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# RISK PROFILE OF
# DUSHANBE

United Nations Development Programme (UNDP) project
*“Enhancing Urban Resilience to Disaster Risk and Climate Change in Central Asia”* (2024–2027)

# RISK PROFILE OF DUSHANBE

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This publication draws on publicly available strategic documents, reports, studies, and expert consultations in the field of disaster risk reduction and climate change adaptation (DRR/CCA). It serves as an essential component of the methodology for integrating these considerations into urban development processes. The views expressed in this publication are those of the authors and do not necessarily represent those of the United Nations (UN), including UNDP, or its Member States. Furthermore, the designations employed herein, their completeness, and the presentation of information are the sole responsibility of the authors and do not necessarily reflect the opinions of the organizations mentioned above. The boundaries and names shown, as well as the designations used in this document, do not imply official endorsement or acceptance by the UN. Facts and figures were collected from open data sources and may not always reflect the most up-to-date information.



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# INTRODUCTION

Dushanbe, the capital and largest city of Tajikistan, is home to more than 1.2 million people. Rapid population growth, dense urban development, aging infrastructure, and its location in a seismically active zone make the city highly vulnerable to earthquakes, flash floods, landslides, and the growing impacts of climate change.

The *Risk Profile of Dushanbe* was developed under the regional UNDP project *"Enhancing Urban Resilience to Disaster Risk and Climate Change in Central Asia"* (2024–2027). Its purpose is to support the integration of disaster risk reduction and climate change adaptation (DRR/CCA) measures into the city's socio-economic development plans for 2026–2030.

This document aims to assess disaster risks and potential climate change impacts and to provide recommendations and an action plan to guide the integration of disaster risk reduction and climate change adaptation into urban planning and development. The profile draws on publicly available strategic documents, reports, studies, and expert consultations in the field of DRR/CCA. It serves as an essential component of the methodology for embedding these considerations into urban development processes.

The analysis reveals that Dushanbe is exposed to a range of natural and climate-related hazards, including **earthquakes, flash floods, mudflows, landslides, extreme heat, and deteriorating air quality**. High population density, the presence of aging and informal housing, worn-out utilities, and the location of critical infrastructure in risk-prone areas further amplify potential impacts. The lack of sufficient disaster risk financing strategies, combined with a high level of vulnerability, can lead to consequences that hinder response and recovery, resulting in greater socio-economic losses.

**This document serves as a tool for:**

- identifying the main natural and climate-related hazards;
- analyzing the vulnerability of the population and infrastructure;
- identifying priority interventions and recommendations to strengthen urban resilience to natural and climate risks.


**The *Risk Profile of Dushanbe* is not a final action plan but rather an analytical framework that can serve as a starting point for developing strategies and measures for disaster risk reduction and climate change adaptation.**

## KEY HAZARDS

**Earthquakes.** Dushanbe lies in a high-seismicity zone, with an estimated magnitude of 8–9. As noted in the *2030 Tajikistan National Development Strategy (NDS)* and the *Dushanbe Green City Action Plan (GCAP)*, a significant portion of the city's housing stock and critical infrastructure, much of it built during the Soviet era, falls short of modern standards for seismic safety and energy efficiency.

**Flash floods and mudflows.** Intensive water flow in the Varzob and Luchob rivers, combined with heavy rainfall, regularly triggers mudflows, inundations, and flooding.

**Landslides.** Informal construction on the slopes of the Gissar Range heightens landslide risks. More than 36% of Tajikistan's territory is exposed to landslides and mudflows, including the suburbs of Dushanbe.

**Air pollution and climate change.** The number of dust storms has risen to 30–35 per year (compared to 2–3 in the 1990s). Over the past 50 years, the average annual temperature has increased by 3.2°C, while PM2.5 concentrations exceed WHO standards by two to three times.

**Climate risks.** Rising temperatures and shifting precipitation patterns are accelerating glacier melt and reducing the availability of water resources. According to the *National Adaptation Plan (NAP)* and the *NDS*, this poses a serious threat to drinking water supply, hydropower generation, and irrigation, while also increasing the frequency of droughts, extreme heat, and dust storms.

**Extreme heat and cold.** By mid-century, the number of days with temperatures above 40°C is projected to rise significantly, posing risks to public health and straining water, energy, and healthcare systems. Dushanbe is also vulnerable to severe cold spells: during the winter of 2007–2008, temperatures dropped to –20**°C**, disrupting power and district heating systems and causing significant socio-economic losses.

