Resilient Tashkent

Inputs into an Urban Resilience Strategy and Investment Program

WORLD BANK GROUP

February 2022

ACKNOWLEDGEMENTS

This report has been prepared by Arup working with Deltares and IKS in collaboration with the World Bank. The report benefits from important inputs from the Municipality of Tashkent and the team would like to express gratitude for the excellent cooperation, guidance and feedback received.

The Work Bank team included Axel Baeumler (Senior Infrastructure Economist), Rosanna Nitti (Senior Urban Specialist), Pablo Vaggione (Consultant), and Ildus Kamilov (Consultant). The Arup, Deltares and IKS Team included Sachin Bhoite, Grace Campbell, Liz Crump, Matthew Free, Hans Gehrels, Cathy Li, Giacomo Magnani, Nusrat Nurmukhamedov, Barbara Polidoro, Spencer Robinson, Bakhtiyar Sadriddinov, and Dima Zogheib. Strategic guidance and oversight was provided by Christoph Pusch (Practice Manager), Marco Mantovanelli (Country Manager, Uzbekistan), Ellen Hamilton (Lead Urban Specialist), Hideki Mori (Operations Manager), and David Sislen (Practice Manager). Peer review comments from Horacio Terraza (Lead Urban Specialist), Cathy Lynch (Senior Urban Specialist), and Steve Rubinyi (Disaster Risk Management Specialist) are gratefully acknowledged. Administrative support was provided by Elena Klementyeva (Program Assistant), Lisa Fonick Haworth (Office Manager), and Marco A. Gallardo (Information Assistant).

The report was developed with support from the Japan-World Bank Program for Mainstreaming DRM in Developing Countries, which is financed by the Government of Japan and managed by the Global Facility for Disaster Reduction and Recovery (GFDRR) through the Tokyo Disaster Risk Management Hub.

PREFACE

The purpose of this report is to provide technical input for decision makers at the Municipality of Tashkent and related Ministries and Agencies at the national level in Uzbekistan to help address some of the key shocks and stresses Tashkent is facing. It focuses on natural hazard related shocks and stresses, including earthquakes, urban flooding and climate change, and presents recommendations that will help Tashkent to commence its urban resilience journey.

The report was developed between February 2019 and December 2021 and is based on a very productive collaboration with the Municipality of Tashkent and related stakeholders through a series of in-person and virtual meetings and workshops. The report serves as a guide to decision makers and technical teams in two key aspects:

- **First, it makes available the evidence base to better understand some of Tashkent's most pressing resilience challenges.**
- **Second, it outlines a framework on how to address some of the identified challenges in a practical and systematic manner.**

More work remains to be done, including the identification of specific infrastructure focused investment programs to enable the built environment to better withstand the shocks and stresses Tashkent is facing. A first interactive workshop held in October 2021 and facilitated by GFDRR's City Resilience Program (CRP) resulted in specific investment proposals which are a good base for further discussions.

Tashkent has a unique opportunity to become the first city in Central Asia to join a growing number of global cities that have adopted and are implementing comprehensive Urban Resilience Strategies and Investment Programs. This report is a first step in that direction.

CONTENTS

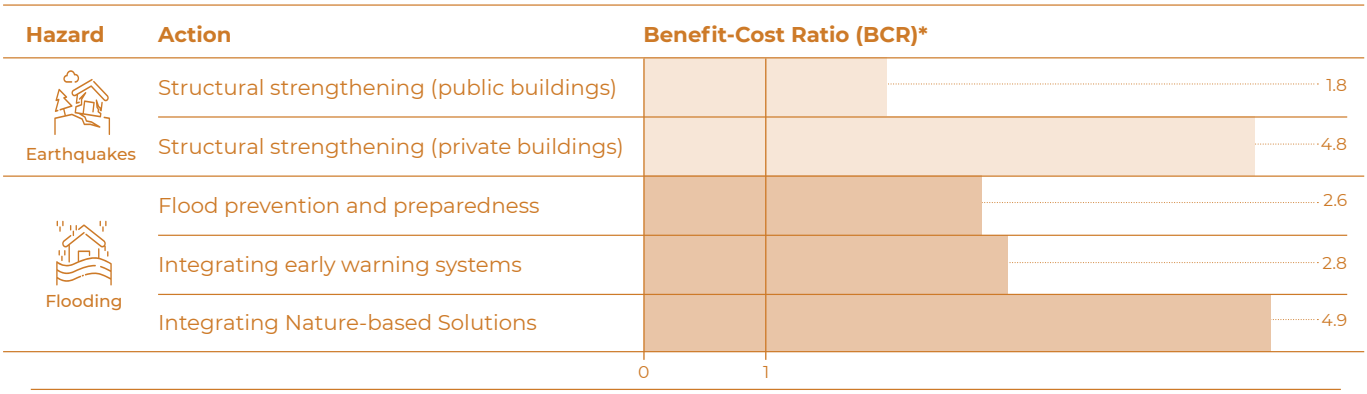
EXECUTIVE SUMMARY

THE OPPORTUNITY

Tashkent's strategic regional position and its projected growth, combined with the natural and human-made hazards it faces, will bring both opportunities and challenges to the city. One of Central Asia's most populous and dynamic cities, Tashkent is the administrative and financial center of Uzbekistan, and its business continuity is essential for the country. The city contributes 16.2% of national GDP[1] and is the largest urban market for goods and services in the central Asian region. Tashkent has strong transport, logistics and retail sectors coupled with a significant industrial heritage. Its advantageous location on the transit routes between China and Europe and with neighboring Kazakhstan, combined with declining restrictions on cross-border movements of goods and people, contribute to the increase in economic activity and the growing inflow of visitors both domestic and international.

Tashkent is expected to continue to grow further at a rapid pace propelled by Uzbekistan's ambitious social and economic reforms. Tashkent is therefore at a very critical stage in its urbanization trajectory. The relaxation of the residence registration system and the development of land markets is likely to trigger urban expansion which is already taking place in the city's fringes. Its built environment needs to accommodate this growth. However, its buildings and infrastructure are already critically vulnerable to a number of hazards, including earthquakes, flooding and climate change, and future growth can further increase risks. It is essential that these risks are managed appropriately.

Resilience benefits largely exceed their costs. Resilience actions can help Tashkent avoid losses from the natural hazards it is likely to face, as well as deliver long term economic, social, and environmental benefits. The benefits of structural strengthening of public and private buildings can help prevent loss of lives, disruption to social services and the massive costs of rebuilding damaged facilities. Investments in flood prevention and preparedness, including early warning systems can reduce damages to physical assets from the flooding events themselves, as well as the loss of livelihoods. Developing nature-based solutions in flood-prone areas have been shown to deliver benefits beyond reducing risks from flooding. For example, their benefits include improved health and well-being of urban citizens, and making the city attractive to visitors and further investment. Research into the types of actions described in this report demonstrate that there is a strong economic case for investing in resilience. The adjoining infographic illustrates the median benefit-cost ratios recorded across a large sample of projects, finding that the value of resilience actions almost always outweighs the costs.



*Median BCRs review and analysis of over 100 investments focused on prevention and preparedness in Europe.
Source: World Bank (2021) Investment in Disaster Risk Management in Europe Makes Economic Sense

City Resilience Strategies prepared under the 100 Resilient Cities Program

A resilience perspective is key to get Tashkent's urban development "right". Instead of failing when disrupted, resilience is the ability of the city's systems to survive an immediate shock, adapt to ongoing consequences, and thrive in a changing long-term context, including preparing to face the effects of climate change. A resilience perspective will help increase the effectiveness of urban planning and improve Tashkent's ability to manage risks. Most importantly, it can help ensure that its existing urban and newly built infrastructure will adapt to the shocks and stresses the city is facing and help to prepare to face the effects of climate change. A reputation and proven track record for resilience will also increase Tashkent's attractiveness to, inter alia, business, investment, and tourism which will support economic and social development. It is therefore an essential consideration for Tashkent's growth and will contribute positively to Uzbekistan's urbanization agenda.

Tashkent has the unique opportunity to be the first city in Central Asia to develop an urban resilience strategy and investment program. Cities around the world are developing resilience strategies to enhance their resilience to local and global shocks and stresses. This report is intended to reinforce Tashkent's potential to be the first city in Central Asia to develop a resilience strategy and through its implementation become a role-model to other cities in the region as well as join other cities globally that are also leading the way in enhancing urban resilience.

ASSESSING RESILIENCE IN TASHKENT

Over half the population of Uzbekistan live in areas of high risk from natural hazards.[2] Of the natural hazards the country is exposed to, earthquakes result in the largest economic losses, with flooding causing the second largest. Tashkent is situated in a region of high tectonic activity and is one of the cities in Central Asia most exposed to potential earthquake hazards. While flooding is less destructive and severe, its regular seasonal recurrence stresses the city's outdated drainage infrastructure and causes disruption to day-to-day activities. Seismic events and flooding were identified in the Tashkent Urban Resilience Diagnostic (2021)[3] as the priority risks to Tashkent and make up the focus of this report.

PRIORITY RISKS AND POTENTIAL IMPACTS IN TASHKENT

Earthquakes

5.0 Mw
Earthquake

115
fatalities

USD 243 million (UZS 2.6 trillion)
economic loss

139
residential buildings collapse

6.7 Mw
Earthquake

22,626
fatalities

USD 16 billion (UZS 172 trillion)
economic loss

21,000
residential building collapse

Earthquakes can lead to significant loss of life in Tashkent. Catastrophic earthquakes, like the Mw = 6.7 scenario, are devastating but rare, occurring only once in 100s to 1000s of years. Moderate earthquakes, like the Mw = 5.0 scenario, are more frequent, potentially occurring every few 10s to 100s of years, but can still cause fatalities from the collapse of buildings, as well as damage to infrastructure, disruption of services, and fires, for example if gas pipes are affected.

Rainfall/Flooding

4-9%
Roads in Tashkent flood annually

USD 40.3 million (UZS 433 billion)
annual economic loss

USD 6.7, 5.5 and 5.4 million (UZS 72, 59 and 58 billion)
annual damage in Yunusabad, Shaykhantokhur and Almazar districts respectively

Flooding in Tashkent is recurrent, causing erosion and property damage from inundation and damage to buildings especially in the historic city. Flooding also causes economic losses through disruption of services like traffic jams and water pollution.

Source: World Bank (2021). Tashkent Urban Resilience Diagnostic, Uzbekistan

Note 1: The above projected losses for earthquakes are based on possible earthquake scenarios of single earthquake events that could occur in the future near Tashkent. The projected losses for flooding are based on a probabilistic assessment of pluvial type flooding (i.e. surface run-off flooding following intense rainfall).

Note 2: A USD to UZD exchange rate of 10,754.3 (25/11/2021) was applied to all USD values presented in this report (source: xe.com).

In the last century, notable seismic events have caused widespread damage and casualties in Tashkent and in other parts of Uzbekistan. The seismic hazard and risk assessment undertaken as part of the Tashkent Urban Resilience Diagnostic (2021)[3], considered the seismic hazard and risk from two earthquake scenarios: a magnitude 6.7 Mw and a magnitude 5.0 Mw earthquake.

A magnitude 6.7 Mw earthquake would be catastrophic for the city and the country, causing estimated total economic losses of USD 16 billion (UZS 172 trillion), equivalent to twice the city's 2019 Gross Value Added (GVA) of UZS 86 trillion. The scenario analysis indicated that approximately 21,000 buildings (15% of residential buildings) in Tashkent would potentially collapse in this event and fatalities could rise above 22,000. A seismic event of this magnitude occurred in 1886, and was reported to be the largest historical earthquake event in the vicinity of the city. A 6.7 Mw earthquake is a rare but potentially catastrophic event, which may only recur at or near the city every few 100s or 1000s of years.

1966 Tashkent Earthquake Memorial

Flood in Tashkent streets
Source: https://www.publika.uz/uploads/2014/05/?C=S;O=A.

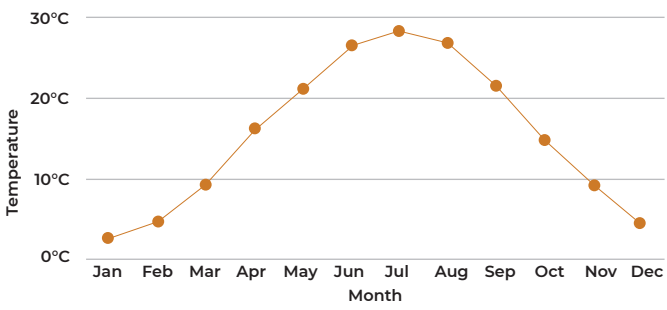
A magnitude 5.0Mw earthquake, could cause significant damage to the city, with total estimated losses of around USD 243 million (UZS 2.6 trillion), equal to about 3% of the city's GVA.[3] The scenario analysis indicated that hundreds of residential and other buildings (<1% of all buildings) could collapse and approximately 115 people could lose their lives, with most of these fatalities occurring because of the collapse of low-rise residential buildings and school buildings. A seismic event of this magnitude is similar in size to the earthquake in 1966 which destroyed much of Tashkent, affected 100,000 people, and resulted in an estimated USD 300 million (UZS 3.2 trillion) in economic losses. The 5.0 Mw earthquake is a smaller but more frequent event, potentially occurring every few 10s to 100s of years.

Flooding causes recurrent seasonal disruption in Tashkent affecting all city districts. While no fatalities are associated with flooding, the economic losses can be estimated to be approximately USD 40.3 million (UZS 433 billion). Flooding, following heavy rainfall, is a regularly occurring seasonal problem causing considerable material damage and disruption through road blockages and business interruption across the city. River flooding – referred to as fluvial flooding – is not typically a significant issue to Tashkent. However, if the city grows and expands onto the low-lying flood plain to the east of the municipal area, the potential for river related fluvial flooding to impact new urban areas would increase.

Aerial photo of Tashkent

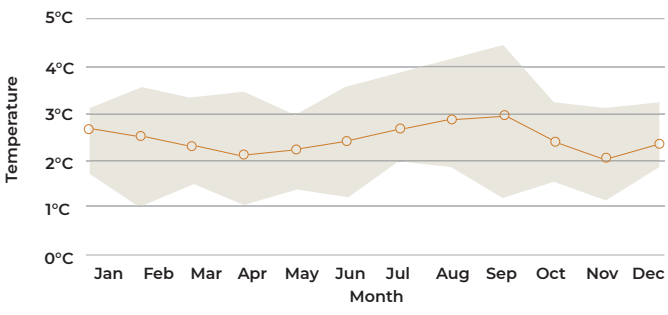
Climate stress threatens to increase damage and deterioration of infrastructure and the strain on energy and water utilities. Climate change hazard modelling predicts that Tashkent will experience drier conditions towards the end of the century, with an increased occurrence of severe drought. Under the highest emissions scenario (Representative Concentration Pathway - RPC8.5) the annual number of hot days could increase by 60 days by 2080-2099, while July mean temperatures would increase by almost 6 °C at the end of the century. The increase of heatwave and drought occurrence will drive up the demand for energy and water, which, if unmet, will potentially affect the health of the population and the city's economic activity.

Historical Observed Monthly Mean Temperature for Uzbekistan at Tamdy District for 1986-2005



The graph shows 1986-2005 baseline climate.

Projected Change in Monthly Temperature for Uzbekistan at Tamdy District for 2040-2059



Projected changes in monthly mean temperature. The graph shows projected changes for 2040-2059 under high emissions (RCP8.5) scenario.

Tashkent is already exposed to multiple, intersecting shocks and stresses. Stakeholder engagement in Tashkent confirmed earthquakes and flooding as the two key natural shocks and stresses in Tashkent. It also provided insights into a broader range of challenges the city is facing. Many stakeholders pointed to stresses including ageing infrastructure, infrastructure failure, poor air quality, population growth, traffic congestion, inadequate sanitation, and environmental degradation. In the case of an already stressed city, if a large shock such as an earthquake were to occur, this could trigger a cascading series of negative events.

KEY STRESSES*


Ageing infrastructure


Population growth


Power outage


Inadequate education


Traffic congestion


Poor air quality


Inadequate health systems


Environmental degradation


Inadequate public transport

OTHER STRESSES

Lack of green space
Drought
Extreme heat
Severe storms
Extreme cold
Lack of biodiversity
Uncontrolled urban development
Unemployment
Lack of investment
Lack of affordable housing
Financial economic crisis
Disease outbreak

*Source: Stakeholder Inception Workshop, Tashkent, February 2020

ENHANCING RESILIENCE

A resilience trajectory for Tashkent, from vision to action. Enhancing resilience will support Uzbekistan in its efforts towards the implementation of the Sustainable Development Goals (SDGs) while creating opportunities to deliver concrete benefits for the population of Tashkent in the short, medium, and long term. Achieving high-level agendas and tangible improvements requires a vision that is underpinned by action. Tashkent' framework for resilience identifies specific risks, prepares the city for the resilience journey, and can transform Tashkent through investments in resilience. The resulting resilience strategy will not only save lives, it will also enhance well-being for the metropolis's citizens.

VISION FOR A RESILIENT TASHKENT

Tashkent will be a city that is able to withstand, respond to and recover from future earthquakes, flooding and the potential impacts of climate change, by transforming its built environment for the benefit of its people and visitors; maintaining its position as the most attractive, safe and sustainable city in the central Asian region - the capital of Uzbekistan.

RESILIENCE PILLARS

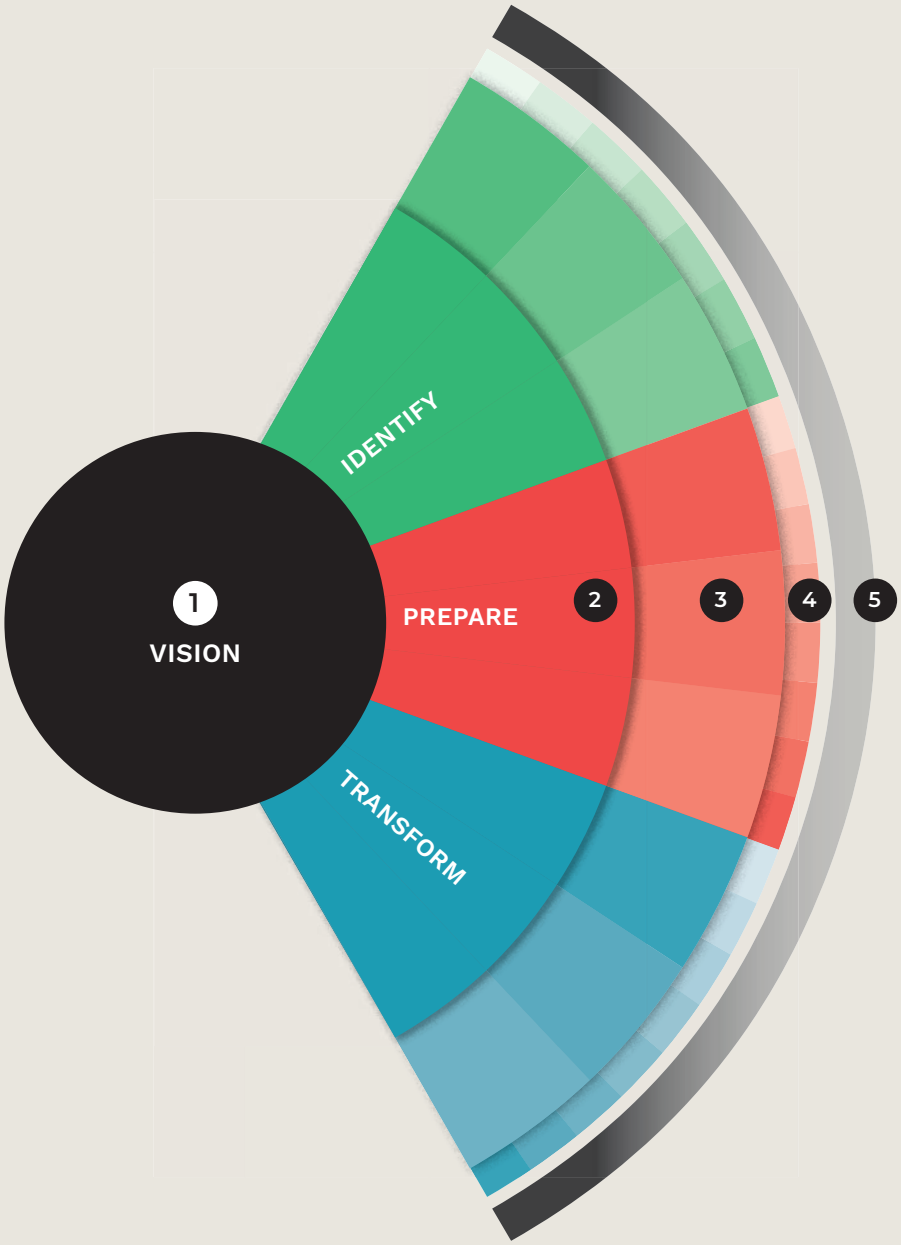
Identify - Making resilience information available, reliable, and usable. A critical first step in managing and responding to risk is to identify shortfalls in the ability to forecast resilience challenges that severely constrain any reliable analysis and therefore the capacity to be prepared and ability to respond. The resilience challenge and specific hazard identification process should be systematic, from the production of digital models to map hazards, vulnerable populations, and exposed assets in the built environment, to quantitative hazard assessments that use data to anticipate impacts of known and unknown risk. It is then essential to establish knowledge transfer mechanisms that convert analysis into useful decision-making resources and raise awareness among senior policy makers and technical teams. Socio-cultural and gender inclusive approaches should ensure that shocks and stresses do not fall disproportionately upon marginalized populations.

Prepare - Improving operational capabilities for resilience-informed urban planning, regulations and design. Tashkent's preparedness for resilience is undermined by ageing infrastructure and outdated technical designs. For Tashkent to become more resilient, modern resilience principles must be embedded in urban planning instruments, building codes and in the lifecycle of new projects, from identification to implementation, as well as in budgeting and financing decision making. Resilience thinking should be championed by senior policy makers and instituted across municipal departments and other stakeholders through regular capacity building exercises and skills training to enhance their ability to manage resilience across sectors.

