2013–SVMA. Thus, the Secretariat for the Environment (SVMA) is responsible for analyzing the RCP and determining the applicable environmental study.

For all geological risk areas, it is assumed that no licensing is required.

- Relocation area

Defined in the project or based on assumptions used for budget estimates:

Geological risk areas – 20% of the area subject to relocation;

Hydrological risk areas – 40% of the area subject to relocation.

- Occurrences

Collected from GeoSampa, covering the entire available history (since 2013), considering events located within up to 10 meters from the risk area boundary.

In the analysis matrix, the presence or absence of occurrences was considered.

In general, it was established that the priority intervention works are those with lower cost, that do not require licensing and expropriation, that have more residents in sectors with high and very high risk (R3 and R4), that are under judicial ruling, have a high IPVS and that already have an executed project with a base date of less than 12 months. The weights considered are presented in the table below.

Table 22: Weights considered for project prioritization (Source: PMRR)

Criterion	Level	Weight	Total
Project	< 12 months	25	25
	> 12 months	10	
	No project	0	
Housing Units in Area R3/R4	Uninhabited	0	20
	< 100	5	
	101 a 500	10	
	>500	20	
IPVS (Social Vulnerability Index)	-1 a 1	0	10
	2 a 4	5	
	5 a 6	10	
Legal Action	Nonexistent / Not reported	0	5
	In progress	1	
	Conviction in R1/R2 area	2	
	Conviction in R3/R4 area	5	
Previous Intervention	Nonexistent	5	5
	Existing	0	
Budget	< 10 million	20	20
	10 to 50 million	10	
	> 50 million	5	
Licensing	Yes / Not declared	0	5
	No	5	
Need for Housing Relocation	< 6.000 m²	5	5
	6.001 m² a 15000 m²	2	
	>15000 m²	0	
Occurrences	Yes	5	5
	No	0	

The table with the hierarchization of the areas is in **Annex 4** of the document. The base date for the extraction of the risk areas is May 2024. The risk areas that do not have sectors and residents classified as R3 and R4 had their score set to zero in this item, as can be seen in the table presented in Annex 4.

With the results, the areas were divided into five blocks. The areas classified as closed by Civil Defense (but still listed in the register) or served by other programs of the Municipal Public Administration were grouped in Block 0. During the development of the PMRR, there was an addition of five new risk areas that are computed in Block 4.

Block 1: > 45 points – total of 121 areas
Block 2: 44 to 35 points – total of 146 areas
Block 3: 34 to 26 points – 156 areas
Block 4: < 25 points – 167 areas
Block 0: closed / served by other programs – 200 areas

When observing the distribution of the number of areas in the blocks, it can be established that it is necessary to employ a continued effort of project development and mapping of the risk areas, which also highlights the importance of an Integrated Works Registry System for their registration and monitoring. Figure 65 below illustrates the application of the analysis matrix.

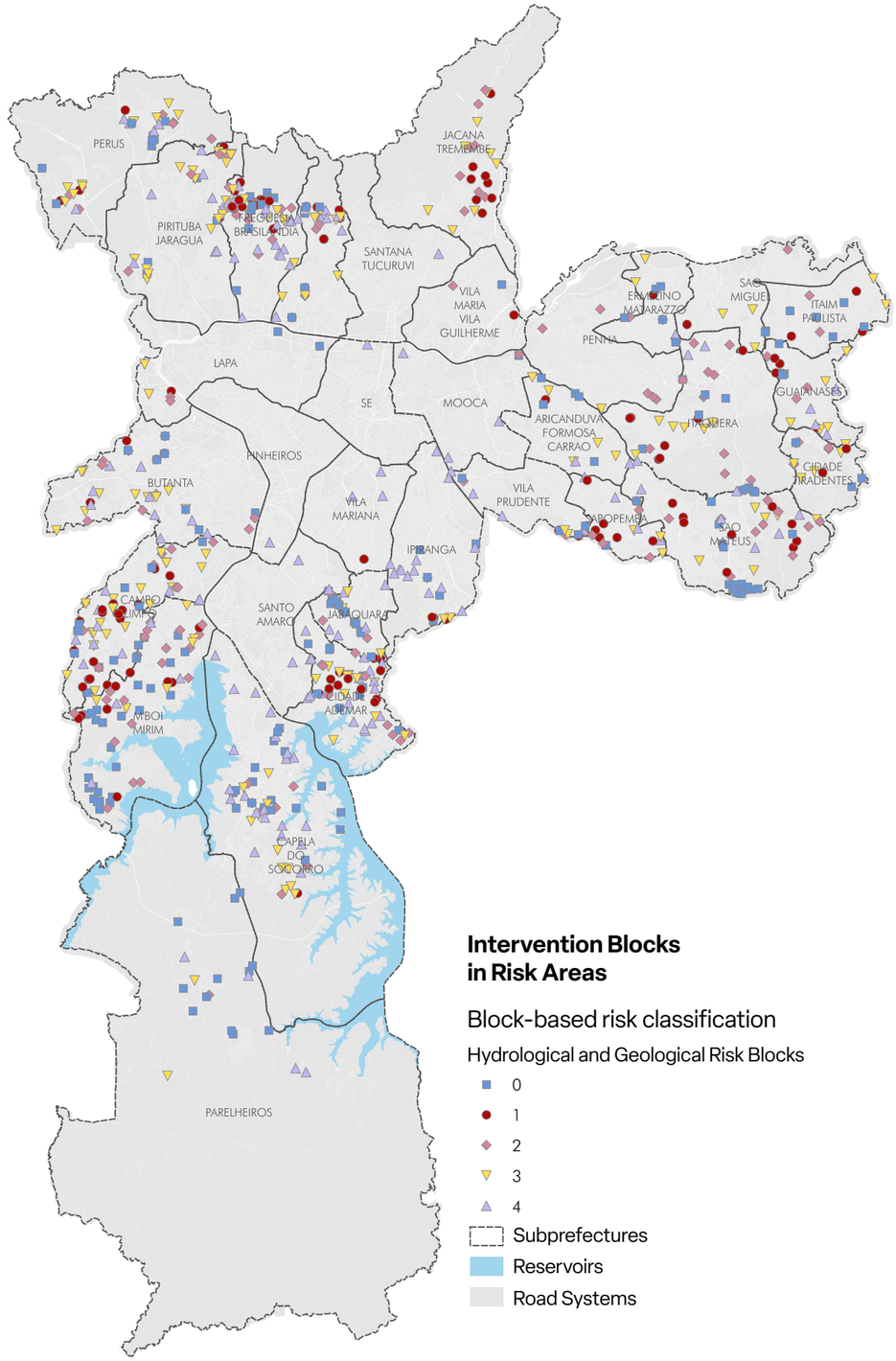

Figure 65: Intervention Blocks in Risk Areas (Source: PMRR)

There are projects being developed within several Secretariats of the Municipal Public Administration; however, it is necessary to emphasize that the information is dispersed.