**Technological risks.** Aging utilities result in major losses — up to 60% in water supply and 40% in district heating. Residential fires, as well as fuel and chemical leaks during flooding in industrial areas, further increase risk levels. According to *GCAP*, solid waste management remains a concern: the city's landfill does not meet international standards, and outdated disposal methods create both sanitary and environmental hazards.

**Industrial risks.** Industrial enterprises within the city contribute substantially to air, water, and soil pollution. The absence of modern environmental monitoring systems exacerbates cumulative health and environmental risks.

## PAST DISASTERS

**Earthquakes.** The 1949 Khait earthquake (magnitude 7.5, more than 7,000 fatalities in the region) and the 1989 Gissar earthquake (magnitude 5.3, hundreds of casualties) illustrate the city's high seismic exposure. Recurrent tremors of magnitude 5–6 have periodically caused damage to buildings in Dushanbe.

**Flash floods.** In the 2010s, flash floods and heavy rainfall repeatedly disrupted transport links and municipal services in Dushanbe, causing prolonged interruptions and significant economic losses for both residents and the city.

**Mudflows and landslides.** Between 2000 and 2020, several major events in the suburban areas of Dushanbe damaged housing, roads, and utility infrastructure. International assessments confirm that these hazards pose an ongoing threat to the city.

**Dust storms.** The frequency of dust storms has risen from 2–3 incidents in the 1990s to more than 30 annually in the 2020s, disrupting transport and contributing to worsening respiratory and other health problems among residents.

**Extreme cold.** In 2007–2008, the city experienced an exceptionally cold winter, with temperatures dropping to –20°C. The event caused widespread disruptions to power and heating supplies, highlighting the vulnerability of Dushanbe's essential services.

**Annual losses from natural hazards in Dushanbe are estimated at 1–1.5% of GRP. Experience to date reveals key vulnerabilities, including insufficient seismic safety in the built environment, outdated utility systems, limited large-scale disaster response capacity, gaps in early warning mechanisms, and informal development in high-risk areas.**

## CITY VULNERABILITY

Dushanbe is home to over 1.2 million people, with 80% concentrated in the four central districts where population density exceeds 9,000 persons per $km^2$.

Rapid growth (≈2.5% annually) is driving the expansion of informal settlements on hillsides and river floodplains.

Vulnerable groups include older persons, children, people with disabilities, low-income households, and migrants, many of whom live in deteriorated housing and dormitories.

A significant share of low-income families reside in substandard housing and informal structures. Combined with high population density (over 9,000 persons per $km^2$ in central areas), these groups face heightened exposure to disaster impacts.

**annual population growth rate of**

**≈2.5%**

Aging utility systems lead to significant service losses — up to 60% of water in supply networks and up to 40% of heat in district heating systems.

Pumping stations, bridges, and substations are frequently located in flood-exposed zones.

The *Dushanbe Green City Action Plan (2022)* and *ESCAP Review (2020)* highlight that a large share of social infrastructure, including Soviet-era schools and hospitals, does not comply with modern seismic resilience and energy efficiency standards.

Disruptions to transport and utilities during flash floods and landslides pose risks to social stability.

Moreover, the rapid expansion of new construction, particularly high-rise residential developments, requires strict supervision of quality standards and adherence to building regulations. Weak enforcement could increase seismic vulnerability and operational risks over time.

**60%**

**40%**

**infrastructure decay**

## CRITICAL SECTORS

**Water supply.** Glacier melt and variable precipitation threaten water reserves, reducing river flow and groundwater levels.

**Agriculture.** Greenhouses and peri-urban farms are exposed to droughts, flash floods, and landslides, undermining local food security.

**Health.** Extreme temperatures, disease outbreaks, and air pollution raise illness rates, place additional strain on hospitals, and reduce workforce productivity.

**Transport.** Flash floods, snowfalls, and mudflows regularly damage transport infrastructure; damage to bridges and roads carries significant economic consequences for the city.