Transform - Transforming the built environment though risk-sensitive investments. A resilient Tashkent requires the implementation of priority actions to lower the impact of disaster events. Widespread and incremental retrofits to education and health facilities and infrastructure networks are essential interventions, as are integrated resource management and long-term strategies to enhance resilience that work with nature-based solutions. Piloting these will lay the groundwork for integrated interventions in, for example, vibrant greenery and public spaces combined with sustainable urban drainage to reduce future flood risks. Socio-cultural interventions, for example gender inclusivity, should ensure that shocks and stresses do not fall disproportionately upon marginalized populations.

ELEMENTS OF THE RESILIENCE FRAMEWORK

Instead of failing when disrupted, resilience is the ability of the city's systems to survive an immediate shock, adapt to ongoing consequences, and thrive in a changing long-term context, including preparing to face the effects of climate change.



1. The **VISION** represents Tashkent's long-term aspiration for a resilient future.

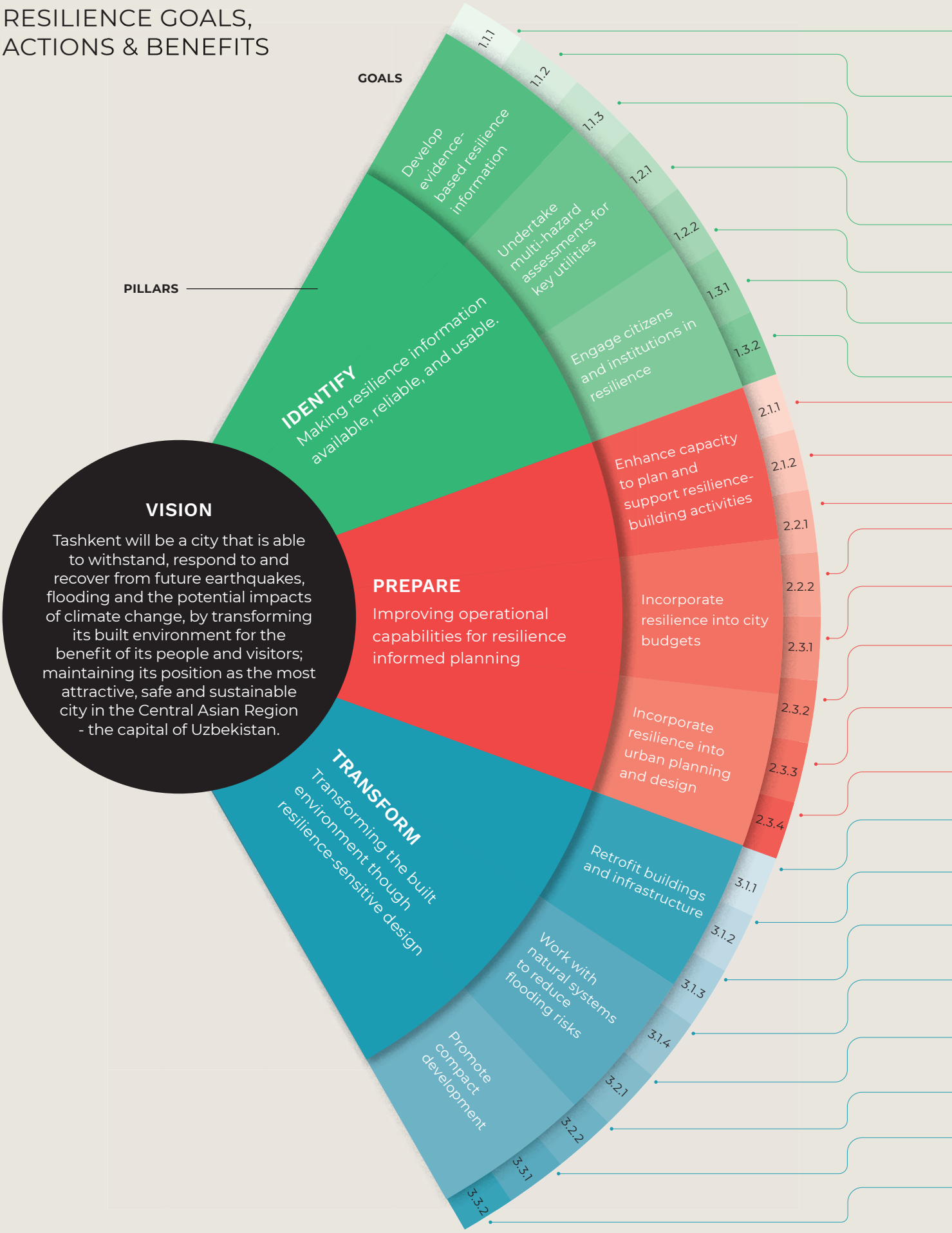
2. **PILLARS** depict the main resilience enhancing functions that Tashkent must perform in both normal times and in times of disruption, namely identify resilience challenges and raise awareness; prepare for and increase capacity in resilience; and invest in transforming Tashkent's urban infrastructure and environment.

3. **GOALS** are short to long-term statements of purpose that will support the delivery of Tashkent's vision. For example, to identify challenges through creating an improved evidence base; to embed resilience in urban planning and management; and to retrofit building and infrastructure.

4. **ACTIONS** are short to long-term prioritized activities that Tashkent should consider investing in to fulfil the goals. These include capital investments as well as supporting activities on existing and new infrastructure. Actions can be simple or complex tasks, mainly at the local level but they may also include some interventions that connect to the national level. To be effective, actions require collaboration between different stakeholders and levels of governance in their design, implementation, ownership, and evaluation. Examples include developing a screening system for prospective urban development and infrastructure investments for their contribution to resilience and the retrofitting and rebuilding education and health facilities to be safe from earthquakes.

5. **RESILIENCE BENEFITS** are the measurable positive contributions resulting from the actions that can directly or indirectly contribute to resilience of the city. For example, an improved coordination of maintenance and risk management through a shared water asset inventory and management system, would result in reduced monetary losses from water pipe leakages and service interruptions and reduce costs associated with frequent maintenance.

RESILIENCE GOALS, ACTIONS & BENEFITS



ACTIONS	BENEFITS
1.1.1 Create a 3D digital model of buildings, infrastructure, and population density	· Data needed to understand building performance and anticipate potential losses associated with future earthquakes and flooding events. · Shared asset inventory for improved coordination of risk management and risk informed development.
1.1.2 Develop a full probabilistic model for seismic shocks	· Geographically informed evidence-base of seismic activity that predicts potential impacts of future earthquakes to buildings and infrastructure. · Data needed to determine requirements for future design and retrofitting of existing assets to increase resilience. · Potential informed financial protection through insurance policies for damages. · Increased digital expertise on natural hazard and risk modelling, risk-based decision making, and dealing with uncertainty.
1.1.3 Develop an integrated digital flood and drainage infrastructure model	· Accurate analytics on Tashkent's hydraulic and hydrological systems through flooding simulations to support the implementation of nature-based drainage and flood risk management solutions. · Coordinated development planning through stakeholder consensus on flood risk, potential measures, and design strategies for protecting existing development and planning of new developments. · Increased digital expertise on hazard and risk modelling, risk-based decision making, and dealing with uncertainty.
1.2.1 Undertake a baseline seismic risk assessment of all education, health, and emergency response facilities	· Provision of a reliable source of information on risks to education and health sector facilities. · Efficient use of resources through targeted investments. · Implementation plans include operational continuity of the facilities.
1.2.2 Prepare multi-hazard assessments for reservoir and related infrastructure	· Data-driven understanding of potential risk of cascading failure of dams and related infrastructure. · Clear and accessible data of reservoirs and canals for planned upgrades. · Identification of sources of potential cascading infrastructure failure from earthquakes and flooding.
1.3.1 Institute risk and resilience knowledge transfer across sectors and to citizens	· Reliable and accessible information on hazard, risk, and resilience. · Consensus building for resilience building activities.
1.3.2 Conduct a Gender Equality and Social Inclusion baseline assessment at city and district level	· Identification of disadvantaged groups (e.g., women, disabled, minorities, poor, etc.), their spatial distribution and factors that are conducive to inclusive planning in Tashkent. · Improved risk management through involvement of people.
2.1.1 Undertake digital skills training and capacity building to manage seismic and flooding risks	· Digital skills building for use of data driven analysis and decision-making. · Seismic and flood resilient design and modelling skills to improve performance of buildings and infrastructure. · Maintenance of city-wide cadastral data, calculating risk and visualizing results.
2.1.2 Establish a resilience team to lead and coordinate the implementation of the resilience strategy	· Leadership on resilience agenda in the city to develop cross departmental resilience plans · Coordination and knowledge sharing of risk related information across sectors.
2.2.1 Include resilience investment measures into the city's budgets	· Support for resilience building activities that are incentivized by being eligible for increased funding. · Higher and more predictable returns on investments in infrastructure with the added benefit and security of avoided losses.
2.2.2 Screen prospective investments for their contribution to resilience	· Ensuring that new developments do not pose new or increased risks to communities. · Promotion of new technologies and solutions to increase capacity of city to withstand current and future shocks and stresses.
2.3.1 Embed resilience into policies, plans and zoning regulations for new or upgraded urban development	· Resilience thinking and concepts embedded into urban development policies, plans and regulatory frameworks, explicitly integrating climate considerations into land use and zoning regulations · Incentives for urban development that contributes to resilience. · Private sector engaged in resilience agenda.
2.3.2 Develop a citywide feasibility study for enhancing natural and semi-natural urban areas designed and managed to deliver ecosystem services (green-blue infrastructure)	· Increased awareness of nature-based solutions which include natural and semi-natural urban areas designed and managed to deliver ecosystem services like flood mitigation and biodiversity. · Incentives for nature-based solutions within upgrading and new developments. · Multiple benefits like biodiversity, cooling, improving air quality, providing spaces for outdoor public activities, and improving the city's image.
2.3.3 Prepare a resilience-led regeneration action plan for Tashkent's urban core	· Encouragement of compact development · Preservation of the rich cultural heritage of Tashkent and generating opportunities for adaptive reuse. · Improvement of quality of life for residents and the experience for tourists. · Prioritize the protection of buildings and sites that are most vulnerable to damage and collapse from earthquakes and flooding.
2.3.4 Develop an integrated water management strategy prioritizing water scarcity and related flooding risks in Southern Tashkent	· Strengthen awareness and early implementation of appropriate adaptation to climate change. · Sustainability of water use in areas of need particularly in times of water scarcity. · Testing of new circular water techniques like water recycling, harvesting, etc. to be potentially applied across the city · Reduce geological risks from land subsidence cause by ground abstraction.
3.1.1 Retrofit and rebuild education, health, and emergency response facilities to be safe from earthquakes	· Avoiding cycles of lost human lives, particularly children. · Protection of long-term human capital and development.
3.1.2 Retrofit and develop a long-term strategy for maintenance of reservoirs and related infrastructure within Tashkent	· Prevention of cascading failure in Tashkent from dam, reservoir, or related infrastructure failure. · Protection of parts of the city and communities downstream that are at risk of flooding from dam failure. · Preservation of water supply function across the city and continued function and operation of water features and water bodies in and around Tashkent.
3.1.3 Upgrade water supply pipeline city-wide	· Reduced monetary losses from leakages and frequent maintenance. · Improved quality and reliability of water supply. · Improved health and wellbeing of citizen.
3.1.4 Undertake systemic design improvements of the district heating systems to be safe from earthquakes	· More reliable heating supply for residents and critical services like the health sector.
3.2.1 Implement pilot projects for green-blue infrastructure	· Attractiveness of place and increased property value. · Biodiversity, health, and well-being gains from access to nature. · Demonstration of nature-based solutions to potentially be applied to wider urban development. · Improved flood management, improved air quality, and cooling of high urban temperatures.
3.2.2 Make streets active and healthy through street design, active transport, landscaping, and sustainable urban drainage	· Reduced surface water flooding. · Manage changing weather conditions including potential impacts of climate change. · Encouraged active urban mobility and increased health and wellbeing. · Enhanced pedestrian experience and safety, reduced air pollution, enhanced biodiversity, and overall image of the city.
3.3.1 Develop an integrated water and sewage management plan in the city center and old town	· Preserved cultural heritage at risk from frequent flood damage. · Robust and upgraded infrastructure to support inner city living. · Urban regeneration opportunities.
3.3.2 Deliver resilience-led regeneration of the urban core and historic areas	· Encourage compact development and increased attractiveness of the urban core · Resilience thinking is applied at a practical level, advancing the coordination of various stakeholders and government departments. · Urban conservation is seen as an important element for urban regeneration. · Enhanced maintenance of infrastructure and existing built assets in the urban core including heritage buildings, increasing the protection to seismic and flooding risks.

IMPLEMENTING RESILIENCE

Given Tashkent's exposure to shocks and stresses and the urban growth that is expected, it is important to instill a sense of urgency in the uptake of a resilience perspective in urban development processes and its implementation through concrete actions. This report proposes an incremental approach to implementation in which, in the short term, resilience will be enabled by studies, reforms, and funding mobilization, while quick win projects will produce immediate outcomes. In the medium term, Tashkent should be in the position of kick-starting the implementation of transformative actions, and in the long run, the city should have built a case to replicate pilots for the biggest transformative projects.

Key for implementing resilience actions in Tashkent is adopting a resilience-informed approach in urban planning and infrastructure investment programming. This includes using resilience criteria to identify and generate synergies between actions from different urban development sectors early in the planning and prioritization phase and establishing the right sequence of enabling and transformative actions to facilitate implementation. Gauging implementation readiness will enable stakeholders to prioritize initiatives that could be implemented early in the process without the need of significant investment or radical changes to the existing governance and regulatory framework.

Implementing resilience actions will require significant funding supported by business cases. The indicative level of investment required for delivering an initial set of actions identified in this report is in the range of USD 500 to 600 million (USZ 5.4 to 6.4 trillion). Each action and package of related actions will require further refinement as they reach maturity to provide accurate illustration of the investment required and feasibility vis a vis available or attainable resources. For example, the additional cost of making assets stronger to resist hazards should be reviewed based on the type of asset, as well as being informed by engineering options and cost-benefit analyses. The appropriateness will depend on the ability of investments to generate market returns (private sector), below-market returns (external funders), or little to no obvious returns with, however, economic internal rate of returns above certain thresholds (public sector).

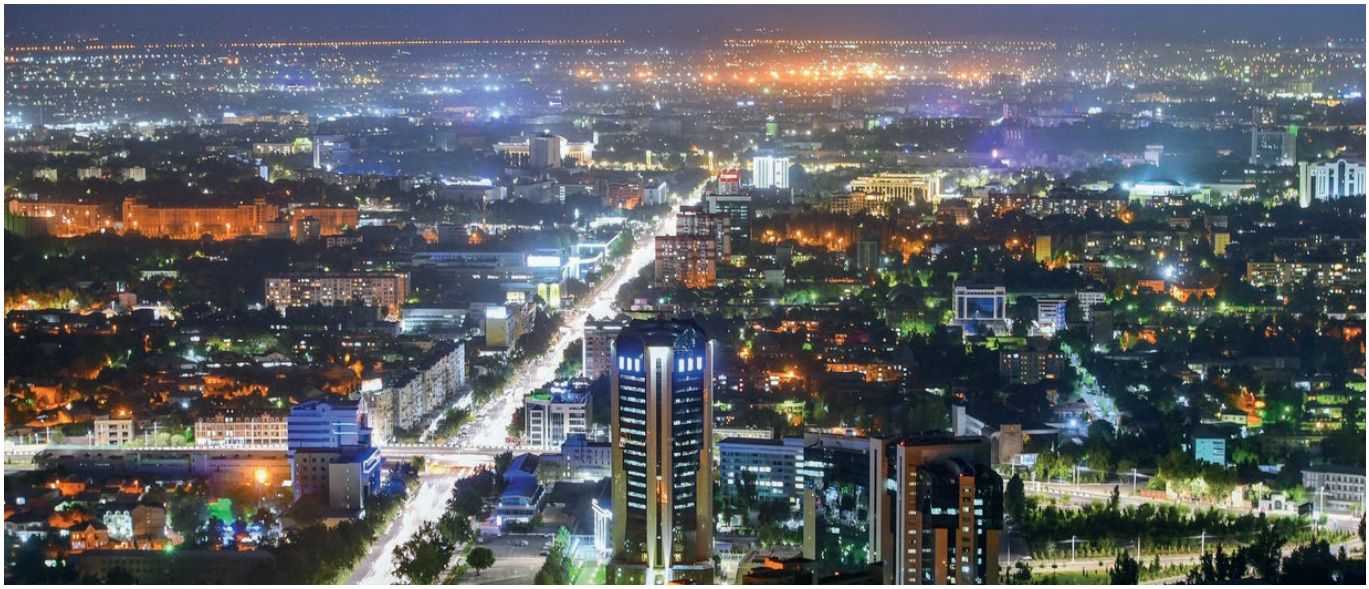
Funding will need to be mobilized from several sources, including from the national and municipal government, private sector, and capital markets. Tashkent's municipal budget makes capital allocations for infrastructure assets, such as hospitals and schools, which may be vulnerable to shocks and stresses. However, the capital investment capacity at the municipal level falls short of that required to deal with the potential losses from the shocks and stresses that have been identified. Fund mobilization will require establishing a dialogue at the national level to explore to what extent Tashkent can capitalize on recent reforms to raise additional financing through borrowing. For example building on a pilot experience which has allowed Tashkent an exclusive right to issue domestic bonds. Furthermore, linking bond issuance to sustainability and resilience criteria can make Tashkent part of a growing number of cities issuing Green Bonds.[4] The table on the next page provides an illustrative estimate of the cost range of the resilience actions within the report. Cost ranges noted describe one-time or capital expenditures associated with the actions, unless otherwise denoted as recurrent costs associated with ongoing operations.

COST RANGES FOR THE ACTIONS

Actions			Cost Range				
			USD 50K to 300K (UZS 540M-3B)*	USD 300K-1M (UZS 3B-10B)	USD 1-25M (UZS 10B-270B)	USD 25-50M (UZS 270B-540B)	USD >50M (UZS >540)
	1.1.1	Create a 3D digital model of buildings, infrastructure and population density		●			
	1.1.2	Develop a full probabilistic model for seismic shocks		●			
	1.1.3	Develop an integrated digital flood and drainage infrastructure model		●			
	1.2.1	Undertake a baseline seismic risk assessment of all education, health and emergency response facilities		●			
	1.2.2	Prepare multi-hazard assessments for reservoirs and related infrastructure		●			
	1.3.1	Institute risk and resilience knowledge transfer across sectors and to citizens		●			
	1.3.2	Conduct a Gender Equality and Social Inclusion baseline assessment at city and district level		●			
	2.1.1	Undertake digital skills training and capacity building to manage seismic and flooding risks			●		
	2.1.2	Establish a resilience team to lead and coordinate the implementation of the resilience strategy	●				
	2.2.1	Include resilience investment measures into the city's budgets	●				
	2.2.2	Screen prospective investments for their contribution to resilience	●				
	2.3.1	Embed resilience into policies, plans and regulations for new or upgraded urban developments		●			
	2.3.2	Develop a citywide feasibility study for enhancing natural and semi-natural urban areas		●			
	2.3.3	Prepare a resilience-led regeneration action plan for Tashkent's urban core	●				
	2.3.4	Develop an integrated water management strategy prioritizing water scarcity and related flooding risks in Southern Tashkent					●
	3.1.1	Retrofit and rebuild education, health and emergency response facilities to be safe from earthquakes					●
	3.1.2	Retrofit and develop a long-term strategy for intenance of reservoirs and related infrastructure within Tashkent					●
	3.1.3	Upgrade water supply pipeline city wide				●	
	3.1.4	Undertake a systemic design improvements of district heating system to be safe from earthquakes					●
	3.2.1	Implement pilot projects for green-blue infrastructure				●	
	3.2.2	Make streets active and healthy through street design, active transport, landscaping and sustainable urban drainage				●	
	3.3.1	Develop an integrated water and sewage management plan in the city center and old town				●	
	3.3.2	Deliver resilience-led regeneration of the urban core and historic areas					●

** Cost ranges noted describe one-time investment associated with implementing the actions. They do not include annual Operation and Maintenance costs as these depend on a number of variables that cannot be determined at this stage (i.e. asset life span, extraordinary maintenance schedule etc.).

MOVING FORWARD INTO A MORE RESILIENT FUTURE



Tashkent skyline. Image by Guidecity

Uzbekistan and Tashkent are undergoing an important urbanization process and there is a favorable policy framework for resilience. A presidential statement has prioritized bringing the country's urbanization level to 60% by 2030.[5] As internal migration barriers are relaxed, a continuing process of concentration of population can be expected in the Tashkent area. This urbanization process should take place in the context of a favorable policy framework for resilience. In 2019, Uzbekistan identified measures to implement the Sendai Framework for Disaster Risk Reduction, including, among others, increasing disaster risk awareness through the integration of data flows, improving the organizational and legal framework for disaster risk management, improving urban planning and norms, building capacity, and improving monitoring, forecasting and prevention systems.

A resilience approach is a key enabler for Tashkent's sustainable urban development journey. Embedding a resilience approach in diagnostics, urban development instruments and infrastructure investments provides opportunities not only for identifying, preparing, and reducing the specific risks described in this report, but also could provide the framework for improving Tashkent's livability. As a resilience approach brings whole systems thinking, urban development will benefit from a holistic view that can make the city stronger in the face of future uncertainties more effectively than dealing with individual components of city systems one by one.

Building resilience requires taking an urgent step forward towards execution, and the World Bank stands ready to support Tashkent in this trajectory. This report provides guidance to the Municipality of Tashkent on the identification of resilience-building actions so that shocks and stresses can be incrementally addressed. Moving forward, the report would need to be followed by a set of specific studies further identifying priority infrastructure investments. In parallel, the timely implementation of a portfolio of enabler actions and quick win projects will make possible, and maximize, the impact of transformative actions for Tashkent's resilient urban future.

SECTION I.