Regarding the number of residents in R3 and R4, there are areas classified in Block 1 that do not have residents in this risk situation. This point results from the prioritization previously adopted for technical visits and project development within the scope of this PMRR, in which emphasis was given to areas with judicial actions resulting in rulings. This led, at this stage, to the inclusion of projects developed with a base date of less than 12 months.

Regarding the existence of projects, there are 416 areas for which no project has been developed, and 150 of these areas have an IPVS above 5, that is, critical. This point highlights the importance of continued efforts in risk mitigation through unified action by the Municipal Public Administration. Figure 39 shows the distribution of resources in the zones of the municipality of São Paulo.

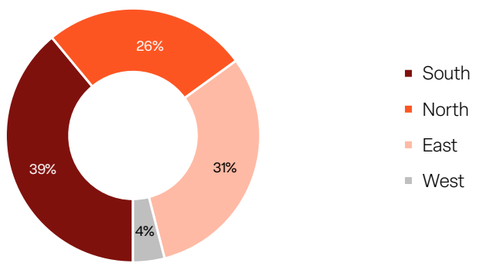

Chart 39: Distribution of Resources by City Zones (Source: PMRR)

Below is the summary table by block; detailed information is presented in Annex 4.

Table 23: Summary of analyses by block. The proposed timeframes correspond to four-year periods (Q), and the budget is expressed in millions of Brazilian reais. (Source: PMRR)

Block (O)	Number of Risk Areas	Total Housing Units	Total Area (m^2)	Relocation Area (m^2)	Residents R3+R4	Budget for project design and implementation (millions)	Proposed Timeframe
0	200	53.523	5.617.368	N/A	15.950	R$ 1.760	N/A
1	121	65.932	5.245.765	1.129.985	25.519	R$ 1.640	1st Q
2	147	44.030	4.214.071	973.122	8.500	R$ 1.320	2nd Q
3	157	32.552	3.486.101	817.088	5.545	R$ 1.090	3rd Q
4	165	12.167	1.275.489	329.143	1.304	R$ 400	4th Q

Block 0 consists of areas that will be addressed by other public administration programs or have ongoing actions for risk mitigation. Risk areas with overlap, when applicable, are also included in this block. It is recommended that, when establishing the work execution schedule, adjacent risk areas be considered. For example, the Camarazal area (BT-12), which overlaps with HBT-05, Tanque and Tanque Itápolis (SB-06 and HSB-05), and Bispo and Córrego do Bispo (CV-10 and HCV-03). Overlaps must be observed, and joint implementation of interventions in the area should be pursued, even if they have different hierarchizations.

Action related to items I, II, III, IV, V, and VI of Article 300 of the PDE.

It will contribute to defining strategies for risk mitigation works according to objective and recognized technical criteria, applying fair and democratic procedures in the relocation of residents, when necessary.

Main Municipal Bodies Responsible for the Action: Municipal Secretariat for Urban Infrastructure and Public Works, Municipal Secretariat for Subprefectures, Subprefectures, and Municipal Secretariat for Housing.

ACTION IX: PRACTICAL MEASURES TO PREVENT REOCCUPATION

The Municipal Public Administration must seek to direct interventions in order to address the social aspects of risk areas. This means that the removal of housing should not be considered the only possible solution, and other alternatives must be evaluated, particularly the regularization of areas occupied by informal settlements, ensuring due access to services that are currently lacking, whether public or private.

Brazilian Urban Law, founded on the idea of urban reform, began its slow and gradual development in 1988, when specific constitutional provisions were established to guide the processes of territorial development and urban management. It was the original chapter introduced by the Federal Constitution of 1988 that established the legal and political foundations for promoting urban reform in the country. The most relevant proposals are: the autonomy of municipal governments, the democratic management of cities, the social right to housing, the right to regularization of consolidated informal settlements, the socio-environmental function of urban property, and the fight against real estate speculation in urban areas.

Regarding the socio-environmental function of property, the Constitution defines urban property as a fundamental right, provided that the social functions established by Master Plans and other Urban and Environmental Laws are fulfilled.

The social function aims simultaneously to guarantee the interests of the population and to ensure urban development, and, for this purpose, within a legal-normative framework, it stipulates the mode of urban management, regulating the use, occupation, and subdivision of land. In this sense, it is clear that **if property must fulfill its social function, the city likewise has a social function that must be satisfied.**

The Federal Constitution of 1988 formally established a Chapter on Urban Policy (Articles 182 and 183), regulating orderly development, the social functions of the city, the municipality's responsibility to implement these precepts, and special urban usucaption. This chapter guides urban policies, which set guidelines for implementing the Master Plan, enabling and moderating the social function of property, as well as establishing measures for participation in city policies.

It is important to note that the meaning of the right to the city is better understood when the Urban Policy Chapter is analyzed together with Article 30, item VIII of the Federal Constitution, which assigns to Brazilian municipalities the competence to "promote, where applicable, adequate territorial planning through the planning and control of the use, subdivision, and occupation of urban land," and with Article 23, item IX, which establishes that the Union and the States, in exercising their competencies, must "promote housing construction programs and the improvement of housing and sanitation conditions."

The synchronicity of all these definitions established by the Federal Constitution of 1988 — the social function of property, democratic urban management, the right to housing, and the right to a balanced environment — represents the effective right to the city, duly regulated by the City Statute[66], which, aiming to build sustainable cities, provides important instruments for Land Regularization.

Federal Law No. 13,465, enacted on July 11, 2017, establishes general rules and procedures applicable to REURB — Urban Land Regularization. This federal law "encompasses legal, urban, environmental, and social measures aimed at incorporating informal urban settlements into the urban territorial framework and granting titles to their occupants" (Art. 9), guided by the principles of economic, social, and environmental sustainability, and of efficient and functional territorial planning (Art. 9, §1), with the ultimate goal of guaranteeing the social right to decent housing and adequate living conditions (Art. 10, VI), ensuring the fulfillment of the social functions of property and the city (Art. 10, VII and VIII).

The CONAMA — National Environment Council — had previously addressed this matter through Resolution No. 369 of 2006. On that occasion, perhaps due to the body's collegiate competence, the subject was treated in a broader manner, since the resolution allows, for social interest regularization, interventions and vegetation suppression in Permanent Preservation Areas (APPs) when possible, and, in this context, more clearly and comprehensively provides integrated solutions that seek an accurate diagnosis of negative environmental impacts and the necessary technical interventions that include the implementation of infrastructure and public services to ensure the permanence of consolidated informal occupations.