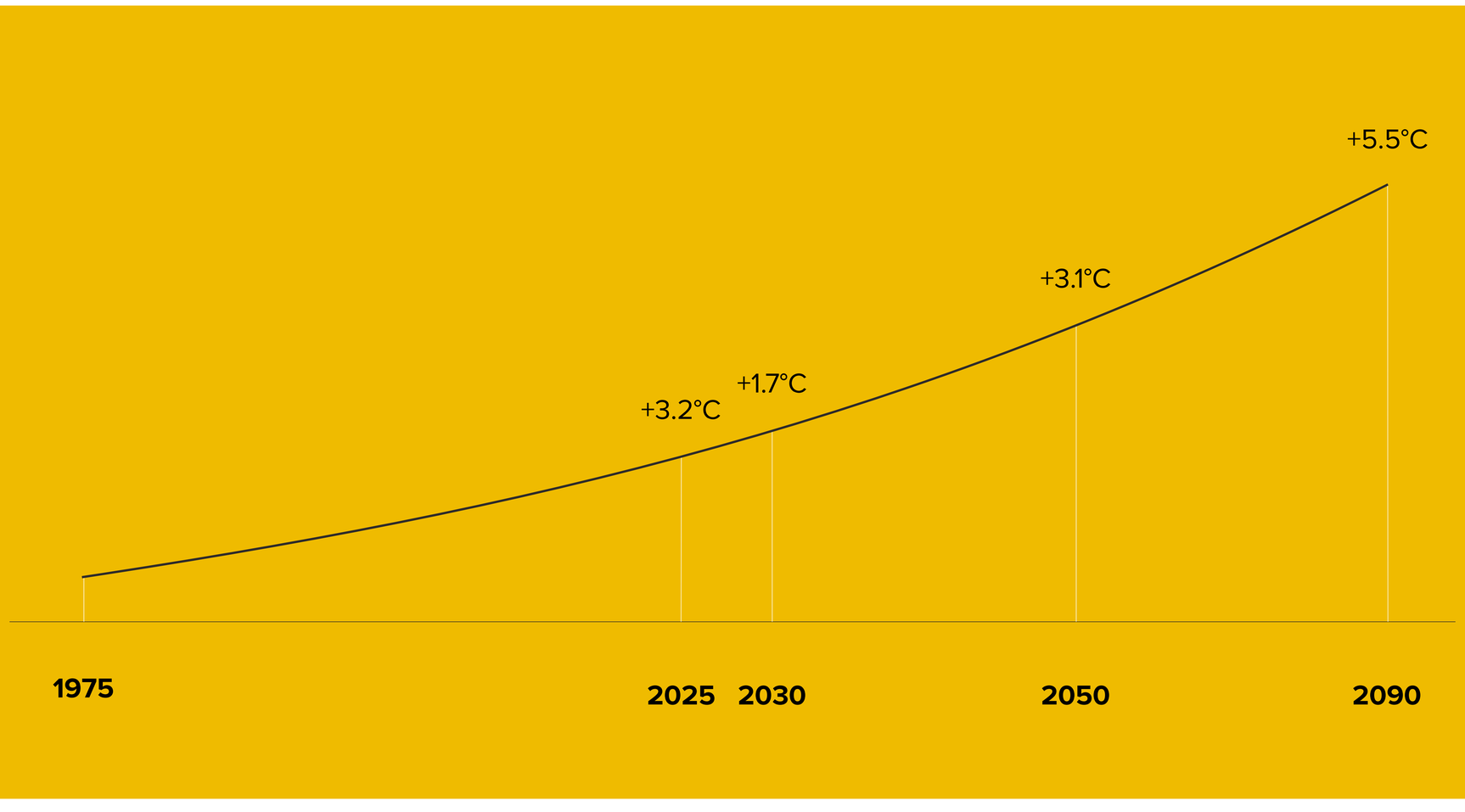
**Dushanbe's vulnerability stems from the interaction of social factors — such as poverty, rapid demographic growth, and informal construction — with the deterioration of physical infrastructure. This interplay heightens the city's susceptibility to the impacts of natural disasters and climate risks.**

## FUTURE RISKS

**+3.2°C**

Average annual temperatures in Dushanbe have risen by 3.2°C over the past 50 years and are expected to continue increasing at a rate exceeding the global average.

*Under a high-emissions pathway (RCP 8.5), the ADB/World Bank Country Climate Risk Profile (2021) projects:*



**Precipitation and Water Resources**

- Rainfall is projected to become more intense yet increasingly unpredictable, heightening the occurrence of flash floods, mudflows, and landslides.
- Prolonged droughts, combined with glacier retreat, are expected to worsen water scarcity and reduce hydropower and agricultural output.
- Agricultural losses are estimated at 15–50% by mid-century.