Introduction

PROJECT BACKGROUND

Uzbekistan is at risk from multiple natural hazards. This carries risks to critical infrastructure, the built environment, and communities. Over half the population and GDP earned in the country are in areas of high risk.[6]

In Tashkent, earthquakes pose a significant risk to the city's development. Their occurrence is relatively infrequent (with recurrence intervals of 10s, 100s, 1000s of years), but their potential impact can be catastrophic. The moderate earthquake of magnitude 5.1 which occurred in Tashkent in 1966 resulted in significant loss of life, damage to infrastructure, and economic losses in the order of USD 300 million (UZS 3.2 trillion).

Flooding is another key hazard in Tashkent. Severe seasonal flooding in the city has a return period of less than 1-year and is caused by rapid surface water run-off following intense rainfall.[7] The potential impact of flooding is heightened by the limited capacity and vulnerability of drainage and sewage infrastructure, which has not been able to keep up with the city's growth over the past decades. The resulting compounded effects cause regular disruption to the functioning of the urban area.

Uzbekistan and Tashkent are also vulnerable to the effects of climate change. In the absence of adaptive management, climate change will exacerbate natural hazards and increasingly impact key sectors including ecosystems, human health, infrastructure, and tourism.[8]

The Government of Uzbekistan recognizes the country's vulnerability to natural disasters and has taken important steps to manage and respond to potential risks. Today, several institutions and programs are in place to improve resilience to earthquakes and other natural disasters. The Global Facility for Disaster Reduction and Recovery (GFDRR) has supported disaster resilience efforts in Uzbekistan since 2009, including enhancing the country's Disaster Risk Management (DRM) capacity to implement disaster preparedness measures and reduce the seismic risks facing public facilities and infrastructure.[9]

This report supports the Municipality of Tashkent's efforts to make the city more resilient to existing and potential risks. It sets out specific recommendations for enhancing the resilience of Tashkent to earthquakes, flooding, and the effects of climate change, while also providing recommendations for improving the city's livability and attractiveness.

The recommendations build on evidence derived from a detailed risk assessment, desk research, multi-stakeholder engagement and technical studies. The report complements the work already undertaken by the Government of Uzbekistan and the Municipality of Tashkent to date and includes recommended actions to deliver the resilience vision for Tashkent. The recommendations provided in this report will enable the Municipality to better plan and respond to shocks and stresses when they occur, make informed decisions on investment priorities in the resilience sector, and support citizens' livelihoods, health, and well-being.

Cities globally are developing Urban Resilience Strategies that set out trajectories to enhance their resilience to shocks and stresses.[10] Tashkent is well-positioned to become the first city in Central Asia to develop a resilience strategy and serve as a role model to other cities in the region.

METHODOLOGY

WHAT IS URBAN RESILIENCE?

People are drawn to cities as centers of economic activity, opportunity, and innovation. As the 21st century unfolds, an increasing majority of the world's population will live in cities. With more than 80% of global GDP generated in cities, urbanization can contribute to sustainable growth if managed well.

However, cities are also where risk accumulates, where chronic stresses develop, and sudden shocks can occur that may result in social breakdown, physical collapse, or economic deprivation. Urban populations are facing increasing challenges from numerous natural and human-caused pressures such as population growth, rapid urbanization, ageing infrastructure, and increased risks from natural hazards and the impacts of climate change. Risk assessments and measures to reduce specific foreseeable risks will continue to play an important role in urban planning, but cities must learn to adapt and thrive in the face

of these diverse challenges - they must learn how to build resilience in an uncertain world.

Resilience as a concept focuses on how cities function as systems to support people's wellbeing – Instead of failing when disrupted, resilience is the ability of the city system to: survive an immediate shock, adapt to ongoing consequences, and thrive in a changed long-term landscape.

FUNDAMENTALS OF RESILIENCE

Making the shift to resilience depends upon a few fundamentals.

From risk to resilience: Transitioning thinking and operations from risk management to resilience will mean making the system stronger in general, along with preparing for both known and unknown risks. The focus will broaden from preparing for specific individual known hazards and risks, to responding to multiple and unexpected challenges.

Resilience as a process: It is important to think of resilience as a process, not a static product or a one-time goal. Plan, implement, monitor, feedback, and continuous participatory improvement will help build continuous improvement and resilience over time.

Whole systems thinking: Taking a holistic view of city operations and procedures can help build resilience more effectively than dealing with individual components of the city's systems one by one. This will require a detailed understanding of how city systems interconnect and are reliant upon each other to function. Holistic systems thinking could avoid situations where a failure in one system leads to cascading failures in other city systems.

These fundamentals were applied to assess resilience and identify resilience actions in Tashkent.

Photo: Inception workshop, mapping shocks and stresses on Tashkent City map

TASHKENT'S RESILIENCE JOURNEY

Resilience-building actions for Tashkent were defined in a collaborative process with the Municipality of Tashkent and the World Bank through engagement, resilience assessment, strategy development and investment planning.

ENGAGEMENT

The recommendations outlined in this report were shaped through engagement with the Municipality of Tashkent and an understanding of their challenges and priorities. The engagement process consisted of an in-person workshop (February 2020), four virtual workshops (due to Covid-19 travel restrictions), targeted interviews with municipal departments, and follow-up meetings. The five workshops took place between February 2020 and June 2021, and included:

- **Inception workshop (February 2020)**, including representatives from the different municipality departments, with the aim of capturing qualitative data and perceptions on the overall resilience of Tashkent. The workshop was attended by the First Deputy Mayor of Tashkent, Mr. Davron Khidoyatov, city departments, and other public agencies.
- **Diagnostic workshops (June 2020 and January 2021)**, including representatives from municipality departments, and power and water companies with the aim of sharing, reviewing, and validating the background resilience diagnostic with a focus on earthquakes, flooding, and disaster governance.
- **Vision workshop (January 2021)**, including representatives from the Municipality departments with the aim of defining a vision for a resilient Tashkent and exploring resilience-building actions to address the risks identified from earthquakes and flooding.
- **Follow-up meetings (February 2021)** with the water and digital department at the municipality of Tashkent to respond to questions raised during the diagnostic and visioning workshop and discuss the findings from the flood model in further detail.
- **Local expert interviews (February 2021 – May 2021)** with selected departments to supplement the findings from the desk-based research and workshops, and to support the development of a list of recommendations – current, future, and potential – for enhancing resilience in Tashkent.

- **Strategy workshop (May 2021)** briefing the senior technical team of the Municipality on the project, sharing, and validating the emerging recommendations on the resilience strategy and investment plan. In addition to the workshops, targeted interviews and follow-up meetings with departments were requested and conducted.
- **Technical Discussions (October 2021)** briefing Tashkent's Public Council on the findings and recommendations of the report and to discuss a way forward to address some of the challenges identified.

RESILIENCE ASSESSMENT

The resilience assessment focused on undertaking an analysis of Tashkent's vulnerability to shocks and stresses, and its capacity to respond. By bringing the resilience assessment together with the engagement described above, it was possible to understand the key resilience challenges, the gaps in the city's capacity to respond, and the opportunities to enhance its resilience.

Earthquakes and flooding were identified as the two highest natural hazard and risk priorities, as well as additional challenges related to ageing infrastructure and climate change. This focus emerged from an initial long list of shocks and stresses which were identified through engagement with stakeholders from the municipality and findings from a desk study review of wider resources. The initial desk study review of hazards and risks included the World Bank tool ThinkHazard![11] and European Commission tool INFORM[12] (the Index for Risk Management).

Insights from secondary sources were integrated with field reconnaissance. Site visits were undertaken within and around Tashkent and Djizzak Region to inform the seismic hazard assessment and to identify and map the distribution of potentially active faults in the Tashkent Region. Similar visits were undertaken in Tashkent to review the engineered and natural drainage systems to inform the flood hazard analysis. Observations of different building typologies, critical facilities and infrastructure were made to inform an understanding of vulnerability and asset exposure to earthquakes.

A digital city exposure model was developed for Tashkent using open-source digital data. Sources included: satellite imagery, geological maps, Open Street Map data, and national and municipal statistics. The model contains information about the spatial distribution and estimated economic value of different physical city assets including residential and industrial buildings, hospitals, schools, roads, railways, population distribution, and land-use. The model includes information about the area of vegetated land and rivers, streams, canals, and other water bodies across the city. The city exposure model was calibrated using information provided by the municipality. This model has then been used in the quantitative seismic and flood risk calculations and provides a city-specific and quantitative basis for development of the recommendations to enhance resilience.

Seismic and flood hazard and risk assessments were undertaken. Seismic hazard has been calculated for two scenario earthquake events: a moderate Mw 5 earthquake that has the potential to occur every 10s to 100s of years, and a catastrophic but rare Mw 6.7 earthquake. Seismic risk was assessed in terms of the mean number of fatalities and economic losses related to replacement of damaged and destroyed buildings (residential, schools, hospitals, industrial buildings) and transport infrastructure (road and rail) resulting from the two different earthquake scenarios. Flood hazard was calculated considering five return period pluvial flooding events and a dam-break scenario event occurring within the city. This was assessed in terms of the mean economic losses resulting from building and transport infrastructure damage. No fatalities were assumed to be associated with pluvial flooding.

The assessment investigated how climate change projections will impact key hazards. Tashkent's location, in the north-east of Uzbekistan and at around 500m altitude at the western end of the Tien Shan mountain range, exposes it to certain weather events not experienced elsewhere in the country. The impacts of climate change were investigated with results showing that climate change will influence weather-related hazards affecting Tashkent, particularly flooding. Existing weather-related hazards - including rainfall, snow, wind, cold and heat - may be exacerbated or reduced; conditions may also become more uncertain, and new hazards may arise.

A review of Uzbekistan and Tashkent's urban governance structure was undertaken to understand the city's capacity to respond to disasters and the opportunities to build resilience in the emergency system. The analysis looked at the wider policy context, focusing on the key initiatives promoted at a national level to improve the disaster response system. It also critically assessed the main gaps and shortfalls of the existing system, both from a governance and a process perspective.

A review of the municipal budget was undertaken, along with an analysis of external funding partners, to determine potential capacity and sources of financing. The review identified capital allocations for infrastructure assets in Tashkent's municipal budget and assessed them against the expected losses from damages due to key shocks and stresses. Existing financial instruments dedicated to enhancing resilience or recovering from disasters (i.e., specific contingency funds) were also reviewed, including the recent reforms aimed at raising additional funds through borrowing.

INPUTS INTO AN URBAN RESILIENCE STRATEGY AND INVESTMENT PROGRAM

A literature review and expert interviews informed the understanding of key challenges, opportunities, and potential projects. The literature review included Tashkent specific and national legislation, available donor literature, academic articles, and media reports. The review helped identify which initiatives for building resilience were already in place or planned. Expert interviews with selected city stakeholders were conducted to understand needs and current activities in various sectors. The expert interviews were particularly useful to help understand the current challenges and potential opportunities for Tashkent.

A resilience vision statement was at the core of our recommendations. The strategy development process started with a vision workshop with the Municipality of Tashkent. The workshop was delivered to capture the key aspirations that stakeholders wanted to see within Tashkent's resilience initiatives.

Resilient Tashkent is structured through a Vision, Pillars, Goals and Actions framework. It was informed by an initial validation process undertaken with the Municipality of Tashkent, which was then further refined with detailing of each action, recommended delivery partners, and the expected resilience benefits. Further research was undertaken on international best practice case studies that could offer Tashkent relevant insights on the implementation process and possible impacts of the proposed actions.

The report provides guidance for prioritizing, phasing, and funding resilience actions. The final section identifies the role of each of the proposed actions within the implementation plan (e.g., quick wins, transformative actions), and details a delivery timeline. A high-level cost range was estimated for all actions, based on existing local or international benchmarks. A review of potential funding sources was undertaken, providing recommendations on how to mobilize private investment. The report also introduces monitoring and evaluation frameworks, illustrating how these could be further developed for Tashkent and the resilience strategy.

The report provides guidance for prioritizing, phasing, and funding resilience actions. The final section of this study identifies the role of each of the proposed actions within the implementation plan (e.g., quick wins, transformative actions), and details a delivery timeline. A high-level cost range was estimated for all actions, based on existing local or international benchmarks. A review of potential funding sources was undertaken, providing recommendations on how to mobilize private investment. The report also introduces monitoring and evaluation frameworks, illustrating how this could be further developed for Tashkent and the resilience strategy.

LIMITATIONS

Local data availability and travel restrictions represented the two main challenges in developing this report. Although literature on resilience in Tashkent was limited, it was still possible to obtain some Tashkent-related insights from country level publications and reports. Travel restrictions due to the Covid-19 pandemic and changes in municipal government personnel made it challenging to develop a detailed picture of economic and institutional capacities in Tashkent. Fortunately, fieldwork was undertaken in and around Tashkent early in the project and therefore it was possible to undertake direct observations of the city's buildings, infrastructure, and geographic setting. Further face to face meetings could not be undertaken following the initial inception workshop held in February 2020. Nevertheless, primary research was supplemented by expert interviews undertaken online, with both local and thematic experts from a range of municipality departments. Together, these elements contributed to the development of a rich and diverse set of recommendations.

SECTION II.

Urban resilience assessment

OVERVIEW

Tashkent faces significant exposure to extreme losses if action is not taken to mitigate key risks. Findings from the resilience assessment outline the need to enhance resilience across Tashkent's infrastructure and part of the city's urban form, in particular in light of earthquake and flood related risks and the impacts of climate change. The resilience assessment also identifies several shortfalls in the existing enabling environment (policy, governance, and budgeting) which currently does not adequately meet the city's resilience needs.

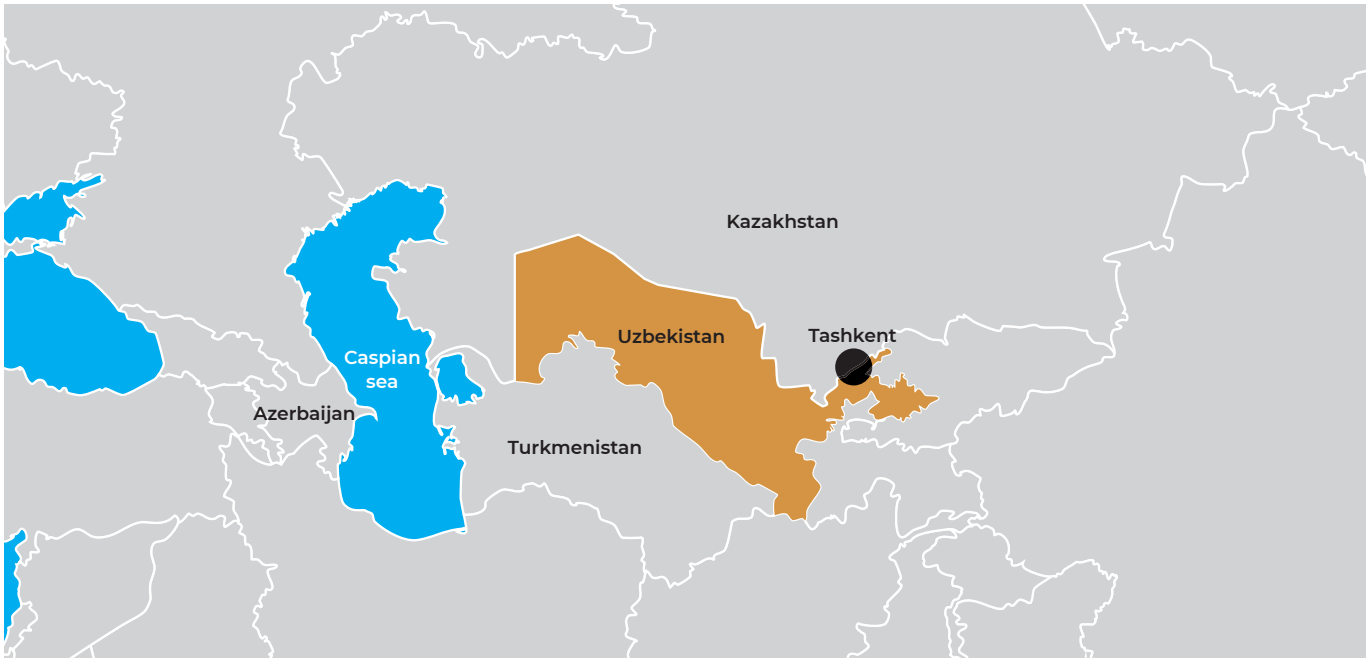
Future urban growth may increase Tashkent's exposure and vulnerability to shocks and stresses. Over the last 35 years, the city has experienced a sprawling expansion along its fringe and beyond municipal boundaries. This, together with a likely acceleration of population growth over the next decade due to the relaxation of the *propiska* system and development of land markets, will increase pressure on the city's existing infrastructure systems and underpin the imperative to build new infrastructure that incorporates resilience principles in its design.

Tashkent's resilience assessment calls for a clear forward-looking plan to address the identified challenges in a timely and integrated manner.

CONTEXT

Uzbekistan is a lower-middle income country in the Central Asia region. It is one of just two double landlocked countries in the world, surrounded by Afghanistan, Kazakhstan, Kyrgyzstan, Tajikistan, and Turkmenistan. Uzbekistan relies upon overland routes through Kazakhstan and the Kyrgyz Republic for access to China and Russia, which together account for 45% of the country's foreign trade. Any disruption to commercial links with its neighbors could therefore place pressure on Uzbekistan's infrastructure and logistics systems.

Tashkent is the capital city of Uzbekistan and the most populous city in Central Asia. It sits at the center of the government's efforts to attract foreign investment into the country. Located in the most industrially developed, north-eastern part of Uzbekistan, Tashkent lies along the national border with Kazakhstan, sharing in the benefits of declining restrictions on cross-border movement of goods and people. The city also acts as a major trade and transportation hub at the intersection of key trading routes, as a critical node on the main route between China and Europe. Tashkent also marks the middle point of the Shymkent-Tashkent-Khujand economic corridor, which is characterized by robust economic activity and cooperation.[13]



Location of Tashkent

Tashkent's economy is transitioning to service-based, though manufacturing and construction remain key sectors. These sectors, heavily reliant on physical assets, are particularly vulnerable to hazards. Despite its industrial heritage, in 2019, services (including transport, logistics and retail) contributed nearly 60% of Tashkent's local GVA, followed by manufacturing (33%) and construction. The latter has experienced the fastest growth with +46% increase between 2018-2019 as opposed to a strong, but relatively lower, +25% growth of manufacturing. An event such as a large earthquake may not only disrupt operations in the short term, but also cause significant damage to the supporting infrastructure, with a significant risk of slowing down or halting economic growth.

Tashkent holds architectural and historical significance. After independence from the Soviet Union in 1991, Tashkent developed the administrative and representative functions required as the capital city of the Republic of Uzbekistan. Subsequent years saw the implementation of large-scale urban renewal projects, the demolition and rebuilding of dilapidated housing, and the creation of new residential neighborhoods. Tashkent's rich history and recent transformations are also reflected in its administrative subdivision. These include 12 districts ('tumans' in Uzbek), and mahallas, neighborhood-level areas which also correspond to self-governing citizen assemblies.

TASHKENT'S BUILT ENVIRONMENT

URBAN FORM AND BUILDING TYPOLOGIES

The urban fabric of Tashkent consists predominantly of three major forms:

1. **Urban low-rise**
   a. Traditional organic fabric
   b. Modern grid with organic growth
2. **Urban high-rise**
   a. linear blocks

DISTRICTS OF TASHKENT

	District	Population
1	Almazar	368,819
2	Bektemir	35,433
3	Chilanzar	251,236
4	Mirabad	139,981
5	Mirzo Ulugbek	277,393
6	Sergeli	189,830
7	Shaykhantokhur	344,125
8	Uchtepa	272,463
9	Yakkasaray	121,011
10	Yashnobod	241,649
11	Yunusabad	337,321
		2,579,261

Tashkent's traditional organic fabric is likely to perform poorly in emergency situations. It is characterized by pre-Soviet era organic streets and infill development around public squares and private courtyards and with low-rise buildings. The street network is curvilinear with few thoroughfare streets and several cul-de-sacs and may not be adequate for demand spikes or rerouting due to disruption, with particularly acute risks for provision of access for emergency services. Most buildings are of older construction and may be prone to flood and earthquake damage. There is relatively limited green open space and typically this is not connected. Essential services including critical infrastructure (water, electricity, drainage) and social infrastructure (schools, and hospitals) may be unevenly distributed, difficult to repair and complex to upgrade in the older parts of the city. Ageing drainage infrastructure and lack of permeable ground surfaces may also increase local flood risk.

The modern fabric with organic growth may still be vulnerable. It consists of plots with relatively straight street edges and paved low permeability surfaces on streets and footpaths. In most areas, the streets are gridded with blocks ranging from 100 to 150 meters in length which are adequate for good neighborhood connectivity of streets to allow access to emergency vehicles. While there is a clear distinction between public and private spaces, unregulated organic infill development is also observed. There is a mix of old and new buildings, some of which may be prone to earthquake damage. The condition of drainage infrastructure is unknown, but a lack of permeable ground surfaces is known to contribute to high surface water run-off and local flooding.

Linear blocks may require seismic retrofit of loadbearing structures. Typical multistorey apartment buildings built in the Soviet period lack robust structural detailing to withstand earthquakes, have deteriorated over time, and could be highly vulnerable. Regular shaped moderate to high-rise buildings designed in modern times appear to be more robust although the expected performance under earthquake conditions requires further investigation. The urban environment is generally defined by active frontages (retail, culture) on main roads and landscaped pedestrian friendly areas in the inner areas. The road networks are adequate and good connectivity of neighborhood streets could allow clear access to emergency vehicles during emergencies. While there is adequate availability of green open spaces, which may reduce the risk of local flooding, these are generally in a poor state of repair and are typically isolated and not connected.

Low-rise residential buildings in Tashkent form the vast majority of the individual building stock housing units (96%[14]). They consist of the following typologies:

- Non-engineered structures, including small adobe and unreinforced masonry buildings.
- Brick bearing-wall systems with wooden floors, one to two stories, pre-1955.
- Brick bearing-wall systems with precast reinforced concrete (RC) floors, three to five stories, pre-1957.