Some highlights of the Municipal Housing Secretariat related to the concept of social urbanism can be found in the interventions carried out in *Grajaú – Parque Cantinho do Céu and Jardim Colombo / Vila Sônia* – Parque Fazendinha, encompassing different reurbanization approaches in areas that already show significantly positive changes in their communities.

Another successful example of applying the concept of social urbanism is the recent actions of the Municipal Public Administration in Jardim Pantanal aimed at local land regularization. Located in a floodplain region, this area historically suffered from recurring floods, and its inclusion within the legal framework enabled the bidding processes for projects and works carried out by SP Urba-

66 Federal Law No. 10,257.

nismo and the Municipal Secretariat for Urban Infrastructure and Public Works (SIURB).

The objective of this Action is to adopt, based on the aforementioned legislation, measures that will allow the regularization of areas that are not public or that require compliance with environmental regulations, particularly ensuring the maintenance of housing for low-income populations in urbanized areas with guaranteed access to public services.

Action related to items I, II, III, IV, V, and VI of Article 300 of the PDE.

It will contribute to coordination with the implementation of the PMH, mainly regarding the urbanistic, legal, land, and environmental regularization of informal and irregular settlements.

Main Municipal Bodies Responsible for the Action: Municipal Secretariat for Housing and Municipal Secretariat for Subprefectures.

ACTION X: COI-SP

Action that integrates Municipal Public Administration bodies and the proposed monitoring systems.

A first line of action lies in strengthening the São Paulo Integrated Operations Center (COI-SP), transforming it into a data integration and processing center for monitoring the city's physical infrastructure — a large municipal Data Lake.

To this end, new functions must be added to COI-SP, since it was initially conceived as a strategic hub for monitoring, managing, and making large-scale decisions of any kind — planned or emergency — that globally affect public safety and social defense in the municipality.

The centralization of data at COI-SP should facilitate and accelerate the identification of natural disaster risk situations (such as the rapid rise in a river's level with overflow beginning at certain points, or slope movements) and the triggering of necessary support actions, given that it is already integrated with more than 32 agencies. Existing monitoring systems within São Paulo's municipal administration, such as CGE/SIURB, Urano/SMSUB, and the Civil Defense system, should also be incorporated into COI-SP's database.

All proposals within this Action Plan that involve the installation of sensors or other technological alternatives must be connected to COI-SP. In addition to rapid response in emergencies, COI-SP should act ***predictively*** in risk areas through data analysis and the enhancement of proposed methodologies, such as the Multicriteria Analysis outlined in Action VIII.

Action related to item V of Article 300 of the PDE.

It will contribute to defining actions and interventions necessary for adopting safety and protection measures.

Main Municipal Body Responsible for the Action: Municipal Secretariat for Urban Security – Civil Defense.

ACTION XI: SENSORS FOR MONITORING SLOPE MOVEMENT

Action aimed at minimizing the impacts of landslides.

There is already technical literature and successful examples of installing inertial sensors (accelerometers and gyroscopes) on slopes, coupled with rain gauges and moisture sensors placed at different depths, for monitoring slope stability and issuing alert signals[67].

Successful tests have also been conducted by a research team at the University of São Paulo, based on installing a set of sensors attached to articulated rods positioned at varying soil depths. The proposal is that these be installed when at least two of the five conditions listed below are met in a given risk area:

- Areas classified as geological risk, with slope inclinations greater than 17° in any sector;

- Areas classified as geological risk, with soil thicknesses of less than 30 m relative to the bedrock;

- Areas with relative heights greater than 30 m, with exposed soil or leaning trees;

- Areas with relative heights greater than 20 m, with exposed soil and housing located less than 5 m away; Areas with evidence, indicators, and/or a history of mass movements.

All data must be properly processed and integrated into the COI-SP alert systems.

Action related to items I, II, and V of Article 300 of the PDE.

It will contribute to characterizing landslide-prone areas, identifying dwellings in imminent risk, and adopting safety and protection measures. It will improve prevention and alert systems.

Main Municipal Body Responsible for the Action: Municipal Secretariat for Urban Security – Civil Defense.

67 CEMADEN itself describes an interesting monitoring system based on topographic sightlines, which are, however, quite difficult to implement in urban areas due to the presence of many obstacles.

ACTION XII: IMPROVEMENT OF THE RIVER AND CANAL TELEMETRY NETWORK

Action aimed at minimizing the occurrence of flooding.

It is necessary to improve the current telemetric network in the city of São Paulo, both by increasing the number of monitored points and by incorporating new functionalities into the existing network.

An initial step focuses on expanding measurement points so that all watercourses with a design flow greater than 25 m^3/s for a 100-year return period (Tr100) are monitored. These watercourses must be detailed in the PDD[68].

Furthermore, telemetric stations should include systems capable of measuring siltation in watercourses — not just river and reservoir water levels and rainfall indices.

This measure enhances the functionality of the telemetric network, making it useful not only for identifying siltation (and maintenance needs) but also for supporting the inspection of completed services (by comparing bathymetric data before and after cleaning).

Action related to item V of Article 300 of the PDE.

It will contribute to characterizing flood-prone areas, identifying dwellings in imminent risk, and adopting safety and protection measures. It will improve prevention and alert systems.

Main Municipal Body Responsible for the Action: Secretariat for Infrastructure and Works.

68 40 Ponte Rasa, Moinho Velho, Zavuvus, Carumbé, Mooca 5, Praça Portugal, Mooca 4, Aricanduva, Uberaba, and Jaguaré 2 (totaling 1,045 m^3).

ACTION XIII: EDUCATIONAL AND TRAINING INITIATIVES

Action aimed at training local communities and subprefecture teams in identifying and executing evacuation procedures in risk situations.

The increased training of residents in risk areas to act as community agents in Civil Defense Protection Nuclei has proven to be a highly effective measure, as it enables the early detection of changes in occupation patterns and slope movement, allowing for faster and more targeted interventions. These activities are currently carried out by NUPDEC.

A plan must be established to ensure the regularity of training sessions and keep populations in risk areas attentive to factors signaling imminent danger. To enhance training effectiveness, this action proposes the development of an application through which agents can make notifications more simply and directly.

This will allow data integration into a notification system managed by Civil Defense, setting priorities for decision-making.

Action related to items I, II, and V of Article 300 of the PDE.

It will contribute, through citizen and Subprefecture participation, to the characterization and quantification of areas at risk of flooding, landslides, and erosion, providing support for the necessary risk reduction actions and interventions.

Main Municipal Body Responsible for the Action: Municipal Secretariat for Security – Civil Defense.

ACTION XIV: ALERT AND SIREN SYSTEM

Action aimed at minimizing the impacts of natural disasters.