**up to a**

**-50%**

**decrease in crop yields by 2050**

**Urbanization and Asset Exposure**

- Accelerated population growth and the expansion of informal settlements are driving residential development into hazard-prone areas, including hillsides and floodplains. At the same time, large-scale high-rise construction is straining urban infrastructure and underscores the need for rigorous enforcement of building codes.
- Building stock and utility systems are projected to reach critical deterioration levels by 2050.
- Population densities exceeding 9,000 persons per $km^2$ in central districts significantly amplify the potential impacts of earthquakes, flash floods, and extreme heat events.

**population density**

**9,000**

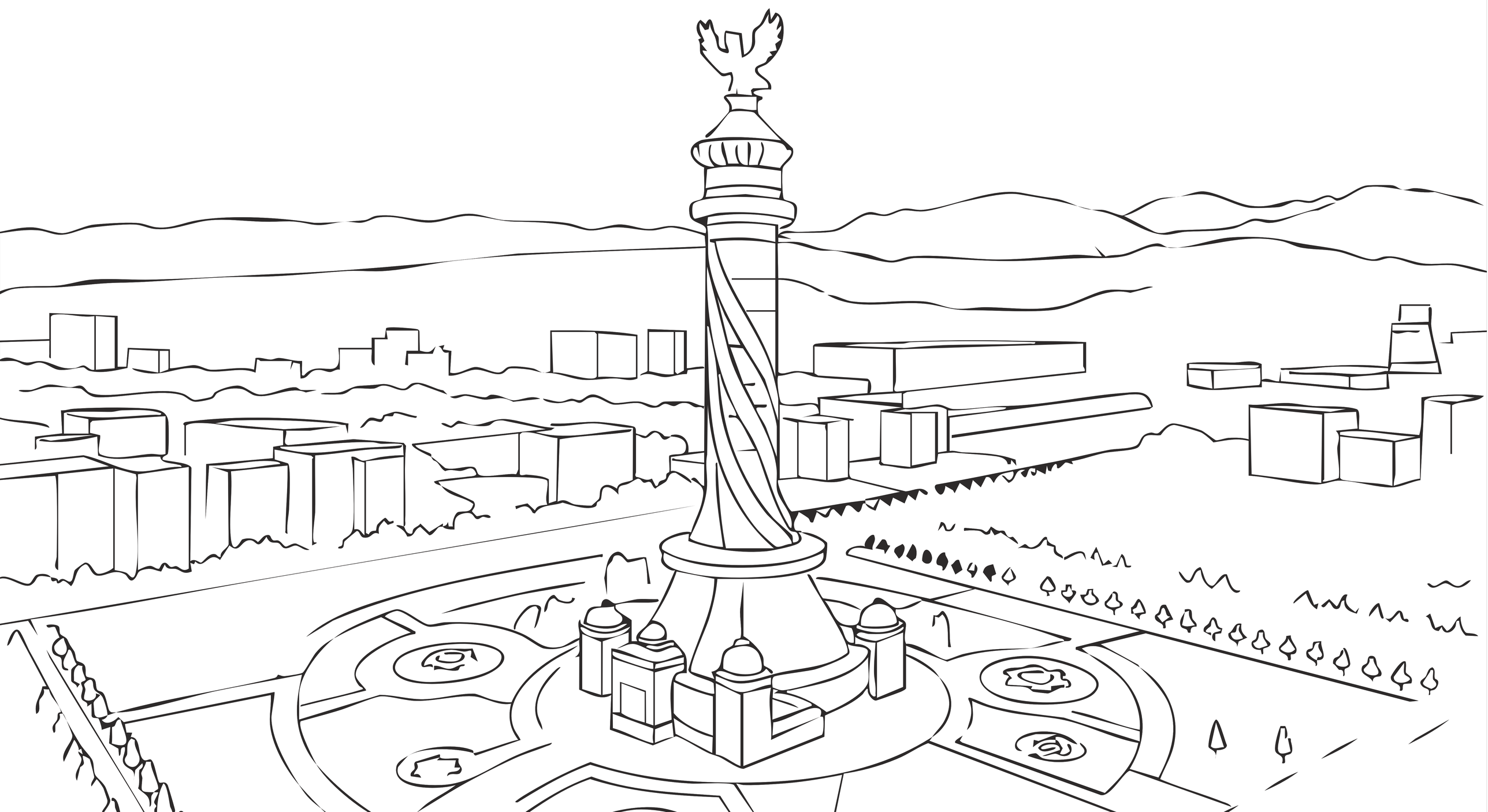
**persons per $km^2$**

**Overall Impacts**

Without proactive disaster risk reduction and climate change adaptation (DRR/CCA) measures, cumulative annual economic losses in the second half of the century could reach 2–3% of the city's gross regional product (GRP).