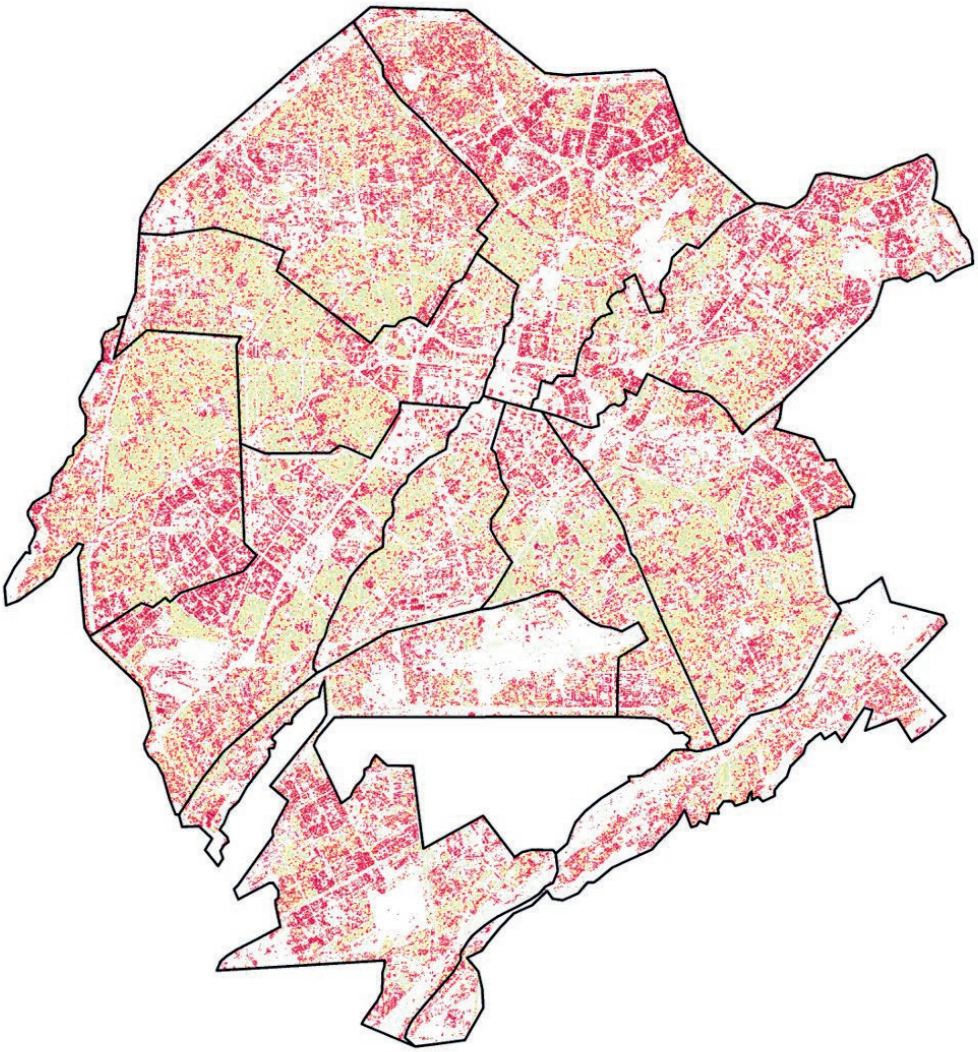
Approximately 36%[16] of the population of Tashkent live in low-rise buildings.

High-rise residential buildings are a minority of individual building housing stock in Tashkent (4%[16]) They consist of the following typologies:

- Brick bearing-wall systems with precast RC floors, some seismic detailing, post-1957.
- Precast RC frames with welded joints and brick infill walls, four to nine stories.
- Precast RC large-panel systems with dry or west joints.

It should be noted that high-rise residential buildings contain many individual housing units within each building and approximately 64%[15] of the population of Tashkent live in high-rise buildings.

Seismic vulnerability of buildings in Uzbekistan is variable and depends on such factors as design, detailing, materials, construction methods and maintenance. For example, extensive damage to adobe brick buildings occurred in the 1966 earthquake due to them not being designed to resist earthquake shaking, their presence in the epicentral zone of the earthquake, and general deterioration before the earthquake. The damage to older brick buildings is caused by factors such as complicated configurations in design, lack of seismic joints and belts, large basements under some buildings, and irregular and asymmetric wall locations.



Dirstribution of low-rise (shown in yellow) and high-rise (shown in red) buildings in Tashkent

Multistorey, modern buildings were less affected by the 1966 earthquake. Conversely, frame buildings have not experienced a major seismic event to date. The typical damage to four story buildings built in the 1940s and 1950s can be characterized as superficial and these buildings were restored following the 1966 earthquake. Frame buildings in Tashkent have not been subjected to a major earthquake. In other areas, these buildings have shown that earthquake damage is possible in load-bearing structures and separation walls.

The most vulnerable building types in Tashkent belong to both the traditional and modern urban fabric. Buildings vary little in design and method of construction in Tashkent because most of them were built over a short period, when design and construction practices were centralized in the former Soviet Union. The 'building series' referred to below are specific standard building designs that were developed during the Soviet period. They are the most vulnerable building types represented by these standard structural types.[16]

- 9, 12, and 16-storey frame panel buildings constructed from 1974 to present. In general, many elements of these buildings are prefabricated and welded in the field. The quality of the welding is typically low.
- Frame structures without diagonal bracing, constructed since 1980. These buildings have an irregular stiffness distribution and very little reserve strength.
- Brick residential buildings built before 1966 and of series 1-310 built 1954 to 1962. These buildings do not have interior longitudinal walls or reinforced concrete cores. In addition, many have experienced damage due to foundation settlement.
- Brick buildings of series 1-310 I[17] built after 1966.

These buildings often have low quality workmanship and poor-quality construction materials. There are no means for controlling processes such as setting of bricks, vibration of concrete, and filling of joints with mortar.

The potential earthquake losses to multifamily residential type buildings is high. According to a recent seismic risk assessment[18], the potential economic losses with a 100-year return period were estimated to be EUR 200 million (USD 230 million, UZS 2.4 trillion) and the potential number of casualties was 100 for multifamily residential buildings. The potential economic losses with a 475-year return period were estimated to be EUR 1.5 billion (USD 1.78 billion, UZS 19 trillion), and the potential number of casualties was 3,000. It should be noted that although the scenario earthquake calculations presented in this report and the seismic losses presented in the cited World Bank assessment cannot be directly compared, it is clear that certain building types in Tashkent are vulnerable to damage and collapse due to earthquake ground shaking and the risk to these buildings and their occupants associated with earthquakes is high.

Aerial photo of typical traditional urban fabric

Aerial photo of typical modern grid with organic growth

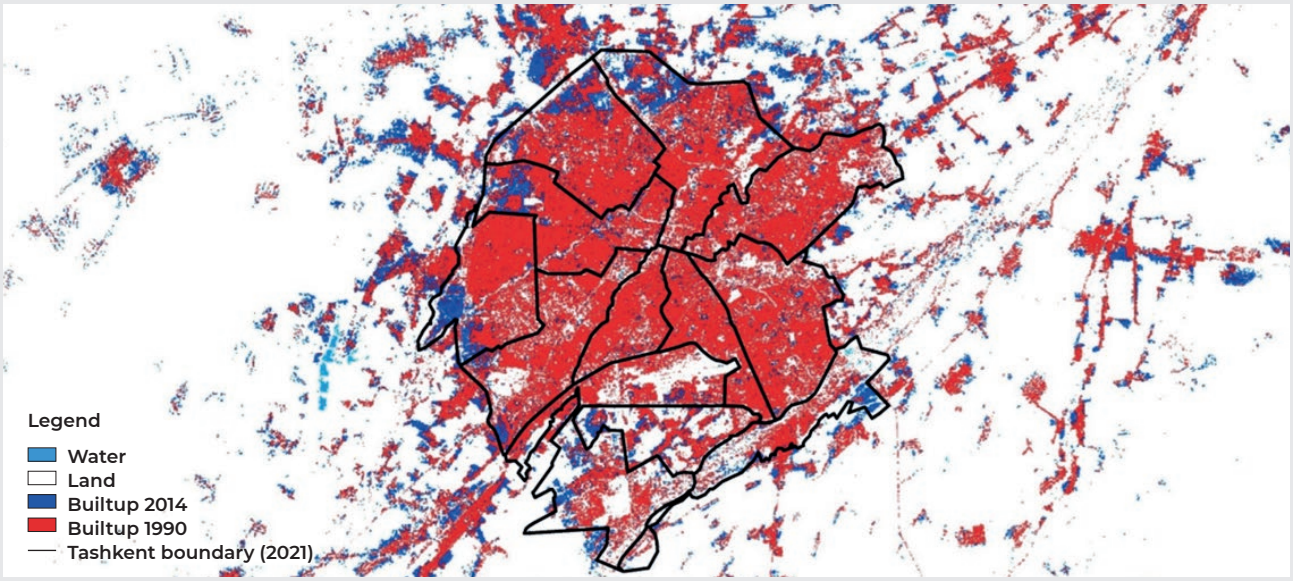
Aerial photo of typical linear blocks

RESILIENCE-INFORMED URBAN PLANNING IS ESSENTIAL FOR TASHKENT'S SUSTAINABLE GROWTH

Tashkent is currently undersized relative to comparator cities, but the relaxation of the residence registration system and the development of land markets is likely to trigger future urban growth. Spatial analysis by the World Bank indicates that Uzbekistan shows a discrepancy between the actual and predicted size of its primary city, Tashkent. A model estimating urban primacy shows that currently Tashkent is roughly half of its predicted size.[19] Reasons that have prevented Tashkent from growing more strongly include Uzbekistan's underdeveloped land market, which constrains housing supply, and migration restrictions due to the household residence registration system known as *propiska*.[20] However, Tashkent remains the strongest magnet city in Uzbekistan and with some of the migration restrictions having been lifted since 2016, rural-urban influx is accelerating population growth. The development of land markets will attract private investment and further propel urban development, which will increase the demand for urban infrastructure and services, both in existing and newly developed urban areas.

With density stagnant in the Tashkent municipal area, growth is taking place in the urban fringes. Tashkent is densifying less than other comparator cities in Central Asia. Tashkent saw only a 2.2% increase in density in 2000-2015 vis-à-vis a 10.9% increase in population, while Ashgabat, Almaty, and Dushanbe have witnessed increases in density ranging from 26.3% to 36.3%. Although Tashkent retains a relatively compact shape spanning approximately 340 square km[21], it has been susceptible to urban sprawl; between 1985 and 2013 the population grew by 10% while the urban area expanded by 20%.[22] Such pattern, where built-up area growth outpaces population growth has been validated by other data sources.[23] Growth is also taking place in the periphery along the Tashkent ring road that also serves as the administrative border of the city. The sprawling pattern exacerbates the challenge of delivering infrastructure and generates additional pressure on vulnerabilities.[24]

Developing in a resilient manner would enable Tashkent to seize urbanization opportunities but requires a clear forward-looking plan. The Municipality of Tashkent needs to develop an anticipatory approach to urban growth in which the vision and the strategy for achieving it is informed by resilience thinking. This is particularly important as capital savings in infrastructure in the order of 25% can be achieved in Tashkent in a scenario of increased density compared with a low-density expansion scenario. Resilience-informed urban planning is essential to support Tashkent towards a livable, productive, climate resilient, and sustainable trajectory.



INFRASTRUCTURE

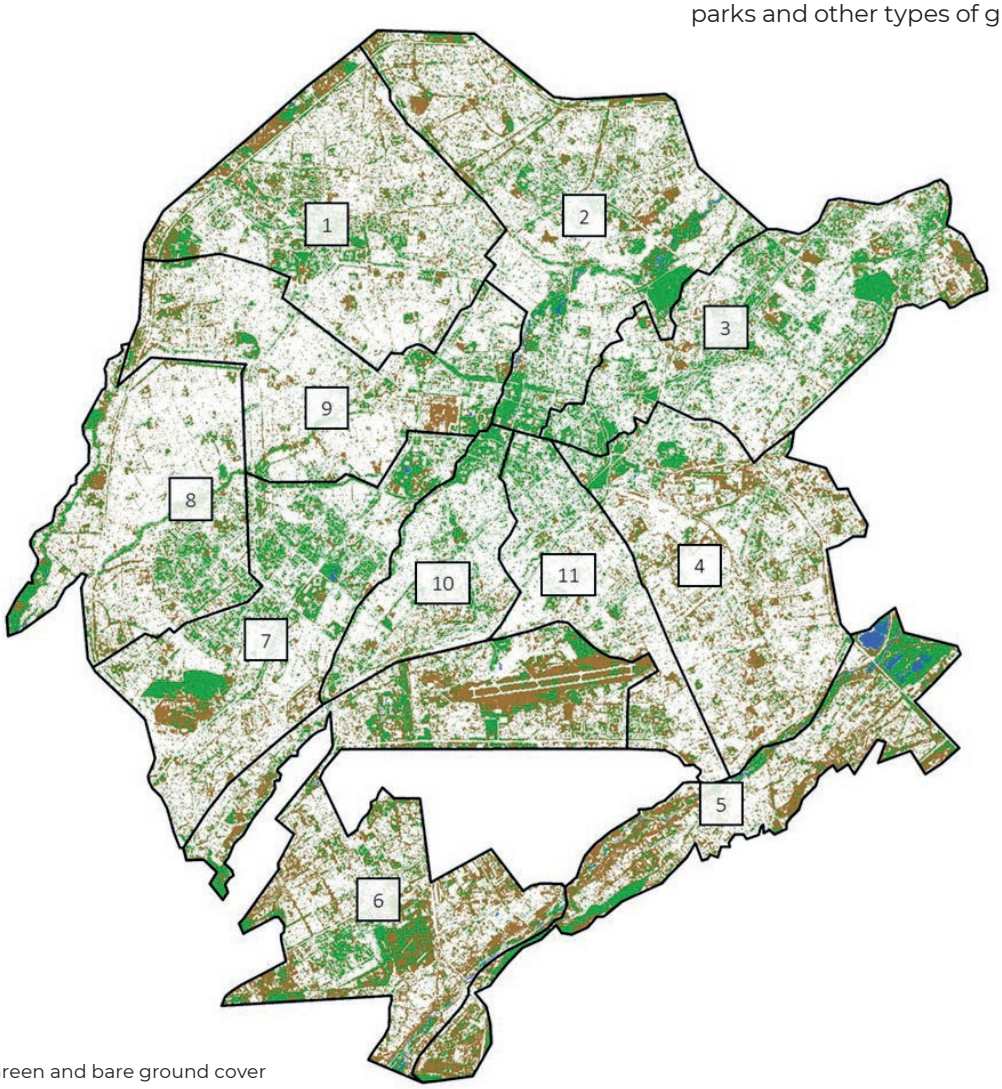
Infrastructure in Tashkent and Uzbekistan faces recurrent challenges due to ageing stock, outdated technical designs, and insufficient maintenance and operational expenditures. These challenges persist despite billions being spent on infrastructure projects between 2000 and 2018. Taken together, these problems mean that urban infrastructure is susceptible to damage from an increased frequency and/or intensity of shocks and stresses. Key infrastructure sectors such as water, sewerage and heating require substantial investments to guarantee their continuity, coverage, and efficiency.

Tashkent's water supply network coverage is good (99.7%), but the sewerage network is lacking with only 90% of the city served. Wastewater collection, treatment and disposal facilities in Tashkent are either lacking or degraded. For example, most of the historic city is not connected to municipal wastewater systems and mostly relies on pit latrines. Leakage from ageing and outdated systems as well as discharge of untreated industrial wastewater, causes pollution in water bodies within and around the city.

The district heating system in Uzbekistan suffers from obsolescence and insufficient upkeep. Most of the sector's assets were built in the mid- to late twentieth century. Tashkent has the largest district heating system in Uzbekistan and represents 70% of the country's overall district heating services provision.[25] Inaccurate estimates of demand growth, together with now outdated industry practices at the time, means much of the network is "oversized". In general, the entire network is characterized by inefficiency and gradual deterioration.

OPEN SPACES

Green space is distributed relatively unevenly across Tashkent and there is a clear need to increase it. Tashkent has 55 square km of green space in the form of vegetated parks, squares, and trees. This equates to approximately 16% of the land use across the city and 21 square meters per capita. Bare and green space alongside rivers creates buffer zones that reduce surface runoff and lessen the impacts of pluvial flooding. The Municipality is currently advancing plans for increasing the total area of green spaces up to 30% by 2023.[26] These will include large public parks as well as neighborhood gardens, increasing not only the provision but also the accessibility and continuity of parks and other types of green areas.



Green and bare ground cover

TASHKENT CITY DISTRICTS

1. Almazar
2. Yunusabad
3. Mirzo Ulugbek
4. Yashnobod
5. Bektemir
6. Sergeli
7. Chilanzar
8. Uchtepa
9. Shaykhantokhur
10. Yakkasaray
11. Mirabad

RESILIENCE CHALLENGES

Uzbekistan is exposed to numerous hazards that will affect its built environment and population. Over half the population and GDP earned in the country are in areas of high risk5. The ThinkHazard![27] natural hazard online tool, developed by the World Bank, lists six natural hazards which could affect Uzbekistan – earthquakes, flooding, extreme heat, landslides, drought, and wildfire. In addition, INFORM, a simple semi-quantitative tool to understand and measure the risk of natural disasters and the conditions which can lead to them, indicates high earthquake hazard is a key driver of risk in Uzbekistan.

Tashkent is also exposed to multiple, intersecting shocks and stresses, with earthquakes, flooding, climate-related risks, and ageing infrastructure. According to ThinkHazard!, shocks such as earthquakes, wildfire, drought, and extreme heat pose the greatest risk to Tashkent. ThinkHazard! reports hazard results for 'Urban' and 'River' flood, these data suggest that both types of flood hazards as defined by ThinkHazard! are low in Tashkent. It is noted that these underlying flood hazard datasets are for a global study and therefore are of too-coarse a resolution to accurately inform a city-scale assessment. By contrast, stakeholder engagement carried out in Tashkent in the scope of this report indicated that urban flooding is an acute concern for the city due to its frequency and impact on ageing infrastructure and buildings. In addition to these shocks, many stakeholders point to stresses including ageing infrastructure, infrastructure failure, poor air quality, population growth, traffic congestion, inadequate sanitation, and environmental degradation. In the case of an already stressed city, if a large shock such as an earthquake were to occur, this could trigger a cascading series of negative events.

Hazard	Uzbekistan	Tashkent
Flood (Urban and River)	High	Low
Earthquake	High	High
Landslide	High	Low
Extreme heat	High	Medium
Wildfire	High	High
Drought	High	Medium

PRIORITY RISKS IN TASHKENT

Seismic events, flooding, and climate change-related risk were identified as the priority risks to Tashkent and make up the focus of this report. These could cause substantial economic losses, and in the case of earthquakes, a high number of fatalities. While the report delves further into developing an urban resilience approach to the priority risks, this approach is applicable to other shocks and stresses. The overall list of shocks and stresses identified and discussed are represented on the image across.

PRIORITY RISKS

Earthquake | Rainfall/ flooding | Climate change

KEY STRESSES

- Ageing infrastructure
- Power outage
- Traffic congestion
- Inadequate health systems
- Inadequate public transport
- Population growth
- Inadequate education
- Poor air quality
- Environmental degradation

OTHER STRESSES

- Lack of green space
- Drought
- Extreme heat
- Severe storms
- Extreme cold
- Lack of biodiversity
- Uncontrolled urban development
- Unemployment
- Lack of investment
- Lack of affordable housing
- Financial economic crisis
- Disease outbreak

SEISMIC HAZARD RISK

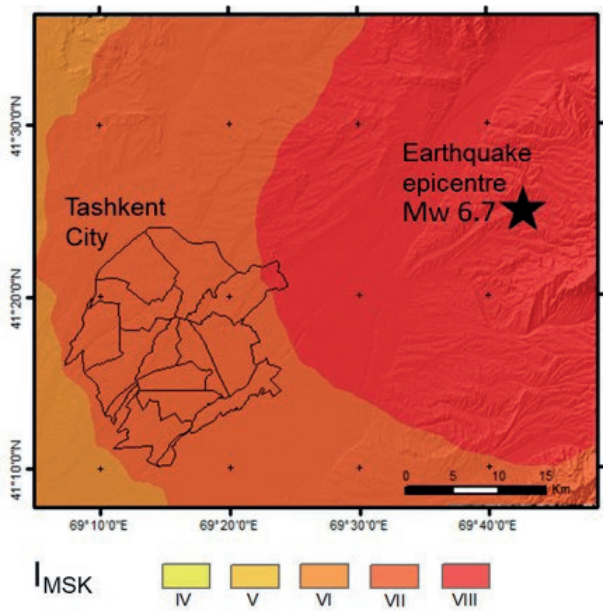
Resilience actions for Tashkent should respond to risks posed by a range of seismic scenarios of varying magnitudes and frequencies. Two different earthquake scenarios were considered: a magnitude 6.7 Mw, which is equivalent to the largest historical event in the vicinity of the city in 1886; and a magnitude 5.0 Mw event, which is similar in size to the event of 1966. The 6.7 Mw earthquake is considered a rare but catastrophic event, which may have a return period of several thousand years, while the magnitude 5.0 Mw has a more frequent occurrence (10s to 100s of years) causing significant damage and fewer fatalities. To increase resilience to earthquakes, the city needs to prepare to withstand, respond and recover from both types of events.

A magnitude 5.0Mw earthquake could cause significant damage to the city, with total estimated losses of around USD 243 million (UZS 2.6 trillion), equal to about 3% of the city's GVA (UZS 86 trillion in 2019[28]). In this scenario, the analysis undertaken indicated that approximately 139 residential buildings (0.07% of residential buildings) in Tashkent would collapse. Nearly all of these would be in the low-rise building stock which appeared to be more structurally vulnerable to earthquake ground shaking. The potential mean number of fatalities would be about 115, with most of these deaths occurring because of low-rise residential building and school building collapses. The potential mean economic losses from this scenario were estimated at approximately USD 161 million (UZS 1.7 trillion) for buildings of all usages and USD 81 million (UZS 871 billion) for road and rail transport infrastructure.