The municipality of São Paulo must adhere to the national alert system developed by the National Center for Risk and Disaster Management (CENAD), in which automatic messages are sent to all cell phones connected to a cell antenna (regardless of the carrier).
The main advantages of this system are:

- it does not depend on prior registration of consumers;

- it instantly reaches the cell phones of people who, at that moment, are encompassed by the antennas of the region at risk (geolocation);

- it triggers an audible alarm even when the cell phone is in silent mode;

- the alert message appears over any content in use on the cell phone screen.

For geological risk areas, where there are sectors classified as R4 and that have had at least one occurrence during the last rainy period, an alert system must be installed to evacuate the risk area.

National experiences show that sirens have become an important short--term prevention tool, since they enable quick warning to residents about the urgent need to leave their homes and seek a safe place. It is essential that the installation of the systems be accompanied by the dissemination of the PLANCONs established for each risk area, as well as the signage of escape routes and meeting points.

Action related to items I, II, and V of Article 300 of the PDE.

It will contribute to prevention and alerting of residents in situations of imminent risk.

Main Municipal Body Responsible for the Action: Secretariat for Security – Civil Defense.

ACTION XV: IMPROVEMENT OF SOLID WASTE MANAGEMENT IN RISK AREAS

Action aimed at increasing integration within the Municipal Administration. Following the extinction of AMLURB, solid waste management, as set forth in the Competences of the Municipal Administration Bodies, had its responsibilities divided between the Executive Secretariat for Urban Cleaning – SELIMP, linked to the Municipal Secretariat of Subprefectures – SMSUB, responsible for indivisible urban cleaning services, and the Regulatory Agency for Public Services of the Municipality of São Paulo – SP REGULA, which currently manages services related to household waste collection.

Therefore, it is considered necessary that SELIMP and SP REGULA, within their respective areas of competence, align their work plans to enable the implementation of continuous actions for household waste and debris collection in risk areas. These adjustments must be consistent with the Integrated Solid Waste Management Plan (PGIRS), as well as with the Multi-Year Plan and the Annual Budget Law, so that, during revision processes, it becomes possible to include and/or improve continuous measures for household waste and debris collection in risk areas, notably through amendments to existing contracts or upcoming procurement procedures, thus constituting a medium- to long-term solution.

Projects such as "Descarte e Revitaliza," which aim to revitalize areas with illegal dumping points, may be strengthened, expanding the network of Eco-points, "Cata Bagulho" operations, and improving public communication regarding composting yards in the region.

In this context, the possibility of integrating the actions proposed by SELIMP and SP REGULA with Civil Defense must also be considered, so that, periodically, there is an update of the number of people, dwellings, and waste volume in each risk area sector, even generating a specific efficiency indicator for the service companies dedicated to those areas.
The development of a specific application for Civil Defense, as proposed, aligns with the guidelines of PGIRS, which encourage the modernization of inspection processes through information technology tools. With this application, it is proposed that a direct communication channel be established between Civil Defense, Subprefectures, SELIMP, and SP REGULA, allowing field teams and community agents to report and document irregular solid waste disposal. The notifications would be sent directly to the responsible units, and the resolution process for these notifications would be integrated into the new efficiency indicator for the risk areas.
In this way, cleaning operations can be intensified in hydrological risk areas (such as cleaning drains and/or inlets, especially near illegal dumping points), during both rainy and dry periods.

Action related to items II, IV, and V of Article 300 of the PDE.

Based on the analysis, quantification, and qualification of risk areas, it is a strategy that aims to contribute to the implementation of the Integrated Solid Waste Management Plan in communities.

Main Municipal Bodies Responsible for the Action: Municipal Secretariat of Subprefectures and Municipal Secretariat of Government (SP REGULA).

ACTION XVI: SENSORING OF THE MICRODRAINAGE NETWORK

Action aimed at minimizing the occurrence of flooding.

The implementation of a network of sensors along stormwater drainage pipes in urban streets is of fundamental importance for improving maintenance and cleaning systems, so that sedimentation is minimized and the water flow capacity of the existing network is maximized.

The sensors most suitable for the proposed purpose are those based on high-frequency sound wave technology to generate real-time images (ultrasound).

These sensors must be installed on the upper part of the pipe and near the drain inlets, to facilitate data transmission. The greatest challenge of the sensor system is related to the sizing of the battery required for its operation.

The measurement frequency may be low (one measurement per day) and should present three alert levels according to the degree of obstruction to the free passage of the fluid: level 1 (less than 20%); level 2 (between 20% and 50%); and level 3 (more than 50%).
The program must be implemented in phases, so that the lessons learned from each stage serve as the basis for the next.

In the first phase, sensors must be installed every 5 km in pipes larger than 1.5 m; in the second, every 1 km in pipes larger than 1.5 m; and in the third, every 1 km for pipes smaller than 1.5 m.

This system must be interconnected with the URANO system, with the service orders for drainage network cleaning, and with COI-SP, as proposed in Action X.

Action related to item V of Article 300 of the PDE.

It will contribute to the characterization of flood-prone areas, identifying dwellings in imminent risk situations and supporting the adoption of safety and protection measures. It will enhance prevention and alert systems.

Main Municipal Body Responsible for the Action: Municipal Secretariat of Subprefectures.

ACTION XVII: PROJECT FOR RAINWATER RETENTION BOXES ON PRIVATE LOTS

Action aimed at minimizing the occurrence of flooding.

In 2002, Law No. 13,276 was enacted, requiring all constructions with an impermeable area greater than 500 m² to have rainwater retention boxes, in order to reduce the demand on the public drainage system resulting from the decrease in permeable area. Figure 66 illustrates the 2002 "Small Pools" Law.

LEI Nº 13.276, 05 DE JANEIRO DE 2002

(Regulamentada pelo Decreto nº 41.814/2002)
(Revogada pela Lei nº 16.402/2016)

TORNA OBRIGATÓRIA A EXECUÇÃO DE RESERVATÓRIO PARA AS ÁGUAS COLETADAS POR COBERTURAS E PAVIMENTOS NOS LOTES, EDIFICADOS OU NÃO, QUE TENHAM ÁREA IMPERMEABILIZADA SUPERIOR A 500M².

(Projeto de Lei nº 706/01, do Vereador Adriano Diogo - PT)

HÉLIO BICUDO, Vice-Prefeito, em exercício no cargo de Prefeito do Município de São Paulo, no uso das atribuições que lhe são conferidas por lei, faz saber que a Câmara Municipal, em sessão de 27 de dezembro de 2001, decretou e eu promulgo a seguinte Lei:

Art. 1º Nos lotes edificados ou não que tenham área impermeabilizada superior a 500m² deverão ser executados reservatórios para acumulação das águas pluviais como condição para obtenção do Certificado de Conclusão ou Auto de Regularização previstos na Lei 11.228, de 26 de junho de 1992.