**2–3%**

**loss in GRP is expected**



# PRIORITY RISK AREAS

1

**Riverfront Areas (Varzob and Luchob)**

- Flash floods and mudflows constitute the primary hazards.
- Flood-prone zones contain residential areas, transport infrastructure, and industrial assets.
- Inadequate stormwater drainage capacity further magnifies risks, increasing both vulnerability and the scale of potential damage.

2

**Hillside Areas (Northeast and Southwest)**

- Informal settlements located on steep slopes are highly susceptible to landslides and mudflows.
- Soil instability and deforestation further exacerbate hazard levels.
- Limited access to infrastructure and evacuation routes heightens vulnerability.

3

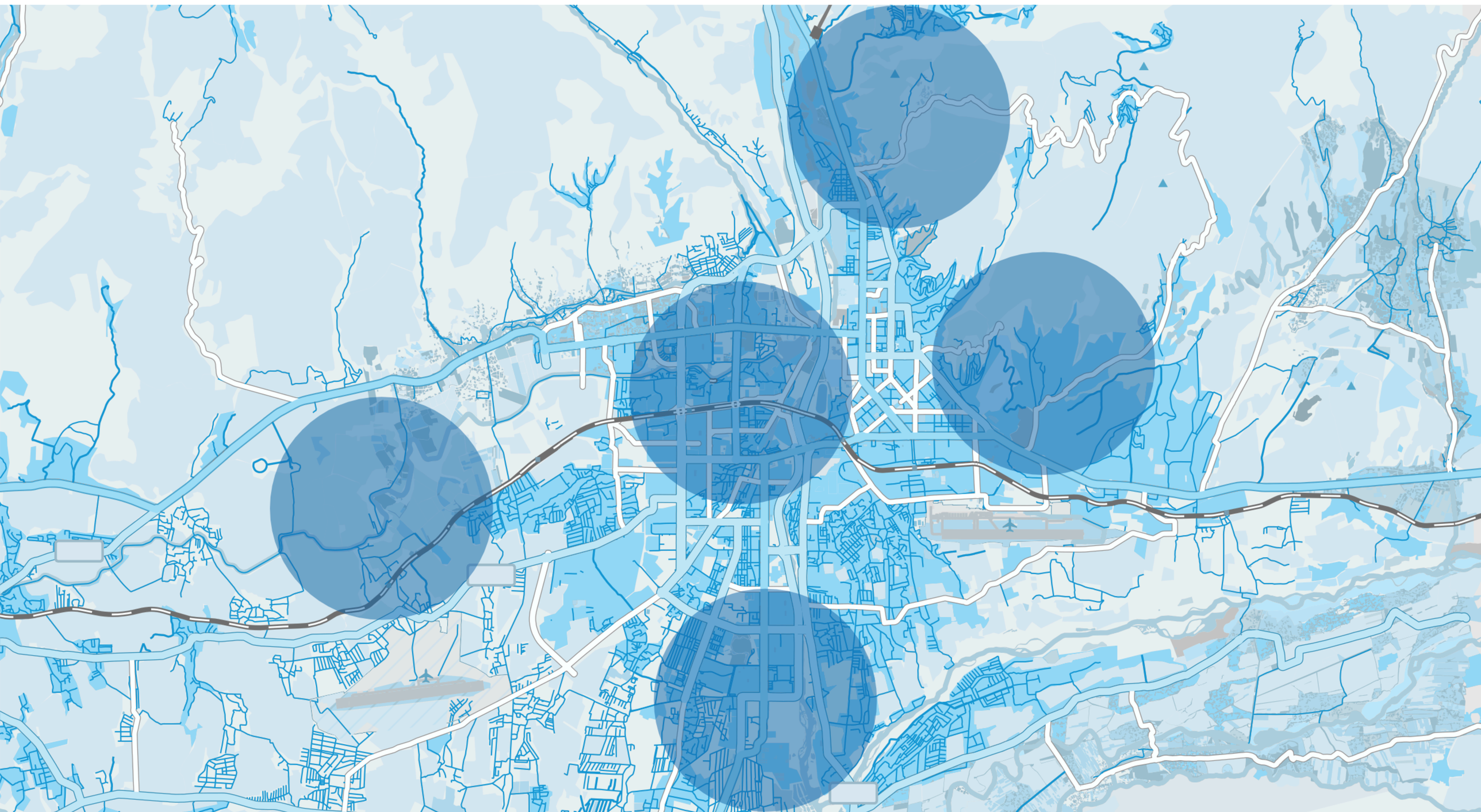
**Central Districts**

- The combination of high population density, aging Soviet-era housing stock, and intensive new construction renders the city center particularly vulnerable to earthquakes.
- Inadequate construction quality control could substantially increase risks.
- A shortage of green spaces amplifies the effects of heatwaves.

4

**Industrial Areas (South and East)**

- These areas face a high risk of flooding of fuel and chemical storage facilities, along with potential secondary industrial accidents triggered by flash floods.
- Aging utility networks also increase the likelihood of fires and leakages.



# RECOMMENDATIONS

**Strengthening Infrastructure**

- Reducing the city's exposure requires seismic assessments of critical facilities — such as schools, hospitals, bridges, expanding residential areas, and utility networks — followed by phased upgrades to withstand natural and climate-related hazards.
- Enhancing stormwater drainage and riverbank protection, combined with restrictions on new construction in floodplains and on unstable slopes, as well as targeted resettlement programmes, will help protect the most at-risk communities.
- Planning and implementation measures should combine traditional engineering solutions with nature-based approaches. This includes restoring riparian green zones, applying bioengineering techniques for slope stabilization, and expanding urban green areas to strengthen the city's long-term resilience and reduce risks.

**Disaster Risk Financing**

- Develop a disaster risk financing strategy with a focus on large-scale disasters.
- Integrate disaster risk reduction into existing public and private investments and projects.
- Establish relevant contingency and revolving funds for both public and private sectors.
- Develop and introduce disaster risk insurance products.
- Develop and introduce green and other types of resilience-building bonds.