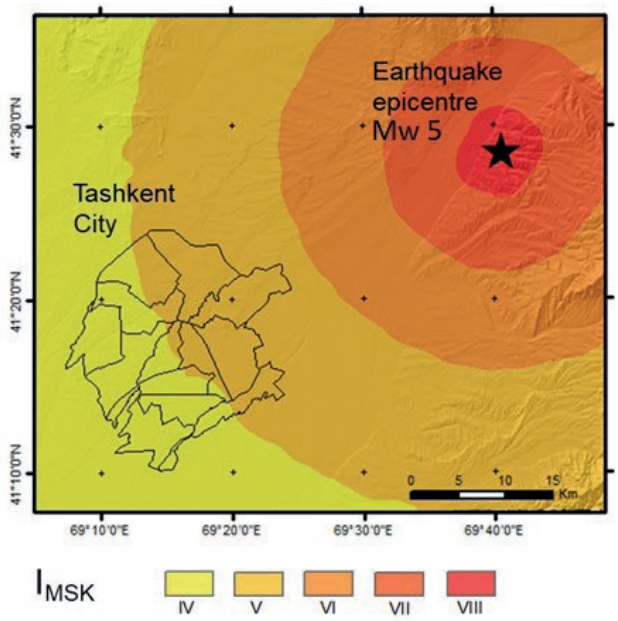
A magnitude 6.7 Mw earthquake would be catastrophic for the city and the country, causing estimated total economic losses of USD 16 billion (UZS 172 trillion), equivalent to twice the city's GVA.[29] The scenario analysis indicated that approximately 21,000 buildings (15% of residential buildings) in Tashkent would potentially collapse in this event. The potential total mean number of fatalities would be 22,626. This estimate is very high. The potential mean economic losses would amount to approximately USD 13.7 billion (UZS 147 trillion) for buildings of all usages and USD 2.3 billion (UZS 24.7 trillion) for road and rail transport infrastructure.

Seismic event	Number of fatalities*	Economic losses*	Building collapse*
5.0 Mw earthquake	115	USD 243 million (UZS 2.6 trillion)	139 buildings (residential)
6.7 Mw earthquake	22,626	USD 16 billion (UZS 172 trillion)	21,000 buildings

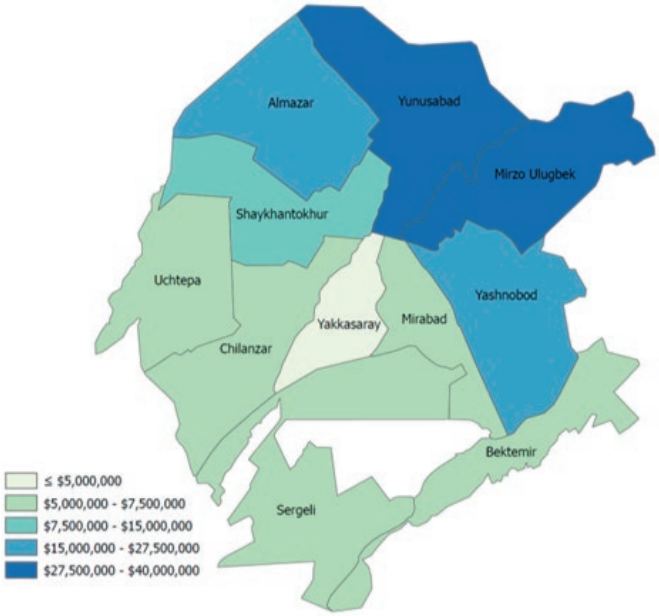
* Potential Mean



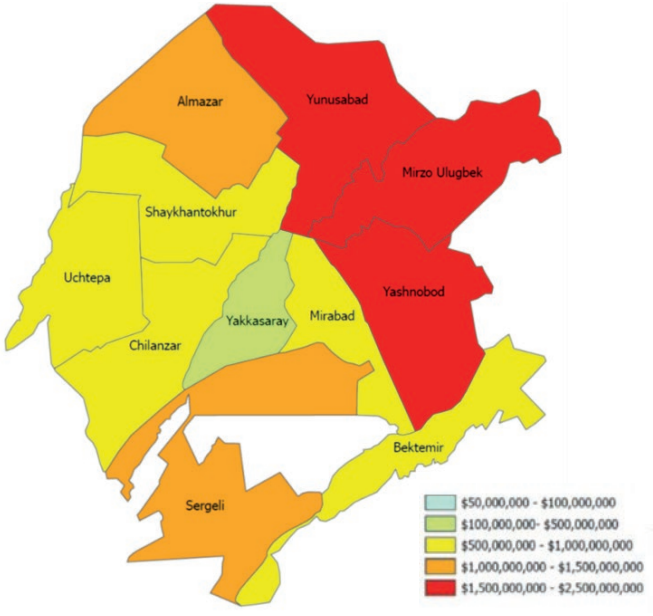
Seismic hazard results in terms of IMSK considering a magnitude Mw 5 scenario earthquake



Seismic hazard results in terms of IMSK considering a magnitude Mw 5 scenario earthquake



Mean economic losses (USD) for residential buildings by district (Mw 5 earthquake scenario)



Mean economic losses (USD) for residential buildings by district (Mw 6.7 earthquake scenario)

FLOODING HAZARD RISK

Recurring floods disrupt Tashkent's functioning and creates the need for frequent maintenance and repair. Flood risk is also heightened by the limited capacity and vulnerability of drainage and sewage infrastructure, which is ageing and has not grown in step with city growth. A recent country-scale flood hazard and risk study by the World Bank GFDRR (2017) estimated that the impact of a 10-year type flood event on Tashkent would be as large as a 100-year type flood event. This indicates that the annual average of affected GDP is dominated by events that happen relatively frequently.

All city districts are subject to pluvial (rainfall runoff) flood damage and potential business interruption. This finding was obtained from further scenario modelling that included a detailed city-scale pluvial flood hazard scenario and a fluvial flood hazard scenario resulting from a dam break. The pluvial flood hazard modelling revealed that all city districts are subject to flood damage and potential road blockage and business interruption, with approximately 4% to 9% of the total road length in Tashkent flooded annually. Additionally, topographic height differences (i.e., the relief) across the city contribute to high flood water flow velocities which have the potential to exacerbate sediment erosion and the formation of gullies. This is not a problem with paved surfaces, but it could affect buildings and infrastructure at locations with unsealed soils, causing damage to foundations, leakages, and temporary shutdowns.

Annual flood damage related to pluvial flooding could be around USD 40.3 million (UZS 433 billion) per year. At a district level, the highest losses would be recorded in the north-western parts of the city, including Yunusabad, Shaykhantokhur and Almazar. This means, respectively, USD 6.7, 5.5 and 5.4 million (UZS 72, 59 and 58 billion) in annual damages. By contrast, the dam break scenario only indicated relatively little flood damage. While this is a negligible contribution to the city's overall flood risk, a dam break would severely impact water provision in Tashkent, posing a threat to people's health, and businesses' continuity.

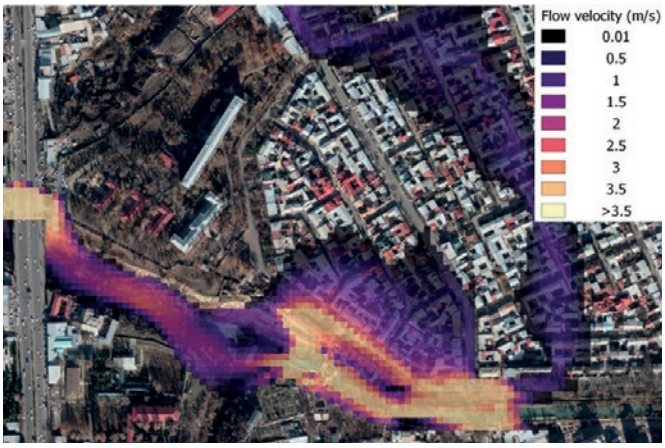
District	Expected Annual Damage (M USD/y)	Expected Annual Damage (B UZS/y)
Bektemir	0.1	1
Sergeli	2.2	23.6
Chilanzar	4.2	45.2
Uchtepa	3.2	34.4
Yakkasary	1.8	19.3
Almazar	5.4	58
Shaykhantokhur	5.5	59.1
Yunusabad	6.7	72
Yashnobod	4.2	45.1
Mirabad	2.1	22.6
Mirzo Ulugbek	4.8	51.6
Total	40.3	433

Table 21.
Expected Annual Damage in million USD/y and billion UZS/y per district. Note Bektemir and Sergeli are only partly included in the analysis. A 12th District, Yangi Hayot is not included in analysis.

Pluvial risk in Tashkent comes from smaller, more frequent events than larger, infrequent ones. The pluvial flood risk scenario developed for this report highlighted that almost all the city is prone to flooding and experiences flood damage. The results indicated that a 100-year flood poses only three times the risk of damage compared to a 2-year return period flood thereby suggesting that most of the flood damage in the city comes from small floods that occur every few years.

No fatalities are expected to result directly from pluvial flooding and road damage is expected to be limited, however, interruptions and indirect economic losses may still be significant. Flooding in Tashkent can be considered as a regularly occurring problem causing considerable material damage and nuisance, for example traffic disruption caused by the flooded streets, rather than an extremely rare catastrophe causing casualties and economic collapse (such as identified for the earthquake scenario risk calculations).

Flooding caused by simulated dam break. Increasing water depth shown in darker blue



Flow velocity caused by simulated dam break. Higher velocity flow shown by lighter yellow colour

Flood areas in Tashkent with a rain event

CLIMATE CHANGE RISK

Uzbekistan faces major challenges relating to desertification, scarcity of water, and further depletion of the Aral Sea. Uzbekistan has a sharply continental climate with cold and often snowy winters, and long, dry, and hot summers. As in the rest of Uzbekistan, Tashkent has an arid continental climate characterized by long, dry, and hot summers and cold, snowy winters, as well as sharp day-night and winter-summer temperature variations. Tashkent's north-eastern location at around 500m altitude to the western end of the Tien Shan mountain range also means the city experiences higher precipitation levels than much of the rest of the country.

These challenges are exacerbated by climate stressors, which will accelerate the deterioration of infrastructure. Literature suggests that Tashkent will be subject to increased temperatures, more extreme and frequent droughts, decreased precipitation, and changes in weather patterns that influence the growing season. Climate stress threatens to increase damage and deterioration of infrastructure, and increase the demand and strain on basic services, particularly energy and water.

Climate projections indicate that Tashkent will experience drier conditions towards the end of the century together with an increased likelihood of severe drought. The annual number of 'hot' days is projected to increase by 24 days by 2040-2059 and 60 days by 2080-2099, under the highest emissions scenario, in which little is done to reduce global temperatures. Under the same scenario, July mean temperatures are set to increase by 2.7°C by mid-century and by 5.7°C by the end of the century, as compared to a baseline of 1986-2005. Heat waves and increases in hot days could impact population health and economic activity in Tashkent.

ENABLING ENVIRONMENT

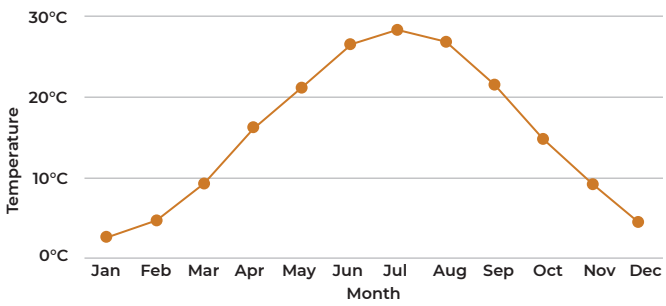
POLICY CONTEXT

Uzbekistan has initiated needed reforms. The modernization of state institutions, increased citizen engagement, and moves toward a functioning market economy are signs of this. Uzbekistan has maintained positive economic growth in recent years. Over the past two decades, there has also been an increase in human capital investments aimed at poverty reduction and shared prosperity, including reforms in the education and healthcare sectors.[30] This has contributed to reduced poverty rates.[31] President Mirziyoyev is the first Uzbek president to acknowledge the existence of poverty in Uzbekistan, and in 2020 he pledged to create a new government institution – the Ministry of Economic Development and Poverty Reduction.[32] There is great opportunity to consolidate these achievements and accelerate progress as part of the resilience strategy.

GOVERNANCE

The lack of an effective mechanism for forecasting and monitoring emergencies is a key shortfall in Uzbekistan's disaster response system. This deficiency, which was identified in Presidential Decree No. 5066 of 2017[33] impeds the reliable analysis of shock risks. Local authorities for responding to emergencies are underdeveloped or absent entirely – and the concentration of the Ministry of Emergency Situations (MoES) rescue services in administrative centers undermine their ability to respond to shocks in more remote areas. Other issues relating to equipment, research, and training were also identified. These challenges severely undermine a coordinated approach to identify, prepare for, and reduce risk.

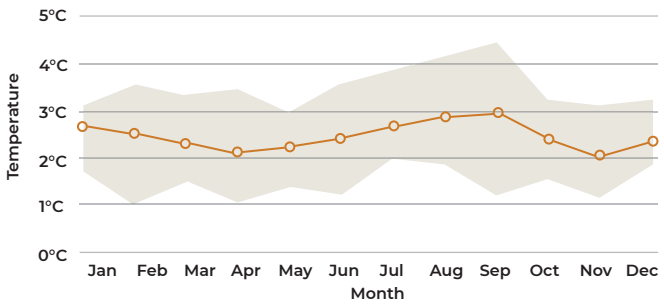
Historical Observed Monthly Mean Temperature for Uzbekistan at Tamdy District for 1986-2005



● Observation

The graph shows 1986-2005 baseline climate.

Projected Change in Monthly Temperature for Uzbekistan at Tamdy District for 2040-2059



○ Ensemble Median and Range

Projected changes in monthly mean temperature. The graph shows projected changes for 2040-2059 under high emissions (RCP8.5) scenario.

Compounding this, processes for reform are difficult. Assessment of conditions and needs is often inadequate. Similarly, a lack of data on the emergency system's performance blurs understanding of appropriate reforms. Even where problems are identified, the prioritization of costs is sometimes unclear or unjustified. There is a need to build capacity in the emergency response system to coordinate on risk identification, and to institute reforms that encourage resilience thinking.

The Sendai Action Plan for Uzbekistan expects to rectify challenges the country is facing.[34] In particular, it sets out bold reforms and tangible actions with an emphasis on the responsible use of data, awareness raising among the population, building capacity at lower tiers of government, and investing in modern equipment. This suggests that the government intends to follow an evidence-based approach to reducing disaster risks. Similarly, moves to strengthen cooperation with international bodies like the United Nations Office for Disaster Risk Reduction imply that Uzbekistan is eager to continue learning from best practices worldwide. This is a positive step to embedding resilience in the country's disaster risk system, provided it's supported by appropriate recommendations.

MUNICIPAL BUDGETING

Tashkent's municipal budget makes capital allocations for infrastructure, such as schools and hospitals, which may be vulnerable to shocks and stresses. The 2021 draft municipal budget totaled USD 279 million (UZS 2,924,431 million), with the revenue deriving mainly from taxes and inter-governmental transfers.[35] Approximately 15% of spending was allocated to capital investments for design, construction (and reconstruction) and equipment of facilities, mostly towards educational or healthcare facilities.

However, the level of capital investment at the municipal level falls short of the scale of potential losses in the event of resilience shocks and stresses. For example, the total amount of capital investments in public buildings is only slightly higher than the expected annual flood damage of USD 40.3 million (UZS 433 billion) per year. This illustrates that the municipality likely suffers far heavier economic losses than the amount contributed into capital construction and repairs that may help build in resilience measures.

In addition to its budget, Tashkent has a local reserve fund, which may be used for unexpected economic, social, cultural, and other expenditures. While these are not earmarked specifically, the fund, with allocations based on indicators dictated in the national budgeting process, can be used in post-disaster contexts. In fact, regulations dictate that local government reserves are the first defense against natural disasters. In 2018, Tashkent's local reserve fund amounted to USD 2.9 million (UZS 23,5 billion).[36]

There is a lack of explicit spending related to enhancing resilience or recovering from the impact of shocks and stresses. While there are examples of global cities that ring-fence budgets specifically for resilience building measures, or resilience goals through the budgeting process, there is no clear spending within the Tashkent municipal budget that is ring-fenced or dedicated explicitly to resilience measures. Moreover, municipal capital expenditure in Uzbekistan is described as limited in fiscal flexibility due to being subject to approval by the central government.[37]

More generally in the country, it is difficult to gauge whether budgeting adequately addresses resilience needs due to insufficient transparency and fragmentation. At the national level, studies have noted lack of consistent data on size and composition of public investment as a challenge. In addition, public utilities have separate budgets that are not publicly transparent. Moreover, investment planning and government budgeting are often separate processes. Because of this fragmentation, there are barriers to understanding an integrated investment pipeline.[38]

Recent reforms have attempted to empower the Municipality of Tashkent to raise additional funds through borrowing. A presidential Decree in 2018 permitted a pilot experience allowing Tashkent an exclusive right to issue domestic bonds for the purposes of investment projects approved by the National Project Management Agency.[39] However, the municipality is still limited by credit worthiness, having received a BB- rating from Fitch Ratings.[40] More broadly, state-owned banks have also began to issue Eurobonds in the last years, and an MOU has been entered with UNDP to better align issuances with Sustainable Development Goals (SDGs) and build accountability for pilot projects.[41] These are likely to target construction of schools, hospitals, water supply, and gender equality policies, which have relevance for resilience impacts.

SECTION III.

Developing a resilience strategy for Tashkent

THE OPPORTUNITY

Cities like Tashkent are centers for innovation and economic activity but also face significant challenges. Over 55% of the world's population lives in urban areas, and this is projected to reach nearly 70% by 2050. With increased urbanization, shocks such as earthquakes and flooding are ever more interconnected and further exacerbated by chronic stresses such as ageing infrastructure, social and economic inequalities, threatening the city and communities.

Cities around the world are developing urban resilience strategies to respond to local and global shocks and stresses. Decision makers in cities have recognized that building resilience is about responding to shocks and stresses, as well as planning and preparing for uncertainty. This requires a new approach to urban governance to come up with solutions that are integrated, effective, inclusive, and forward-looking to deliver multiple benefits and maximize the value of any city investment.

Tashkent is well-positioned to be the first city in Central Asia to have a resilience strategy at a time when climate risks are growing. By adopting resilience as a guiding approach in urban development, Tashkent can bring renewed focus on the city's assets and infrastructure systems that will support both sustainable urban growth and enhance the wellbeing of Tashkent's citizens. Transforming Tashkent into a resilient city will make it a regional leader in resilience planning and will help it join other cities globally leading the way in advancing the resilience agenda, including London, New York, Athens, Paris, Milan, and Amman.

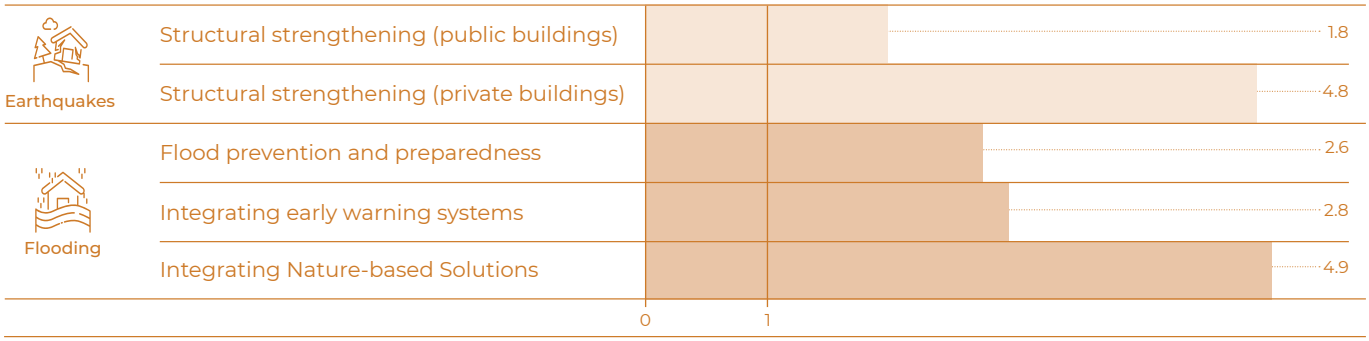
Understanding and planning for resilience will enhance the city's ability and capacity to plan for the risks that weaken its urban fabric. Ageing infrastructure and buildings, coupled with outdated technical standards, mean that Tashkent's built environment is highly vulnerable to damage and/or failure should a large-scale shock such as a major earthquake occur. Secondly, the city currently lacks the adequate diagnostic tools to identify key risks, such as, seismic and flooding. Building resilience in Tashkent will help the city to proactively plan for a resilient urban growth and respond to future shocks or stresses rather than wait until they occur and respond reactively. Embedding resilience will bring together various stakeholders and government departments to foster collaborations and transform risks into opportunities that will improve the quality of life for people in the short and long term.

City Resilience Strategies prepared under the 100 Resilient Cities Program

Building resilience in Tashkent is also about providing more reliable services and a high-quality urban environment for all.
Government stakeholders engaged in this report believe that Tashkent should aspire to become the most attractive city in Central Asia, with the view to attracting visitors from the region and around the world. Embedding a resilience approach into urban development processes is central to fulfil this aspiration, and to balance the growth and improvements needed with interventions that encourage inclusivity and positive impacts for its citizens. Conversely, inclusivity and safety must infuse all plans and strategies, ensuring that resilience benefits are equitably distributed.

The 2021 World Bank study "Investment in Disaster Risk Management in Europe Makes Economic Sense" reviewed and analyzed over 100 investments focused on prevention and preparedness in Europe for a number of hazards, including floods and earthquakes. The infographic below summarizes some of the key findings.

Resilience benefits largely exceed their costs.
Resilience actions can help Tashkent avoid losses from the natural hazards it is likely to face, as well as deliver long term economic, social, and environmental benefits. The benefits of structural strengthening of public and private buildings can help prevent loss of lives, disruption in social services and massive costs of rebuilding damaged facilities. Investments in flood prevention and preparedness, including early warning systems can reduce damages to physical assets from the flooding events themselves, as well as the loss of livelihoods. Developing nature-based solutions in flood-prone areas has been shown to deliver benefits beyond reducing risks from flooding, for example, their benefits include improved health and well-being of urban citizens; and making the city attractive to visitors and further investments. Research in the types of actions described in this report demonstrate that there is a strong economic case for investing in resilience.