Art. 2º A capacidade do reservatório deverá ser calculada com base na seguinte equação:

V = 0,15 x Ai x IP x t

V = volume do reservatório (m3)
Ai = área impermeabilizada (m2)
IP = índice pluviométrico igual a 0,06 m/h
t = tempo de duração da chuva igual a um hora.

§ 1º - Deverá ser instalado um sistema que conduza toda água captada por telhados, coberturas, terraços e pavimentos descobertos ao reservatório.

Figure 66: Illustration of the 2002 Rainwater Reservoirs Law

Since then, several adjustments have been made, with the latest—issued in 2016—establishing the minimum storage volume and limiting the maximum outflow rate.

Since the publication of the law, an impressive 830,000 housing units have been recorded, totaling 27 km² of land in the municipality of São Paulo allocated for the construction of residential buildings. In addition, another 4 km² have been used for commercial buildings and 0.5 km² for shopping centers.

Given these substantial figures, it is estimated that the storage requirement already exceeds 1,100,000 m³, equivalent to the combined capacity of the first ten priority storage works under the PDD.

Despite this enormous potential, some property owners have failed to comply with this legal obligation, resulting in storage tanks—originally verified at the *Habite-se* (occupancy permit) stage—being used for other purposes, thus not contributing to the attenuation of rainfall peaks. This noncompliance overloads the urban drainage system and accelerates the occurrence of flooding.

Therefore, it is proposed that the current regulatory framework be amended to require residential and commercial building owners to install automatic level sensors in each of their reservoirs and maintain a direct communication system with the municipal administration.

The Municipality would be responsible for the following activities:

- Updating the registry of existing storage tanks in developments (location and volume);

- Preparing the technical specification for the hardware (tolerance and installation position);

- Preparing the technical specification for the information transmission and reception protocol (frequency of data transmission and receipt of notifications);

- Equipping the Urano System with the technological tools necessary to receive and process the information;

- Establishing and carrying out training and inspection routines.

Action related to item V of Article 300 of the PDE.

This action will contribute to reducing the impact of interventions required for the implementation of urban reservoirs as a measure to mitigate flood risks, making the city more resilient to extreme rainfall events.

Lead Agency Responsible for the Action: Municipal Secretariat for Urbanism and Licensing.

ACTION XVIII: IMPROVEMENT OF THE PROJECT AND WORK REGISTRATION SYSTEM IN RISK AREAS

Action aimed at enhancing integration within the Municipal Administration.

As previously demonstrated, the decentralization process of the Municipal Public Administration helps restore a sense of community and brings local political leaders closer to popular demands. However, given the cross-sectoral nature of the actions required for risk management, coordinated and synergistic work among various agencies is essential.

Throughout the development of this plan, the technical team encountered the execution and registration of interventions based on parameters different from those established by the competent sector of the municipal administration.

Therefore, it is proposed to map existing systems and, if necessary, develop new ones, resulting in a portal interconnected with GeoSampa, where various administrative entities would be responsible for entering planned interventions (locational and functional characteristics). Additionally, the system itself would assess the interventions' compliance with the guidelines established by the administration.

For example, in the case of an emergency intervention in a stream area due to erosion, the Subprefecture, upon entering the intervention data into the system, would receive a *green signal* if it complies with the Drainage Plan's guidelines, thereby becoming part of the registry of existing projects.

This accelerates the process of achieving functional compliance for a project.

Action related to item V of Article 300 of the PDE.
It will assist in monitoring safety and protection measures, ensuring alignment among municipal actions in risk areas.

Lead Agency Responsible for the Action: Municipal Secretariat of Government.

ACTION XIX: SOCIAL URBANISM WORKS

Action aimed at reducing urban precariousness.

As important as reducing the population's exposure to risk is the requalification of occupied areas, promoting greater connection between residents and their living environment, thereby increasing their sense of belonging.

Thus, the Intervention Plans developed by the Subprefectures must always consider the need for actions that prevent reoccupation and simplify the land regularization process in areas occupied by informal settlements or urbanistically consolidated yet irregular areas. These are simple interventions that make use of the site's own topography and characteristics to create mixed-use areas (e.g., for leisure or sports).

Therefore, in addition to the set of minimum intervention projects for a risk area, a social urbanism intervention project should be developed.

It is clear that each area's program of needs is unique and should result from an in-depth study by the team responsible for developing the solution, but some key questions must be considered:

- Is there a connection between the space intended for urbanistic intervention and the nearby housing?

- Is it possible to walk through this area? Is the space accessible to people with physical disabilities or reduced mobility?

- Are there means of access to this space (public or private transport, bicycle, or even on foot)?

- Does the space provide safety? Can it be monitored?

- Does the space enable different types of activities (individual or group)?

Examples of interventions applying social urbanism concepts were developed during the preparation of the PMRR and are presented below as case studies.

JARDIM COMERCIAL II



Figure 67: Summary Sheet – Jardim Comercial II (Source: PMRR))



Figure 68: Digital Image of the Project for Jardim Comercial II (Source: PMRR)

These adjustments will complement the actions aimed at eliminating the risk in Jardim Comercial II. The proposed occupation plans will be integrated with the urban fabric of this community, ensuring a comfortable, accessible, and democratic public space.

ODASSI NAZZALI

For the treatment of the hydrological risk area CV – 12 (Odassi Nazzali), a project for the channeling of the stream was developed, featuring a U-shaped section made of precast concrete at the bottom of the channel. In addition, a gabion step was implemented above the U-shaped section, maintaining a conFigure tion close to the existing natural slope in the upper stretch of the channel.

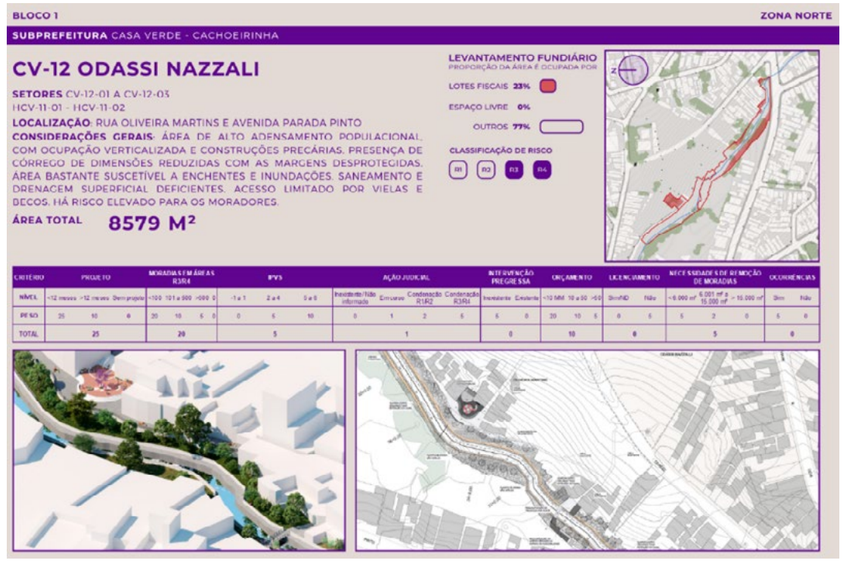

Figure 69: Technical Sheet of the Risk Area “Odassi Nazzali” (Source: PMRR)

The social urbanism project planned the creation of a green area adjacent to the stream, composed of small Atlantic Forest species and shrubs. In addition, a **square** was designed with facilities to serve the local community and provide a public space integrated with the existing landscape.