**Climate Change Adaptation**

- Given the intensifying impacts of climate change, it is essential to prioritize reducing water losses in urban networks, modernizing stormwater systems, and introducing rainwater harvesting technologies.
- Expanding green areas and adopting green roof solutions can help mitigate urban heat stress, while promoting green transport will further reduce emissions.
- Increasing flood and mudflow risks in the face of climate change require comprehensive runoff management, including slope reforestation, the establishment of green corridors along riverbeds, and upgrades to drainage infrastructure in high-risk urban areas.
- In parallel, contingency plans should be developed to address extreme heat, dust storms, and episodes of air pollution.

**Institutional and Community Strengthening**

- Strengthening coordination among the Committee for Emergency Situations, the Hydrometeorological Service, the Mayor's Office, and relevant sectoral agencies is critical to ensure clear roles and responsibilities. Active engagement of the private sector and local communities should also be a priority.
- Regular public awareness and preparedness campaigns on earthquake, flood, and heatwave response — together with the establishment of neighborhood volunteer groups — can significantly enhance the city's overall readiness for emergencies.

### Data and Monitoring Systems

- Establishing an integrated risk database that consolidates information on natural hazards, vulnerability, and urban infrastructure is essential for evidence-based planning.
- Expanding the coverage of hydrometeorological stations and regularly updating maps of slopes, floodplains, and glaciers will provide more accurate risk assessments.
- Ensuring public access to this information, complemented by user-friendly mobile applications for early warning and community feedback, will significantly strengthen urban resilience.

## CONCLUSION

The *Risk Profile of Dushanbe* highlights that the capital of Tajikistan faces a wide range of natural, climate-related, and technological hazards, which together cause significant annual impacts on the population and the city's socio-economic development. Addressing these challenges requires a systemic approach that combines the seismic strengthening of buildings, the modernization of critical infrastructure, and the expansion of green spaces with improved early warning systems and active community engagement in disaster preparedness.

**References**

The preparation of this profile drew on the review of official documents, national strategies, and technical reports. The principal references include: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