*Median BCRs review and analysis of over 100 investments focused on prevention and preparedness in Europe.
Source: World Bank (2021) Investment in Disaster Risk Management in Europe Makes Economic Sense

EARTHQUAKE

- For earthquake risk reduction, structural strengthening of existing buildings yielded a mean benefit-cost ratio (BCR) of 1.8 for public buildings and a mean BCR of 4.8 for private buildings under probable maximum loss (PML) analysis. The analysis of hypothetical investments in seismic strengthening and energy efficiency in education facilities across Europe yielded BCRs ranging from 0.6 to 2.2, while an ex-ante analysis for the retrofitting and reconstruction of 350 schools in Turkey yielded a BCR of 1.53
- The National Plan for Seismic Risk Prevention in Italy yielded respective BCRs of 1.65, 1.66, and 3.5 for seismic upgrading, demolition and reconstruction, and local strengthening of public buildings.[42]

FLOOD

- For flood prevention and preparedness investments (which included: structural protection through levees or other types of barriers, green and blue infrastructure, early warning systems), the study found that the majority of benefit/cost ratios can be greater than 1.5, with a median of 2.6. Investments that integrated nature-based solutions and early warning systems were found to have the greatest benefits, with median BCRs of 4.9 and 2.8, respectively.[43]
- A study from Poland (structural protection along the Odra River) found a BCR of 5.14, where most of the benefits derived from economic opportunities afforded by flood protection and a reduction in physical and mental health impacts on residents within the flood area.[44]

BENEFITS OF RESILIENCE STRATEGIES

Resilience strategies that have evolved into plans with specific infrastructure interventions have helped cities in attaining the following results:

Influencing strategic planning and urban development policy. To address complex challenges (like managing sustainable development and mitigating climate change), cities have had to take up ambitious agendas resulting in wide-ranging changes across sectors. In Glasgow, for example, resilience is now embedded into all the city's strategies, and it is part of the recently issued Strategic Development Framework for Glasgow City Center, the Circular Economy Route Map, the Action Plan from the Climate Emergency Declaration, and the city's Economic Strategy.

Future-proofing urban projects. In Milan, the municipal government developed a new masterplan for the Niguarda neighborhood driven by a localized understanding of the city's shocks and stresses. This is enabling them to deliver innovative resilience-building initiatives for public spaces, housing, and streets to respond, recover from and transform despite current and future threats like extreme heatwaves, flooding, poverty, cyber-attacks, and an ageing population. Athens and Bristol, meanwhile conducted a review of their municipal budgets to understand the existing proportion of funding that contributes to the cities' resilience, and further earmarked budgets and developed criteria for resilience-building activities.

Building capacity and leadership for cross-departmental and regional collaboration. Resilience Teams, set up to collaborate across departments, sectors, and regions, have opened new opportunities for solving challenges. Many cities in Europe and the Middle East have formalized new positions like 'Deputy Mayor for Urban Resilience' to also serve as Chief Resilience Officers. For example, Athens has a created a new position of Deputy Mayor of Green, Urban Resilience and Adaptation to Climate Change.

Overcoming funding challenges and channeling technical support to deliver resilience initiatives. Athens has been able to raise financing support from the European Investment Bank to implement some of the actions in its resilience strategy linked to greening and extreme heat. Tirana, meanwhile, has taken it a step further by embracing nature-based solutions to tackle urban flooding, extreme heat, and loss of biodiversity. The municipal government is doing this by developing an 'Orbital Forest' that will enhance and connect the city's surrounding green assets, which is attracting interest and funding from the European Bank of Reconstruction and Development.

Being part of global city networks. Many cities subscribe to networks that share their common commitment to resilience and sustainability. By declaring their commitment to achieving ambitious goals (with appropriate resources), cities have positioned themselves globally as safe and vibrant places to live, work and visit. City networks such as Resilient Cities Network, C40 and EBRD Green Cities provide cities with a global platform to demonstrate leadership, seek support, share knowledge and solutions.

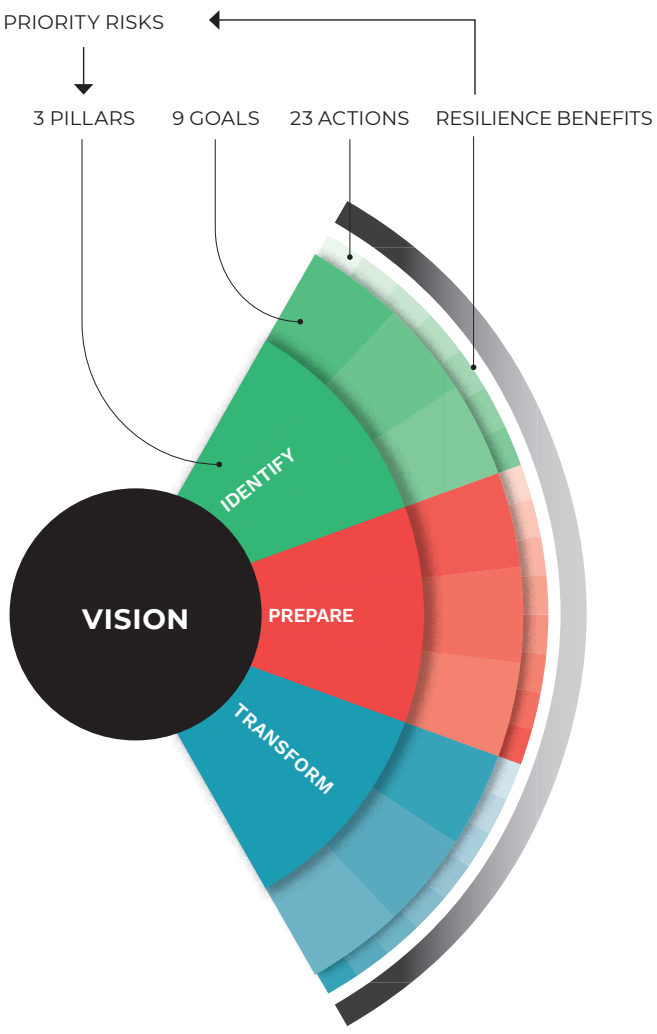
RESILIENCE FRAMEWORK FOR TASHKENT: VISION, PILLARS, GOALS AND ACTIONS

Resilient Tashkent provides input to address Tashkent's resilience challenges and improve its livability. Embedding resilience thinking into urban planning and management and infrastructure investment identification will help Tashkent become more livable, productive, and sustainable. The three pillars of the city's resilience development strategy are: *Identify* resilience hazards, *prepare* for resilience, and *transform* Tashkent through investments in resilience. These pillars allow Tashkent to develop an initial set of initiatives that are intended to save lives and, enhance well-being for citizens while delivering economic benefits through avoided potential losses associated with natural disasters as well as other shocks and stresses. Such a transformational path will make Tashkent a regional urbanization leader and help the city join a select group of global cities that are advancing the resilience agenda.

The framework provides a starting point for developing long-term resilience as well as initiating cross-departmental and cross-institutional dialogue to highlight opportunities to embed resilience into municipal projects and policies, including a concrete operation discussion to deliver wider benefits to Tashkent. The framework is structured under the following elements:

- The **vision** which represents Tashkent's long-term aspiration for a resilient future
- **Pillars** depict the main resilience enhancing functions that Tashkent must perform in both normal times and in times of disruption, namely identify resilience hazards and raise awareness; prepare and increase capacity for resilience; and transform Tashkent's urban infrastructure and environment.
- **Goals** are short to long-term statements of purpose that will support the delivery of Tashkent's vision. For example, to identify resilience hazards through evidence; to embed resilience in urban planning and management; and to retrofit building and infrastructure.
- **Actions**, which are short- to mid-term activities that Tashkent should consider investing in to fulfil the goals. These include supporting activities as well as capital investments on existing and new infrastructure. Actions can be simple or complex tasks, mainly at the local level but they may also include some interventions that involve the national level. To be effective, actions require collaboration between different stakeholders and levels of governance in their design, implementation, ownership, and evaluation. Examples include developing a screen system for prospective urban development and infrastructure investments for their contribution to resilience and retrofitting and rebuilding education and health facilities to be safe from earthquakes.
- **Resilience benefits** are the positive contributions stemming from the actions that can directly or indirectly contribute to resilience of the city, for example an improved coordination of risk management through a shared asset inventory, and reduced monetary losses from water pipe leakages and frequent maintenance.

RESILIENCE PILLARS



Tashkent Resilience Framework

VISION FOR A RESILIENT TASHKENT

“

Tashkent will be a city that is able to withstand, respond to and recover from future earthquakes, flooding and the potential impacts of climate change, by transforming its built environment for the benefit of its people and visitors; maintaining its position as the most attractive, safe and sustainable city in the Central Asian Region - the capital of Uzbekistan.

”

RESILIENCE PILLARS

PILLAR 1: IDENTIFY

Making resilience information available, reliable, and usable

Evidence-based resilience hazard identification is the critical first step for Tashkent. The ability to combine risk data for earthquakes and flooding with data of building and infrastructure vulnerabilities to ground shaking and inundations needs to be improved in Tashkent. This will ensure that the probability, magnitude and location of earthquakes and flooding risk areas are known. This should be done in a systematic and evidence-based way by deploying the production and use of digital models that map buildings and sites that face risks from earthquakes and flooding. This will help the city to quantify the impacts in terms of loss of life, physical damages, and interruption of service- and help decision makers to plan for resilience rather than react to disaster outbreaks.

Multi-hazard assessments on critical infrastructure and buildings can help prioritize strategic interventions. Built assets like water reservoirs and social infrastructure need to be prioritized for detailed assessment as they can affect larger numbers of people and damage to them can result in cascading long-term disruption to the city. Upgrades to these key urban assets should include an assessment of the layout and the operations of the facilities. This can inform prioritization of the most at-risk facilities, as well as development of a medium- and long-term plan to upgrade them incrementally and with minimum disruption.

Inclusion and integration processes should be built into risk identification. The use of resilience information can be maximized with knowledge transfer mechanisms that convert analyses into useful communication and decision-making resources. Further, an important component of risk identification is a good understanding of how it affects people, especially groups that may be most vulnerable already and become worse off because of major disruptive events in the city. A cross-disciplinary baseline of the risks and social parameters, will create a good foundation for building further actions to better plan for and reduce risks.

PILLAR 2: PREPARE

Improving operational capabilities for resilience informed planning and design

The skills and clear mandate to enhance resilience need to be improved in Tashkent. Effective use of data requires new digital skills and processes to be introduced in the city. Further, skills to enhance the ability to manage resilience across sectors will ensure that short and medium-term investments can continue to deliver resilience benefits in the future. Resilience thinking should be championed by leadership and teams that are well-resourced and have decision making support, as well as the ability to integrate across municipal departments and other stakeholders.

Appropriate resources need to be made available to support resilience building. Budgetary allocations to resilience building efforts can be made by supporting initiatives that are urgently needed, at the same time, financial mechanisms should also be put in place to ensure that risk reduction is considered across building sectors. New tools should be used to plan the lifecycle of existing and new projects, from identification to implementation, and in financing decision making.

For Tashkent to become more resilient, modern resilience principles must be embedded into urban development processes. While some risks may be unavoidable, the city's ability to withstand earthquakes and flooding events needs to be improved. This should involve adoption of innovative best practices like resilience-led urban regeneration, nature-based solutions, and sustainable transport. This will not only improve risk preparedness, but also set-up resilience principles to guide the future growth of the city, including urban regeneration and the development of new areas.

PILLAR 3: TRANSFORM

Transforming the built environment though resilience-sensitive design

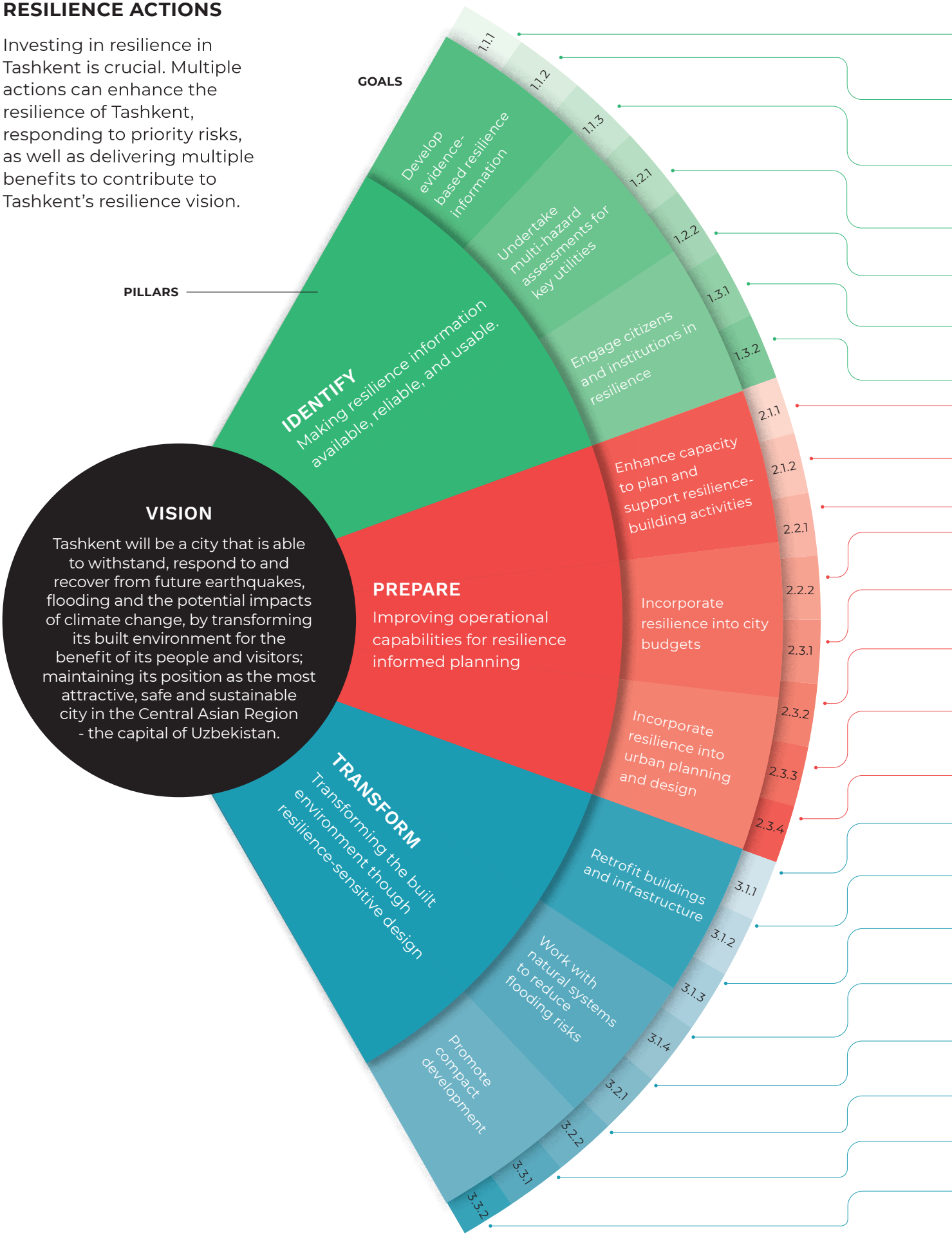
Tashkent requires widespread upgrades and incremental retrofits to buildings and infrastructure. Earthquake and flooding risks may have the worst consequences when large scale infrastructure like dams or education and health facilities are damaged. This is both due to the sheer number of people affected directly by the disasters, as well as the long-term consequences of the loss of the critical service. For example, collapse of schools can result in fatalities of children as well as disruption in education and economic activity.

Deploying nature-based solutions can help the built environment to withstand risks posed by flooding. It will also lay the groundwork for integrated interventions in, for example, vibrant greenery and public spaces combined with sustainable urban drainage to reduce future flood risks. Enhancing natural systems can not only help reduce flooding risk, but can also improve overall livability and attractiveness of the city.

Urban regeneration in Tashkent should enhance the traditional city, to reduce its fragility, as well as to leverage its value for future development. Culturally sensitive interventions, for example, through conservation efforts should ensure infrastructure failure does not pose risks to buildings and people. It will also ensure that these risks do not fall disproportionately upon marginalized populations. Tashkent's cultural heritage will thus economically and socially contribute to Tashkent's future vision for resilience.

RESILIENCE ACTIONS

Investing in resilience in Tashkent is crucial. Multiple actions can enhance the resilience of Tashkent, responding to priority risks, as well as delivering multiple benefits to contribute to Tashkent's resilience vision.



ACTIONS	BENEFITS
1.1.1 Create a 3D digital model of buildings, infrastructure, and population density	· Data needed to understand building performance and anticipate potential losses associated with future earthquakes and flooding events. · Shared asset inventory for improved coordination of risk management and risk informed development.
1.1.2 Develop a full probabilistic model for seismic shocks	· Geographically informed evidence-base of seismic activity that predicts potential impacts of future earthquakes to buildings and infrastructure. · Data needed to determine requirements for future design and retrofitting of existing assets to increase resilience. · Potential informed financial protection through insurance policies for damages. · Increased digital expertise on natural hazard and risk modelling, risk-based decision making, and dealing with uncertainty.
1.1.3 Develop an integrated digital flood and drainage infrastructure model	· Accurate analytics on Tashkent's hydraulic and hydrological systems through flooding simulations to support the implementation of nature-based drainage and flood risk management solutions. · Coordinated development planning through stakeholder consensus on flood risk, potential measures, and design strategies for protecting existing development and planning of new developments. · Increased digital expertise on hazard and risk modelling, risk-based decision making, and dealing with uncertainty.
1.2.1 Undertake a baseline seismic risk assessment of all education, health, and emergency response facilities	· Provision of a reliable source of information on risks to education and health sector facilities. · Efficient use of resources through targeted investments. · Implementation plans include operational continuity of the facilities.
1.2.2 Prepare multi-hazard assessments for reservoir and related infrastructure	· Data-driven understanding of potential risk of cascading failure of dams and related infrastructure. · Clear and accessible data of reservoirs and canals for planned upgrades. · Identification of sources of potential cascading infrastructure failure from earthquakes and flooding.
1.3.1 Institute risk and resilience knowledge transfer across sectors and to citizens	· Reliable and accessible information on hazard, risk, and resilience. · Consensus building for resilience building activities.
1.3.2 Conduct a Gender Equality and Social Inclusion baseline assessment at city and district level	· Identification of disadvantaged groups (e.g., women, disabled, minorities, poor, etc.), their spatial distribution and factors that are conducive to inclusive planning in Tashkent. · Improved risk management through involvement of people.
2.1.1 Undertake digital skills training and capacity building to manage seismic and flooding risks	· Digital skills building for use of data driven analysis and decision-making. · Seismic and flood resilient design and modelling skills to improve performance of buildings and infrastructure. · Maintenance of city-wide cadastral data, calculating risk and visualizing results.
2.1.2 Establish a resilience team to lead and coordinate the implementation of the resilience strategy	· Leadership on resilience agenda in the city to develop cross departmental resilience plans · Coordination and knowledge sharing of risk related information across sectors.
2.2.1 Include resilience investment measures into the city's budgets	· Support for resilience building activities that are incentivized by being eligible for increased funding. · Higher and more predictable returns on investments in infrastructure with the added benefit and security of avoided losses.
2.2.2 Screen prospective investments for their contribution to resilience	· Ensuring that new developments do not pose new or increased risks to communities. · Promotion of new technologies and solutions to increase capacity of city to withstand current and future shocks and stresses.
2.3.1 Embed resilience into policies, plans and zoning regulations for new or upgraded urban development	· Resilience thinking and concepts embedded into urban development policies, plans and regulatory frameworks, explicitly integrating climate considerations into land use and zoning regulations · Incentives for urban development that contributes to resilience. · Private sector engaged in resilience agenda.
2.3.2 Develop a citywide feasibility study for enhancing natural and semi-natural urban areas designed and managed to deliver ecosystem services (green-blue infrastructure)	· Increased awareness of nature-based solutions which include natural and semi-natural urban areas designed and managed to deliver ecosystem services like flood mitigation and biodiversity. · Incentives for nature-based solutions within upgrading and new developments. · Multiple benefits like biodiversity, cooling, improving air quality, providing spaces for outdoor public activities, and improving the city's image.
2.3.3 Prepare a resilience-led regeneration action plan for Tashkent's urban core	· Encouragement of compact development · Preservation of the rich cultural heritage of Tashkent and generating opportunities for adaptive reuse. · Improvement of quality of life for residents and the experience for tourists. · Prioritize the protection of buildings and sites that are most vulnerable to damage and collapse from earthquakes and flooding.
2.3.4 Develop an integrated water management strategy prioritizing water scarcity and related flooding risks in Southern Tashkent	· Strengthen awareness and early implementation of appropriate adaptation to climate change. · Sustainability of water use in areas of need particularly in times of water scarcity. · Testing of new circular water techniques like water recycling, harvesting, etc. to be potentially applied across the city · Reduce geological risks from land subsidence cause by ground abstraction.
3.1.1 Retrofit and rebuild education, health, and emergency response facilities to be safe from earthquakes	· Avoiding cycles of lost human lives, particularly children. · Protection of long-term human capital and development.
3.1.2 Retrofit and develop a long-term strategy for maintenance of reservoirs and related infrastructure within Tashkent	· Prevention of cascading failure in Tashkent from dam, reservoir, or related infrastructure failure. · Protection of parts of the city and communities downstream that are at risk of flooding from dam failure. · Preservation of water supply function across the city and continued function and operation of water features and water bodies in and around Tashkent.
3.1.3 Upgrade water supply pipeline city-wide	· Reduced monetary losses from leakages and frequent maintenance. · Improved quality and reliability of water supply. · Improved health and wellbeing of citizen.
3.1.4 Undertake systemic design improvements of the district heating systems to be safe from earthquakes	· More reliable heating supply for residents and critical services like the health sector.
3.2.1 Implement pilot projects for green-blue infrastructure	· Attractiveness of place and increased property value. · Biodiversity, health, and well-being gains from access to nature. · Demonstration of nature-based solutions to potentially be applied to wider urban development. · Improved flood management, improved air quality, and cooling of high urban temperatures.
3.2.2 Make streets active and healthy through street design, active transport, landscaping, and sustainable urban drainage	· Reduced surface water flooding. · Manage changing weather conditions including potential impacts of climate change. · Encouraged active urban mobility and increased health and wellbeing. · Enhanced pedestrian experience and safety, reduced air pollution, enhanced biodiversity, and overall image of the city.
3.3.1 Develop an integrated water and sewage management plan in the city center and old town	· Preserved cultural heritage at risk from frequent flood damage. · Robust and upgraded infrastructure to support inner city living. · Urban regeneration opportunities.
3.3.2 Deliver resilience-led regeneration of the urban core and historic areas	· Encourage compact development and increased attractiveness of the urban core · Resilience thinking is applied at a practical level, advancing the coordination of various stakeholders and government departments. · Urban conservation is seen as an important element for urban regeneration. · Enhanced maintenance of infrastructure and existing built assets in the urban core including heritage buildings, increasing the protection to seismic and flooding risks.