Figure 70: Digital Image of the Project for “Odassi Nazzali” (Source: PMRR)

TRIBO

The intervention for risk mitigation foresees the canalization of the stream using gabion walls and a gabion mattress (Reno mattress) bottom, as these are more flexible and better suited to the characteristics of the watercourse, allowing vegetation to develop between the stones over time.

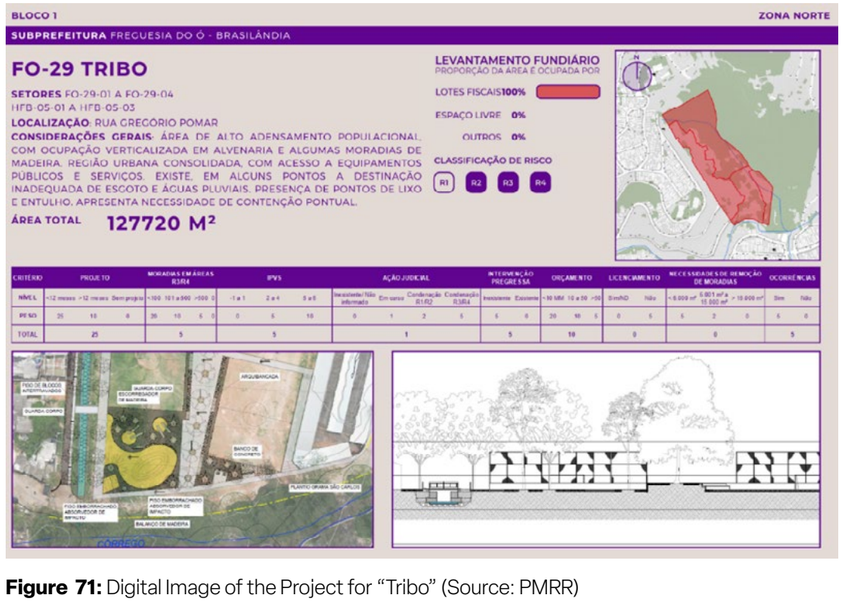

Figure 71: Digital Image of the Project for “Tribo” (Source: PMRR)

The social urbanism project planned the creation of a landscaped area on the forest-side bank of the stream, while on the opposite bank, the implementation of a **square** was proposed, equipped for recreational and sports activities, integrating the space already used by the local community for sports (soccer field).



Figure 72: Technical Sheet of the Risk Area “Tribo” (Source: PMRR)

In this context, it is essential to propose a Local Action Plan built in collaboration with the community, as socioeconomic issues, sustainability, and governance will be addressed, allowing public managers to implement public policies in the area undergoing intervention or resettlement.

Thus, it is necessary to develop social urbanism projects for the areas already registered, in order to establish a project database.

Action related to items I, II, III, IV, V, and VI of Article 300 of the PDE.

It will support the implementation of the Municipal Housing Plan (PMH), especially regarding urbanistic, legal, land tenure, and environmental regularization of precarious and irregular settlements, as well as structural interventions for risk reduction, establishing priorities, deadlines, and cost estimates.

Main Responsible Bodies: Municipal Housing Secretariat and Municipal Subprefectures Secretariat.

ACTION XX: CONTROL OF PLAN IMPLEMENTATION

Action aimed at ensuring the effectiveness and transparency of the implementation of the PMRR Action Plan.

In order to guarantee effectiveness, transparency, and public participation during the implementation period of the Municipal Risk Reduction Plan (PMRR), the creation of the Municipal Council for Risk Defense and Reduction (CMDRR) is proposed.
This Council will function as a consultative and deliberative body, composed of representatives from the public sector, civil society, and community leaders. It will include representatives from the municipal departments involved in the PMRR and may also include members from state and federal agencies, non-governmental organizations, religious institutions, and neighborhood associations.

The creation of the CMDRR aims to promote democratic and transparent participation in the PMRR's actions. The Council will draft its own Internal Regulations, and it is recommended that the Chair of the Municipal Civil Defense Council be held by the Municipal Executive Secretary for Priority Deliveries, while the Vice-Chair position should be assumed by the Coordinator of COMDEC.

The CMDRR will operate voluntarily, without remuneration for its members. Its main functions will be:

Monitoring PMRR Actions: supervise the implementation of the plan's actions, ensuring that resources are correctly applied and that interventions meet the needs of communities in risk areas;

Community Participation: organize public hearings and consultations to discuss progress, incorporating community demands and suggestions;

Transparency and Accountability: prepare progress reports and performance indicators, ensuring that all actions and investments are carried out clearly and responsibly;

Training and Awareness: promote capacity-building for community leaders and volunteers to identify and mitigate risks, strengthening community resilience;

Intersectoral Coordination: facilitate integration among departments and entities, coordinating actions in urbanization, housing, and waste management to optimize resources and improve efficiency;

Development of Governmental Targets: based on the PMRR's interdepartmental government targets, develop indicators to monitor each action according to the timelines and responsibilities set out in the plan.

It is recommended that, by decree, the CMDRR be tasked with monitoring and ensuring the implementation of the PMRR. To this end, it will develop monitoring tools and systematic updates of action indicators, ensuring resource allocation and compliance with investment targets.

Although the Council will manage these indicators, the effectiveness of the actions will be guaranteed by the Municipal Administration, allowing for more efficient oversight. The creation of the CMDRR fulfills the need for social oversight, ensuring that the PMRR is implemented inclusively and effectively, with greater representativeness and attention to the needs of communities exposed to risks.

This Council will enable a coordinated, integrated, and transparent approach to PMRR implementation.

Holistic action related to the entirety of Article 300 of the PDE.
Main Responsible Body: Municipal Government Secretariat.

SUMMARY OF THE ACTION PLAN AND ESTIMATED BUDGET

The table below presents the correlation between the proposed actions and the terminology introduced at the beginning of this section.