PILLAR 1

IDENTIFY

Making resilience information available, reliable, and usable

GOALS

1.1 Develop evidence-based resilience information

ACTIONS

1.1.1 Create a 3D digital model of buildings, infrastructure, and population density
1.1.2 Develop a full probabilistic model for seismic shocks
1.1.3 Develop an integrated digital flood and drainage infrastructure model

1.2 Undertake multi-hazard assessments for key utilities

ACTIONS

1.2.1 Undertake a baseline seismic risk assessment of all education, health, and emergency response facilities
1.2.2 Prepare multi-hazard assessments for reservoir and related infrastructure

1.3 Engage citizens and institutions in resilience

ACTIONS

1.3.1 Institute risk and resilience knowledge transfer across sectors and to citizens
1.3.2 Conduct a Gender Equality and Social Inclusion baseline assessment at city and district level

GOAL 1.1

Develop evidence-based risk information

Infrastructure and buildings in Tashkent are ageing and require maintenance and upgrading to meet safety standards and to provide adequate performance when exposed to earthquakes and flooding. To ensure that upgrading is timely and efficient, analysis of earthquake and flooding hazards and risks are needed for the city's buildings and infrastructure. There is a need to develop an evidence-based approach to hazard and risk identification, as well as critical maintenance needs, for which virtual representations of the city's physical assets, using data, data analytics and machine learning may be used to support efficient and phased infrastructure upgrading. A facility within the municipality should be considered to serve as a hub for integrating all virtual data into a single comprehensive model representing different urban systems, the potential shocks and stresses and the performance requirements.[45]

ACTION 1.1.1

Create a 3D digital model of buildings, infrastructure, and population density

TIMESCALE
Short

COST RANGE
USD 300K-1M (UZS 3-10B)

DELIVERY PARTNERS

- Department of Emergency Situations
- Emergency Department of Tashkent City
- UzGidroMet
- Republican Center for Seismic Prognostic Monitoring of the Ministry of Emergency Situations of the Republic of Uzbekistan
- Ministry for the Development of Information Technologies and Communications
- Ministry of Construction
- TashBosh PlanLITI design institute (master plan of Tashkent)
- UzInfoCom

CONTEXT

The scale of building and infrastructure improvements needed in Tashkent is large and lacks location and details on specific vulnerability from earthquakes and flooding. A digital geospatial model of Tashkent that maps the location and engineering characteristics of buildings and infrastructure in 3D would support the municipality in identifying hazard and assessing maintenance needs. A preliminary 3D model has already been developed during the diagnostic phase of this project, but a more systematic version, related to seismic and flood and drainage models, owned by the municipality, is now needed.

ACTION

- Gather high-resolution satellite data, accurate cadastral mapping, and detailed census information as well as an inventory of infrastructure assets.
- Develop a comprehensively mapped database that identifies the buildings, infrastructure and sites that are vulnerable to earthquakes and flooding. The data would include, for example, details of location, construction material, age, usage, current maintenance condition, and number of occupants.
- Identify the structural system designed to manage earthquake loads in buildings and infrastructure.
- Develop an integrated terrain elevation and drainage model to understand surface water run-off.
- Identify the user unit of the 3D model, develop usability guidelines, assign roles, and train personnel within an identified unit to operate and regularly maintain and update the information used in the model.
- Develop a protocol for the user unit to make the data available to other departments, ensure coordination with the flood and drainage infrastructure model and the seismic hazard and risk model, and make model consultation an explicit process step for city planning and investment decision-making.

RESILIENCE BENEFITS

- Data needed to understand building performance and anticipate potential losses associated with future earthquakes and flooding events.
- Shared asset inventory for improved coordination of risk management and risk informed development, as well as identifying critical infrastructure maintenance needs.

ACTION 1.1.2

Develop a full probabilistic model for seismic shocks

TIMESCALE
Short

COST RANGE
USD 300K-1M (UZS 3-10B)

DELIVERY PARTNERS

- Department of Emergency Situations
- UzGidroMet
- Republican Center for Seismic Prognostic Monitoring of the Ministry of Emergency Situations of the Republic of Uzbekistan

CONTEXT

Earthquakes occurring across Uzbekistan and the Central Asia region can cause varying levels of ground shaking and associated seismic hazards (liquefaction, shake-down settlement as well as geotechnical and structural damage) across Tashkent. An analysis of the amount of ground shaking from all possible sources and all distances at each site in the city is needed to better understand earthquake risks to Tashkent's buildings, infrastructure, and population. The seismic model would relate to 3-Dimentional data for buildings and infrastructure in the city and the flood and drainage model.

ACTION

- Create a probabilistic seismic hazard model for the Tashkent region that can be used to analyze the risks from earthquakes to all sites, buildings, and infrastructure across the city. The probabilistic model should consider a forecasting window of 50 years for buildings and 100 years for infrastructure, providing a long-term indication of the city's exposure to seismic hazards. The model should consider seismic sources up to 300km from the city, including seismic sources in neighboring countries.
- Review the existing seismic hazard model developed as part of the Earthquake Model Central Asia (EMCA) project, which should provide a good basis for future development of the seismic hazard model for Uzbekistan and provide the basis for regional collaboration about seismic hazard and risk knowledge sharing.
- Identify the user unit of the seismic hazard and risk model, develop usability guidelines, assign roles, and train personnel within the identified unit to operate and regularly maintain and update the information used in the model.
- Develop a protocol for the user unit to make the data available to other departments, ensure coordination with the flood and drainage infrastructure model and the 3D model, and make model consultation an explicit process step for city planning and investment decision-making.

RESILIENCE BENEFITS

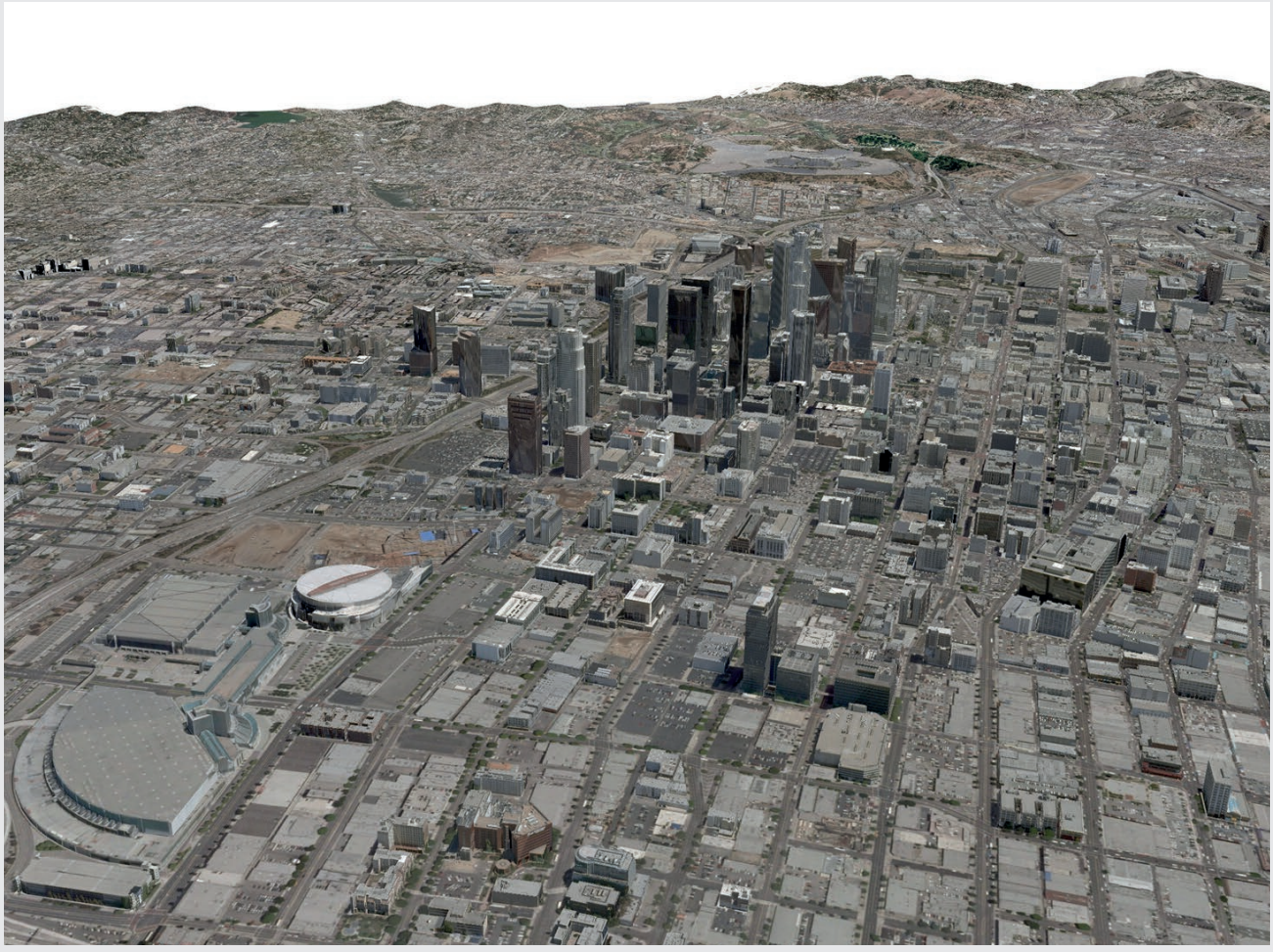
- Geographically informed evidence base of seismic activity that predicts potential impacts of future earthquakes to buildings and infrastructure.
- Data created to determine requirements for future design and retrofitting of existing assets to increase resilience as well as preparing a business case.
- Data created to inform financial protection through insurance policies for damages.
- Increased digital expertise on natural hazard and risk modelling, risk-based decision making, and dealing with uncertainty.

INSIGHT

Los Angeles earthquake hazard model (2001)

An earthquake hazard and risk analysis for Los Angeles County was undertaken using available land-use maps, a probabilistic earthquake hazard model developed by the Southern California Earthquake Center, and the Federal Emergency Management Agency's new HAZUS earthquake loss stimulation software.

The analysis shows that the annual long-term earthquake risk in Los Angeles Country, because of direct structural and non-structural damage, is USD 338 million per year. The extent to which planned future land-use growth would affect this risk estimate was also investigated. Planned land-use growth of 14.2% would result in an increase in annual risk to USD 449.5 million, a 15.8% increase over the risk to current land uses. Because of ever increasing disaster costs, planners need to be able to evaluate the risks that their community faces, both in the present and in the future. It is particularly important for planners to be sure that they are not planning future growth in hazardous locations.



3D Model of Los Angeles, USA

ACTION 1.1.3

Develop an integrated digital flood and drainage infrastructure model

TIMESCALE
Short

COST RANGE
USD 300K-1M (UZS 3-10B)

DELIVERY PARTNERS

- Department of Emergency Situations
- UzGidroMet
- Tashkent Water and Wastewater Services (SuvSoz)

CONTEXT

Floods occur seasonally in all areas of Tashkent, mainly due to pluvial (rainfall surface run-off based) flooding. The flooding occurs because of a combination of factors including the intensity of seasonal rainfall, the terrain and topographic differences across the city, the extent of paved and impermeable ground surfaces and the inadequate sizing and capacity of the storm-water drainage system. Flooding scenarios are likely to worsen due to climate change. There is a need to understand in greater detail (beyond the 10-meter resolution study in the background diagnostic) the estimated losses and the affected areas, as well as the combined functioning of the city's hydrological (rainfall and runoffs) and hydraulic (natural or artificial water movement) systems to make design decisions and plan mitigation measures. This action should relate to 3-Dimentional data for buildings and infrastructure in the city and the seismic model.

ACTION

- Develop an integrated model for flooding and drainage infrastructure for Tashkent, to allow the modelling of water at catchment scale, including rivers, drainage systems, waterways, surface water run-off and groundwater.
- Model and analyze rainfall-runoff processes in the local catchment, water levels in the upstream rivers, waterways and tributaries, and interior hydraulic processes within the urban water system.
- Undertake and update local level surveys where required to anticipate flooding risks.
- Update flooding occurrences on the model regularly, including estimated damages and losses incurred to improve the accuracy and reliability of the models.
- Identify and scope protective measures including estimated capital and operating cost to allow cost-benefit analyses to be undertaken and prepare a business case for increasing flood risk management. This should be developed by comparing cost of implementing protective measures against the potential cost of damage from flooding.
- Identify the user unit of the seismic hazard and risk model, develop usability guidelines, assign roles, and train personnel within the identified unit to operate and regularly maintain and update the information used in the model, as well as running, calibrating, and validating the analyses.
- Develop a protocol for the user unit to make the data available to other departments, ensure coordination with the seismic model and the 3D model, and make model consultation an explicit process step for city planning and investment decision-making.

RESILIENCE BENEFITS

- Accurate analytics on Tashkent's hydraulic and hydrological systems through flooding simulations to support the implementation of nature-based drainage and flood risk management solutions.
- Coordinated development planning through stakeholder consensus on flood risk, potential measures, and design strategies for protecting existing development and planning of new developments.
- Increased digital expertise on hazard and risk modelling, risk-based decision making, and dealing with uncertainty.
- Identification of benefits from NBS (i.e., rate of water absorption).

GOAL 1.2

Undertake multi-hazard assessments for key utilities

The design of utility networks and education and health facilities in Tashkent typically does not adequately consider the potential risks from earthquakes and flooding, putting many facilities and water distribution, power, and gas distribution networks at severe risk from earthquakes. Damage of such facilities and networks can cause large scale risk to life and disruption to services, with cascading impacts throughout society, economic losses, and social disruption (e.g., disruption to power and water supply). The 3D digital model developed for buildings and infrastructure (refer to action 1.1.1) should be expanded and consistently used as the basis for developing a deeper understanding of the risk information for utilities.

ACTION 1.2.1

Undertake a baseline seismic risk assessment of all education, health and emergency response facilities

TIMESCALE
Short/medium

COST RANGE
USD 300K-1M (UZS 3-10B)

DELIVERY PARTNERS

- Department of Emergency Situations
- Department of Public Education
- Department of Healthcare

CONTEXT

Education, health and emergency response facilities in Tashkent are vulnerable to ground shaking and earthquake damage. Potential earthquake damage to these buildings would cause large scale loss of life, disruption in healthcare services, interruption to education as well as causing significant economic impact to the city and its citizens. As a priority, there is a need to understand earthquake risks to these facilities across the city.

ACTION

- Carry out a comprehensive mapping of the current state of facilities (including care homes, clinics, fire stations, nurseries, day-care facilities and orphanages).
- Include information on the layout of different specialized functions of the education, health and emergency response facilities within this baselining exercise, in addition to construction types, materials, building layouts, and occupancy.
- Document building typologies and assessment methods by which all education, healthcare and emergency response facilities may be categorized and assessed.
- Identify retrofit and redevelopment needs for the most vulnerable and priority facilities.
- Plan retrofit and redevelopment works with minimal service disruption.

RESILIENCE BENEFITS

- Provision of a reliable source of information on risks to education, health and emergency response facilities.
- Efficient use of resources through targeted investments.
- Implementation plans include operational continuity of the facilities.

ACTION 1.2.2

Prepare multi-hazard assessments for reservoirs and related infrastructure

TIMESCALE
Short/medium

COST RANGE
USD 300K-1M (UZS 3-10B)

DELIVERY PARTNERS

- Department of Capital Construction
- Department of Operation and Maintenance of Canals
- Department of Emergency Situations

CONTEXT

Dam collapse, as seen at Sardoba Reservoir (May 2020), shows the extent of damage that can be caused to downstream communities and infrastructure following the failure of these facilities. Reservoirs and related infrastructure such as canals built during the Soviet period in and around Tashkent are vulnerable to failure caused by extreme rainfall and potential earthquake ground shaking. This vulnerability is interpreted to be due to a combination of outdated design and construction methods, poor maintenance, and deterioration of the facilities over time. This raises the need for a robust assessment of these structures and operations considering multiple hazard scenarios.

ACTION

- Establish a comprehensive understanding of risks affecting reservoir and related infrastructure through multi-hazard and risk assessments. This should include structural details of the reservoir, the dam, spillways, and related facilities.
- Assess the condition of the electrical and mechanical equipment required to control and operate the facilities, including emergency notification systems.
- Compare the findings from this assessment with national standards as well as global best practice – for example, guidance from the International Commission on Large Dams.
- Assess the data related to extreme weather conditions (e.g., rainfall within related catchments and conditions that could impact the operation of the facilities).
- Undertake flood modelling based upon extreme weather and projected climate change conditions.
- Share findings with all delivery partners to improve end-to-end warning systems operated and further disseminate through the Department of Emergency Situations.

RESILIENCE BENEFITS

- Data-driven understanding of potential risk of cascading failure of dams and related infrastructure.
- Clear and accessible data on reservoirs and canals for planned upgrades.
- Identification of sources of potential cascading infrastructure failure from earthquakes and flooding.

INSIGHT

Anatolia, Turkey (2020)

This case study describes the assessment of the seismic resistance and resilience of dams in northwest Anatolia in Turkey. The study emphasizes that dams should be assessed using a set of appropriate design metrics to ensure there is an adequate factor of safety to prevent a catastrophic release of reservoir water, especially under seismic excitation.

This is a crucial task in earthquake safety evaluation and risk management of existing dams. There are many large dams under the effect of near-source zones in Turkey. This case study presents guidelines to address the safety concerns of large dams subjected to earthquakes. It synthesizes the simulations performed for 15 large dams located in 2 separate basins in the northwest Anatolia region in Turkey. Most of these dams are impacted by nearby seismic sources resulting from active geological fault systems. For dams with hydraulic heights ranging from 35m to 89m, the seismic hazard ratings of the dam sites and the risk ratings of the complete structures were determined, and the potential failure modes were estimated.

As a result of this study, 40% of dams have been classified as “extremely high” risk, while others fall into the “high” risk category. Through a better understanding of vulnerability, this project improved the safety of dams, reduced the risk of catastrophic events, as well as informed codified guidelines for addressing safety concerns.

GOAL 1.3

Engage citizens and institutions in resilience

Knowledge of hazard and risk information in Tashkent needs to be accessible to all departments within the municipality as well as be clearly communicated to decision makers and citizens. This knowledge can improve risk management in local government, making urban planning well informed, and provide greater accountability. Complex data when simplified for diverse audiences can also help build consensus for future resilience building efforts.

ACTION 1.3.1

Institute risk and resilience knowledge transfer across sectors and to citizens

TIMESCALE
Medium

COST RANGE
USD 50-300K (UZS 540M-3B)

DELIVERY PARTNERS

- Department of Emergency Situations
- Representatives from Mahallas

CONTEXT

Awareness of earthquake and flooding hazards and risks within all departments of the municipality of Tashkent is important to inform infrastructure and urban development plans being implemented city-wide by diverse stakeholders. A common understanding of risk and resilience knowledge can enable risk-informed and coordinated decision-making among municipal staff and departments and with other stakeholders and citizens.

ACTION

- Assess the institutional improvements needed and potential demands for knowledge products and capacity development within the municipality.
- Assess and raise awareness of disasters to citizens by involving the local media in the planning process, and hosting training events and evacuation drills with communities and schools.
- Undertake a baseline assessment of municipality staff for their existing awareness of hazard and risk information, including raising awareness of practical concepts and terminology (e.g., hazard, exposure, vulnerability, risk, resilience etc.)
- Develop and deliver a Knowledge Management (KM) plan in Tashkent that includes regular sharing of hazard and risk information, updates to hazard and risk scenarios at different locations and the potential impacts on socio-economic indicators across different areas of the city.
- Raise awareness of sources of up-to-date hazard and risk data and the relevance of hazard and risk information to their work.
- Create easy to understand communication materials and visuals on online platforms that can be easily shared with stakeholders and through citizen engagement and participation of local leaders at the Mahalla level.
- Create a dedicated role for Hazard and Risk Knowledge Manager supported by an appropriately resourced team to be instituted with the municipality, to capture and disseminate hazard and risk knowledge across different municipal sectors, stakeholders, and citizens.

RESILIENCE BENEFITS

- Reliable and accessible information on hazard, risk, and resilience.
- Consensus building for resilience building activities.

ACTION 1.3.2

Conduct a Gender Equality and Social Inclusion baseline assessment at city and district level

TIMESCALE
Short

COST RANGE
USD 50-300K (UZS 540M-3B)

DELIVERY PARTNERS

- Department of Mahalla and Family Issues
- Department of Relations with Civil Society and Religious Organizations
- Public Council under Municipality
- Representatives from Mahallas

CONTEXT

Tashkent is witnessing ambitious new urban development projects aimed at driving progress and attracting foreign investment, delivered by private and public bodies. These projects present a big change to the daily lives of common citizens, especially women, vulnerable groups and communities living in the city. There is a need to better understand existing social, economic, and cultural circumstances to avoid unintended consequences and address people's needs, ultimately contributing to making urban development in Tashkent inclusive and accessible.