Thus, it can be seen that the non-structural and non-interventionist actions quadrant has the fewest propositions, while the structural and non-interventionist actions quadrant has the most.

This is a common feature in any type of planning — such as that developed in the PMRR — which seeks to anticipate problems and establish protocols for diagnosis, prognosis, and treatment.

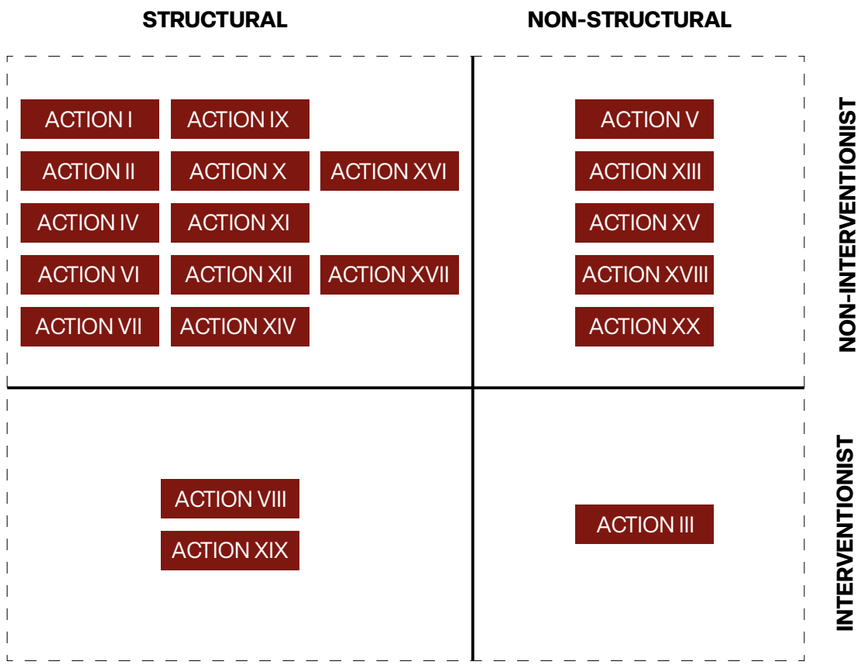

Figure 73: Summary Table of the Action Plan

Regarding costs, the quadrant characterized by structural and interventionist actions is the one that requires the greatest amount of financial resources and time for its implementation.

Table 24: Summary of the Action Plan (Source: PMRR)

	Action	Reference Value (millions)	Proposed Time Frame	Remarks
I	Establishment of a Governmental Target	No cost	1 Four-Year Period	
II	Creation of a Budgetary Structure for Fundraising	No cost	1 Four-Year Period	Need for specific study
III	Establishment of a Managing Council for Contracting Projects and Works in Risk Areas	No cost	1 Four-Year Period	
IV	Improvement of Procedural Flow	< R$ 5 million per year	1 Four-Year Period	Need for specific study
V	Update of Drainage and Containment Project Guidelines	R$ 1–2 million	1 Four-Year Period	
VI	Continuous Monitoring and Prioritization of Risk Areas	R$ 5–10 million for implementation + R$ 5–10 million per year for maintenance	1 Four-Year Period	Need for specific study
VII	Update and Approval of the PMH	< R$ 20 million	1 Four-Year Period	Need for specific study
VIII	Risk Mitigation Works	~R$ 11 billion	1–4 Four-Year Periods	
IX	Practical Measures to Prevent Reoccupation	R$ 2–5 million for implementation + < R$ 3 million per year for maintenance	1 Four-Year Period	Need for specific study
X	COI-SP	R$ 50–100 million for implementation + R$ 20–50 million per year for maintenance	1 Four-Year Period	Need for specific study
XI	Installation of Slope Movement Monitoring Sensors	R$ 5–20 million for implementation + R$ 5–10 million per year for maintenance	1–2 Four-Year Periods	Need for specific study
XII	Improvement of River and Channel Telemetry Networks	R$ 5–10 million for implementation + R$ 2–5 million per year for maintenance	1 Four-Year Period	Need for specific study
XIII	Educational and Training Actions	< R$ 5 million per year	1–4 Four-Year Periods	
XIV	Alert and Siren System	R$ 2–5 million for implementation + < R$ 3 million per year for maintenance	1–4 Four-Year Periods	Need for specific study
XV	Improvement of Solid Waste Management in Risk Areas	< R$ 5 million per year	1 Four-Year Period	Need for specific study
XVI	Monitoring of the Micro-Drainage Network	R$ 5–20 million for implementation + R$ 5–10 million per year for maintenance	1–3 Four-Year Periods	Need for specific study
XVII	Design of Retention Boxes in Private Lots	R$ 5–20 million for implementation + R$ 5–10 million per year for maintenance	1–2 Four-Year Periods	Need for specific study
XVIII	Improvement of the Municipal Intervention Registration System	R$ 5–10 million for implementation + R$ 3–5 million per year for maintenance	1–4 Four-Year Periods	Need for specific study
XIX	Social Urbanism Works	R$ 5–15 billion	1–4 Four-Year Periods	Need for specific study
XX	Monitoring of Plan Implementation	No cost	1–4 Four-Year Periods	

Table 25 aims to present CAPEX and OPEX expenditures over time, considering years zero to four as the first four-year period, five to eight as the second, and so on, until reaching the fourth four-year period.

The assumptions adopted for the preparation of Table 25 are as follows:

- Investments range from R$ 17 to 28 billion over a 16-year horizon;

- Slope stabilization and stream works represent between 15% and 30% of total investments over the 16-year horizon;

- New housing units represent another 15% to 30%;

- Social urbanism works represent between 30% and 50%;

- Monitoring actions account for between 2% and 3%.

The schedule presented below shows the temporal dimension of the activities planned in the Action Plan. It is worth emphasizing the importance of continued activities for the success of the PMRR.

	ACTION	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040
I	Creation of a Governmental Goal	■	■	■	■												
II	Creation of a Budgetary Structure for Resource Mobilization	■	■	■	■												
III	Creation of the Management Council for Contracting Projects and Works in Risk Areas	■	■	■	■												
IV	Improvement of the Procedural Flow	■	■	■	■												
V	Update of Drainage and Containment Project Guidelines	■	■	■	■												
VI	Continuous Monitoring and Prioritization of Areas	■	■	■	■												
VII	Update and Approval of the PMH (Municipal Housing Plan)	■	■	■	■												
VIII	Risk Mitigation Works	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
IX	Practical Measures to Prevent Reoccupation	■	■	■	■												
X	COI-SP	■	■	■	■												
XI	Sensors for Monitoring Slope Movement	■	■	■	■	■	■										
XII	Improvement of the Telemetry Network for Rivers and Channels	■	■	■	■												
XIII	Educational and Training Actions	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
XIV	Warning and Siren System	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
XV	Improvement of Solid Waste Management in Risk Areas	■	■	■	■												
XVI	Micro-drainage Network Sensing	■	■	■	■	■	■	■	■	■	■	■	■				
XVII	Retention Basin Projects on Private Lots	■	■	■	■	■	■	■	■								
XVIII	Improvement of the Intervention Registration System by the Municipality	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
XIX	Social Urbanism Works	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
XX	Plan Execution Control	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■

Figure 74: Action Plan Activity Schedule

Table 25: Summary of Investments (Source: Siurb)

N	Action	1Q 1A 2025	1Q 2A 2026	1Q 3A 2027	1Q 4A 2028	2Q 1A 2029	2Q 2A 2030	2Q 3A 2031	2Q 4A 2032	3Q 1A 2033	3Q 2A 2034	3Q 3A 2035	3Q 4A 2036	4Q 1A 2037	4Q 2A 2038	4Q 3A 2039	4Q 4A 2040	Total
I	Creation of a Governmental Goal	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
II	Establishment of a Budget Structure for Resource Allocation	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
III	Intersecretarial Ordinance for Project and Works Contracting in Risk Areas	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
IV	Improvement of Procedural Flow	3,0	3,0	3,0	3,0	3,0	3,0	3,0	3,0	3,0	3,0	3,0	3,0	3,0	3,0	3,0	3,0	48,0
V	Update of Drainage and Containment Project Guidelines	2,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	2,0
VI	Continuous Monitoring and Prioritization of Risk Areas	5,0	5,0	5,0	5,0	5,0	5,0	5,0	5,0	5,0	5,0	5,0	5,0	5,0	5,0	5,0	5,0	80,0
VII	Update and Approval of PMH	5,0	5,0	5,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	15,0
VIII--A	Risk Mitigation Works – SIURB Projects	390,0	390,0	390,0	390,0	385,0	385,0	385,0	385,0	330,0	330,0	330,0	330,0	100,0	100,0	100,0	100,0	4.820,0
VIII--B	Risk Mitigation Works – Housing Assistance	362,5	362,5	362,5	362,5	362,5	362,5	362,5	362,5	362,5	362,5	362,5	362,5	362,5	362,5	362,5	362,5	5.800,0
XIX	Practical Measures to Prevent Reoccupation	0,5	0,5	0,5	0,5	2,0	2,0	2,0	2,0	2,0	2,0	2,0	2,0	2,0	2,0	2,0	2,0	26,0
X	COI-SP	12,5	12,5	12,5	12,5	20,0	20,0	20,0	20,0	20,0	20,0	20,0	20,0	20,0	20,0	20,0	20,0	290,0
XI	Slope Movement Monitoring Sensors	1,3	1,3	1,3	1,3	5,0	5,0	5,0	5,0	5,0	5,0	5,0	5,0	5,0	5,0	5,0	5,0	65,0
XII	Improvement of River and Channel Telemetry Network	1,3	1,3	1,3	1,3	2,0	2,0	2,0	2,0	2,0	2,0	2,0	2,0	2,0	2,0	2,0	2,0	29,0
XIII	Educational and Training Actions	3,0	3,0	3,0	3,0	3,0	3,0	3,0	3,0	3,0	3,0	3,0	3,0	3,0	3,0	3,0	3,0	48,0
XIV	Early Warning and Siren System	0,5	0,5	0,5	0,5	2,0	2,0	2,0	2,0	2,0	2,0	2,0	2,0	2,0	2,0	2,0	2,0	26,0
XV	Improvement of Solid Waste Management in Risk Areas	3,0	3,0	3,0	3,0	3,0	3,0	3,0	3,0	3,0	3,0	3,0	3,0	3,0	3,0	3,0	3,0	48,0
XVI	Microdrainage Network Sensing	1,3	1,3	1,3	1,3	5,0	5,0	5,0	5,0	5,0	5,0	5,0	5,0	5,0	5,0	5,0	5,0	65,0
XVII	Private Lot Retention Box Projects	1,3	1,3	1,3	1,3	5,0	5,0	5,0	5,0	5,0	5,0	5,0	5,0	5,0	5,0	5,0	5,0	65,0
XVIII	Improvement of Municipal Intervention Registry System	1,3	1,3	1,3	1,3	3,0	3,0	3,0	3,0	3,0	3,0	3,0	3,0	3,0	3,0	3,0	3,0	41,0
XIX	Social Urbanism Works	312,5	312,5	312,5	312,5	312,5	312,5	312,5	312,5	312,5	312,5	312,5	312,5	312,5	312,5	312,5	312,5	5.000,0
XX	Plan Implementation Control	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Total		1.105,8	1.103,8	1.103,8	1.098,8	1.118,0	1.118,0	1.118,0	1.118,0	1.063,0	1.063,0	1.063,0	1.063,0	833,0	833,0	833,0	833,0	16.468,0
Possible sources																		
Treasury		22,8	22,8	22,8	22,8	47,0	47,0	47,0	47,0	47,0	47,0	47,0	47,0	47,0	47,0	47,0	47,0	655,0
FMSAI		317,3	317,3	317,3	317,3	328,5	328,5	328,5	328,5	328,5	328,5	328,5	328,5	328,5	328,5	328,5	328,5	5.211,0
FUNDURB - housing		337,9	337,9	337,9	337,9	337,9	337,9	337,9	337,9	337,9	337,9	337,9	337,9	337,9	337,9	337,9	337,9	5.800,0
FUNDURB - sanitation / urbanism		715,5	713,5	713,5	708,5	718,5	718,5	718,5	718,5	663,5	663,5	663,5	663,5	433,5	433,5	433,5	433,5	10.113,0
Specific linked sources		3,0	3,0	3,0	3,0	3,0	3,0	3,0	3,0	3,0	3,0	3,0	3,0	3,0	3,0	3,0	3,0	48,0
Financing		1.065,0	1.065,0	1.065,0	1.065,0	1.060,0	1.060,0	1.060,0	1.060,0	1.005,0	1.005,0	1.005,0	1.005,0	775,0	775,0	775,0	775,0	15.620,0

When analyzing the values presented in the table above, it becomes evident that the Municipality will need to allocate Treasury funds in conjunction with funds related to Actions directed toward risk areas.
A study conducted by SIURB demonstrates the need for financial contributions from additional sources beyond those listed in the table.

The activity flow presented alongside outlines the activities planned in the Action Plan, emphasizing the importance of simultaneous and predecessor activities for understanding the key actions required for structuring the Action Plan.

Figure 75: Workflow for Risk Area Activities

This Plan was composed with the typographies: **Elza** and **Noka**.

Photo: Córrego do Bispo



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