ACTION

- Develop a baseline that represents the existing conditions for gender equity and social inclusion in the city.
- Analyze data from key indicators relating to inclusivity.[46]
- Undertake processes to engage people, especially vulnerable groups potentially affected by all future developments, and ensure future urban development plans and projects are designed to include and benefit them.
- Develop key gender and inclusion considerations in Tashkent and integrate these considerations into policies and decision making.

RESILIENCE BENEFITS

- Identification of disadvantaged groups (e.g., women, disabled, minorities, poor, etc.), their spatial distribution and factors that are conducive to inclusive planning in Tashkent.
- Improved project design and risk management through the involvement of people.

INSIGHT

Participatory design to create a public space that serves all genders equitably in Mendoza, Argentina (2018)

In 2018, the Municipality of Mendoza and the Ministry of Interior, Public Works, and Housing, Government of Argentina, undertook a public space upgrading project in La Favorita neighborhood through a gender perspective. International consultants, students, and women of La Favorita collaborated to formulate solutions to their challenges through changes in the public realm. The process aimed for the gender-inclusive redesign of the square.

The participatory methodology included a series of activities to develop a shared understanding of gender issues in urban planning; examining the neighborhoods's public spaces; identifying challenges faced in the urban environment and potential solutions; and collectively prioritizing potential solutions. Once the needs, challenges, and initial vision were established, the project team worked with women to create six proposed plans for the redevelopment of the Plaza that were presented back to the community for feedback and voting.

The Municipality of Mendoza has committed to construct the plaza, and the selected design will put into place recommendations crafted by and for the women of La Favorita. In addition, the project was successful in creating buy-in among government partners around the importance of a gender-inclusive process and product. As a result, municipal partners have decided to implement similar gender-inclusive participatory processes in future planning and design projects, and the Government of Argentina intends to incorporate these practices into its national upgrading protocol.

Participatory workshop in Mendoza, Source: Kounkey Design Institute

PILLAR 2

PREPARE

Improving operational capabilities for resilience-informed planning

GOALS

2.1 Enhance capacity to plan and support resilience-building activities

ACTIONS

2.1.1 Undertake digital skills training and capacity building to manage seismic and flooding risks

2.1.2 Establish a resilience team to lead and coordinate the implementation of the resilience strategy

2.2 Incorporate resilience into city budgets

ACTIONS

2.2.1 Include resilience investment measures into the city's budgets

2.2.2 Screen prospective investments for their contribution to resilience

2.3 Incorporate resilience into urban planning and design

ACTIONS

2.3.1 Embed resilience into policies, plans and zoning regulations for new or upgraded urban development

2.3.2 Develop a citywide feasibility study for enhancing natural and semi-natural urban areas designed and managed to deliver ecosystem services (green-blue infrastructure)

2.3.3 Prepare a resilience-led regeneration action plan for Tashkent’s urban core

2.3.4 Develop an integrated water management strategy prioritizing water scarcity and related flooding risks in southern Tashkent

GOAL 2.1

Enhance capacity to plan and support resilience-building activities

As the use of digital technologies and assessment methods becomes more widespread, additional skills will be required to manage risks, and thus build resilience. Training and other forms of capacity building will help municipal staff across various department to become more confident in using technical programs and sharing their learning across departments and sectors. Urban resilience should be considered a priority factor at decision making and technical levels to drive targeted interventions that meet the needs of the most at-risk populations in the city.

ACTION 2.1.1

Undertake digital skills training and capacity building to manage seismic and flooding risks

TIMESCALE
Short

COST RANGE
USD 1-25M (UZS 10-270B)

DELIVERY PARTNERS

- Department of Emergency Situations
- UzGidroMet
- National Center of Seismic Forecasting
- Departments of Digital Development

CONTEXT

The projected growth of the city and associated increased physical risks to buildings and infrastructure necessitate improvements to the capacity of the municipality to plan for this growth and mitigate associated earthquake and flood risks. Effective use of digital technologies and data can accelerate evidence-based planning, and this will require new and enhanced digital skills.

ACTION

- Deliver a capacity building program for digital skills needed to manage seismic and flood hazard and risk assessment models described in previous actions under Goals 1.1 and 1.2).
  - Conduct a cross-departmental capacity needs assessment to identify knowledge gaps and demand.
  - Design the capacity building program based on the gaps and demand for new skills within wider institutional and cross-departmental setup within the municipality. This should be complemented by developing new processes for coordination, for example between departments in charge of urban planning and emergency management and the user unit of the digital models to regularly update the data as new buildings and infrastructure are developed.
  - Undertake formal and informal training on software; use of data to build, manage, and update the digital models; and the use of tools to coordinate information flows between departments.

IMPACTS

- Digital skills building for use of data driven analysis and decision-making.
- Seismic and flood resilient design and modelling skills to improve performance of buildings and infrastructure.
- Maintenance of city-wide cadastral data, calculating risk and visualizing results.

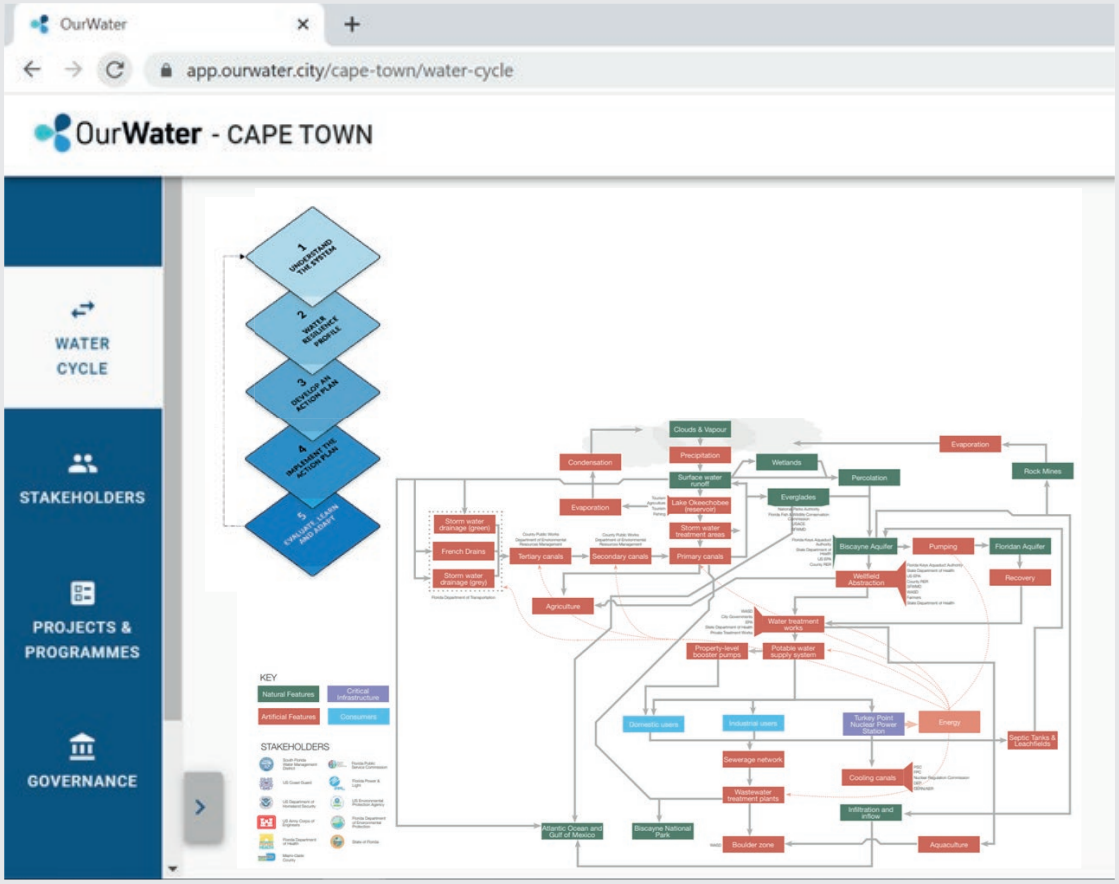
INSIGHT

Our Water Tool (2019)

In the face of increasing urbanization, population growth and uncertainty around climate and other natural and human-caused hazards, the three inherent parts of the water systems are critical: the technical (the physical and cyber components), the ecological (both naturally occurring and designed-in nature-based components) and the social (those who depend upon the system, as well as those who own, operate, and maintain them). In cities, the interdependencies between different systems, different organizations, and public and private sectors is rarely understood.

OurWater, a digital tool, has been developed to help cities better understand their local water context. It helps cities to understand the natural and human-caused assets and systems that make up their water basin; the types of shocks and stresses they face, their impact on natural and human-caused water systems, and the interaction between key stakeholders involved in urban water management. OurWater allows users to input information about the water system and governance processes they participate in, and to map relationships between stakeholders throughout the entire water system. The digital tool creates a platform for city-wide information supplied by users across multiple sectors and levels of government.

To help cities enact the multi-step City Water Resilience Approach (CWRA) process, a suite of resources were developed, including digital and analogue tools. The CWRA was a joint effort developed in collaboration with the Stockholm International Water Institute (SIWI), along with city partners in Amman, Cape Town, Greater Miami and the Beaches, Mexico City, Kingston upon Hull, Greater Manchester, Rotterdam and Thessaloniki, and with contributions from 100 Resilient Cities and the Organization for Economic Co-operation and Development (OECD). In Hull, UK, the City has used it to create a roadmap and plans, and to prioritize actions and align 'living with water' initiatives with existing programs.



Water Governance Tool

ACTION 2.1.2

Establish a resilience team to lead and coordinate the implementation of the resilience strategy

TIMESCALE
Short

COST RANGE
USD 50-300K (UZS 540M-3B)

DELIVERY PARTNERS

- All municipal departments

CONTEXT

Leadership and coordination between sectors including social and economic development, housing, water supply, sewerage, and transport (roads and rail) is essential for planning for resilience in Tashkent. Resilience and climate considerations should be institutionalized within government systems and as part of good governance procedures. This effort would be most effective if leadership is provided by the municipality.

ACTION

- Create a cross-departmental taskforce to champion resilience in Tashkent.
- Prepare Terms of Reference of the proposed Resilience Team, including the source of its operational budget, to include an institutional organogram, agree the roles and responsibilities, reporting and communication with senior management (i.e., Mayor and/or First Deputy Mayor) and other municipality officials. The Resilience Team can include staff from different departments or recruit new staff capable of working across departments.
- Launch the formation of the Resilience Team, tasked with technically developing and operationally delivering Tashkent's resilience strategy. The Resilience Team should also facilitate knowledge sharing and help identify common goals among diverse stakeholders.

IMPACTS

- Leadership on resilience agenda in the city to develop cross-departmental resilience plans.
- Coordination and knowledge sharing of risk related information across sectors.

INSIGHT

Institutionalizing resilience throughout City Hall in Los Angeles (2019)

Building resilience requires a collaborative effort and clear leadership. To champion resilience, cities that are accepted into the 100RC Network create new Chief Resilience Officer (CRO) positions, supported by a resilience team within their governments. The role ranges from being a resilience champion through to bringing diverse stakeholders together.

The resilience office engages holistically across departments, leveraging the CRO's unique convening power to get officials from disparate parts of city government in the same room and laying the groundwork for them to collaborate on resilience-building. As a result of this consultative approach, the Resilience Strategy that the city developed resonated with the various departments.

To further formalize this distributed and collaborative ownership of resilience work, as announced in the strategy, the Mayor of Los Angeles appointed over 30 Departmental Chief Resilience Officers (DCROs) within the city's government. The DCROs are now working together on initiatives focused on critical infrastructure, disaster preparedness and recovery, and extreme heat mitigation. The departmental CROs are now sitting alongside the CRO at the forefront of implementing Los Angeles Resilience Strategy.

GOAL 2.2

Incorporate resilience into city budgets

Embedding resilience should be supported by adequate financial and human resources. Equally, risk data from digital modelling and multi-hazard assessments should be integrated into the investment and broader project management lifecycle. In this way, the contribution of an investment in resilience can become a decision-making criterion in granting planning approvals. Ensuring that investments make tangible contributions to resilience can also increase the municipality's credit ratings if they correspond to achieving sustainable development goals.

ACTION 2.2.1

Include resilience investment measures into the city's budgets

TIMESCALE
Short

COST RANGE
USD 50-300K (UZS 540M-3B)

DELIVERY PARTNERS

- Department of Emergency Situations
- Department of Finance
- Department of Investment and Foreign Trade

CONTEXT

In Tashkent there is currently no defined resources or funding for 'resilience' work to ensure that urban development is safe from the potential impacts of a changing climate, earthquakes, and flood risks. There is a need for the Municipality of Tashkent to review and assess its city budget and allocate funding specifically towards resilience-building actions.

ACTION

- Allocate a proportion of the city budgets towards resilience-building activities, including incentives for embedding resilience within existing and planned projects, and allocations for new and/or upgrading of emergency response facilities.
- Instruct departments and district municipalities to develop resilience focused investments as well as formulate criteria for assessing budget requests.
- Consider the development of a policy to make budget allocations conditional to their contributions to resilience benefits identified within this report; as well as calculating avoided losses from earthquakes and flooding.

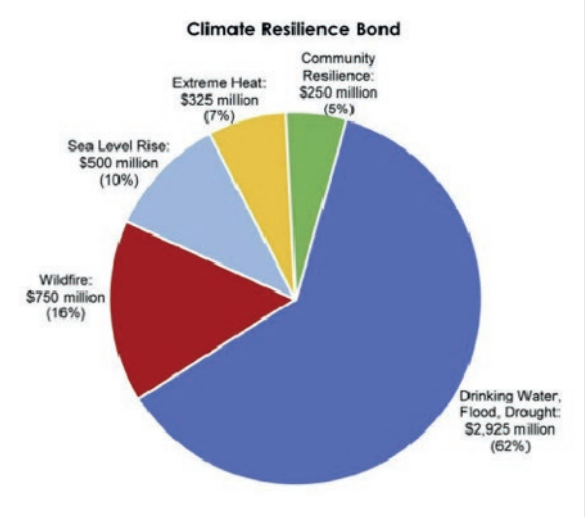
IMPACTS

- Support for resilience building activities that are incentivized by being eligible for increased funding.
- Higher and more predictable returns on investment in infrastructure with the added benefit and security of avoided losses.

INSIGHT

California's budgeting for climate resilience (2021)

In California, the government has proposed a USD 12 billion budget targeted specifically at climate initiatives, as part of the state's budgeting process. This budget includes a fund to reduce greenhouse gases, low-interest loans for climate-related projects, and a USD 4.75 billion bond to reduce risks from water, fire, extreme heat, and sea-level rise, as well as providing support to community resilience planning activities.



The overall climate budget includes USD 66 million for reducing flood risks, USD 51 million to speed up the deployment of electric-vehicle infrastructure and USD 103 million for water resiliency. The budget also includes more than a billion dollars for emergency preparedness and wildfires. More than USD 110 million is intended to go to a home-hardening pilot focused on low-income communities in fire zones.

The ring-fencing of a portion of overall budget, also seen in global cities like Paris and Oslo for climate adaptation measures, helps to transparently report public spending, signal goals to the private sector, and allows for monitoring and reporting.

ACTION 2.2.2

Screen prospective investments for their contribution to resilience

TIMESCALE
Medium

COST RANGE
USD 50-300K (UZS 540M-3B)

DELIVERY PARTNERS

- Department of Capital Construction
- Department of Housing and Public Utilities
- Department of Emergency Situations
- Department of Finance
- Department of Investment and Foreign Trade

CONTEXT

Although targeted investments in risk reduction from known risks like earthquakes are needed, all future investments in different sectors have the potential to contribute to resilience. For example, a road upgrading program could include sustainable flood mitigation measures or ensure access for emergency vehicles. A mechanism for the municipality to embed resilience into all investments in urban development is needed for resilience to be mainstreamed in Tashkent.

ACTION

- Develop screening criteria to evaluate projects for their contribution to the resilience of Tashkent.
- Screen, select and promote projects that contribute to Tashkent's ability to withstand and recover from shocks. Investments should clearly highlight risk mitigation or adaptation benefits in development projects to receive funding, for example inclusion of neighborhood level flood mitigation measures in buildings redevelopment.
- Integrate risk data (including seismic and flood and drainage models as well as from natural hazards and climate change) into investment decisions.

RESILIENCE BENEFITS

- Ensuring that new developments do not pose new or increased risks to communities.
- Promotion of new technologies and solutions to increase the capacity of the city to withstand current and future shocks and stresses.

GOAL 2.3

Incorporate resilience into urban planning and design

In addition to implementing measures to improve its response to emergencies while also investing to upgrade currently outdated buildings and infrastructure, it is critical for Tashkent to anticipate future impacts from disasters, chronic or recurring seasonal events, and to make evidence-based decisions that protect urban development projects. Resilience considerations could guide the municipality to adopt innovative urban concepts like nature-based solutions, social value-led development, and circular economy principles. Ultimately, the municipality should include resilience considerations into all future urban development through instruments like urban plans, zoning regulations, and building codes.

ACTION 2.3.1

Embed resilience into policies, plans and zoning regulations for new or upgraded urban development

TIMESCALE
Medium

COST RANGE
USD 300K-1M (UZS 3-10B)

DELIVERY PARTNERS

- Department of Capital Construction
- Department of Emergency Situations
- Department of Economy
- Legal Department of the Municipality

CONTEXT

Tashkent faces challenges in adopting and enforcing policies that are aligned with the national Disaster Management Laws, Plans, Strategies and/or Action Plans. For example, climate adaptation action should be explicitly integrated into land use and zoning regulations and the latest seismic design guidelines should be adopted for the redevelopment of public facilities. New policy tools are needed to overcome outdated standards and regulatory implementation challenges in Tashkent.

ACTION

- Incorporate resilience into land use planning and zoning regulations and use levers such as building codes, risk disclosure and incentives to stimulate resilient urban development projects. In addition to construction norms and standards, climate change adaptation should account for the performance needs of resilient infrastructure to achieve reliable and safe service provision, especially under seismic and flooding conditions.
- Guide municipal and private agencies to update their policies, plans and designs (e.g., water, energy, and gas supply sectors) to reflect the latest available information on disaster risks as well as reflect climate change global commitments, i.e., Nationally Determined Contributions to carbon emission reduction.
- Formulate financial incentives and penalties to drive the implementation of considerations of resilience into urban development projects. Penalties for non-compliance must be sufficiently high and strictly enforced so as not to become part of the costs of doing businesses.
- Organize and proactively participate in city-wide events targeted at the private sector to elevate awareness of the need, importance of, and implementation of resilience into urban development projects.

RESILIENCE BENEFITS

- Resilience thinking and concepts embedded into urban development policies, plans and regulatory frameworks, explicitly integrating climate considerations into land use and zoning regulations.
- Incentives for urban development that contributes to resilience.
- Private sector engaged in resilience agenda.

ACTION 2.3.2

Develop a citywide feasibility study for enhancing natural and semi-natural urban areas designed and managed to deliver ecosystem services (green-blue infrastructure)

TIMESCALE
Medium

COST RANGE
USD 300K-1M (UZS 3-10B)

DELIVERY PARTNERS

- Department of Capital Construction
- Department of Operation and Maintenance of Canals
- Tashkent Water and Wastewater Services (SuvSoz)
- Department of Beautification
- Department of Transport
- Department of Economy

CONTEXT

The needed improvements to infrastructure in Tashkent to adapt to future climate risks from flooding will be very costly, and time-consuming if done through hard infrastructure only. They can also lead to increased contribution to Green House Gas emissions and climate change. The municipality could test more sustainable options that combine hard infrastructure solutions with nature-based solutions in urban areas, for example building new (and connecting to existing) natural green spaces, water channels, and water bodies that connect to river tributaries that flow through the city.

ACTION

- Evaluate the current state of green-blue infrastructure systems and identify opportunities to improve and expand them. Map the potential for specific green-blue sites and classify them by typology (for example, field, park, playground, wetlands, etc.). The mapping should also highlight, by district, the priority areas that lack access to green spaces, as well as areas in need of drainage upgrades due to current and future climate-change.
- Identify opportunities to introduce nature-based solutions, including swales, water detention and retention ponds, and naturalizing existing canals and waterways, and other measures to provide more green and blue connected spaces across the city such as greening, new parks, or 'daylighting' underground streams where they occur.
- Identify opportunities to provide more green and blue connected spaces across the city through measures like street greening, new parks, or 'daylighting' underground streams where they occur. Nature-based solutions should be tested, including swales, retention ponds and naturalizing existing canals and waterways. These nature-based solutions should include possible locations for water detention (holding it semi-permanently, possibly as water features) and retention (holding it temporarily and releasing it in a controlled way into a known outlet).
- Identify opportunities to enhance biodiversity within existing green and blue spaces by supporting the establishment of soils, native plants, insects and appropriate wildlife.

RESILIENCE BENEFITS

- Increased awareness of nature-based solutions which include natural and semi-natural urban areas designed and managed to enhance climate adaptation through flood mitigation and biodiversity.
- Incentives for nature-based solutions within upgraded and new developments.
- Multiple benefits, including biodiversity, cooling, improving air quality, providing spaces for outdoor public activities, and improving the city's image.

INSIGHT

Green-blue infrastructure

Green-blue infrastructure refers to "strategically planned networks of natural and semi-natural areas within the urban built environment".[47] They include environmental features like green areas and water bodies designed and managed to deliver a wide range of natural ecosystem services. In Tashkent, these areas could be designed for flood mitigation, increased access to open spaces, active transport, improving air quality, enhancing biodiversity, reducing urban heat island effect and overall attractiveness of the city. Cities around the world have recognized the benefits of investing in green-blue infrastructure to better adapt to future changes in climate.

Tashkent already faces disruptive flooding events on a regular basis. This is mainly in-land "pluvial" flooding caused when the existing engineered drainage system is overwhelmed following intense rainfall. Flooding is likely to increase with urban growth and climate change if it does not consider sustainable urban drainage. For examples, nature-based sustainable urban drainage solutions (SuDS) create natural conditions, such as soft ground, rocks, and topography, to capture and optimize water absorption and infiltration. This also results in a lower use of hard impermeable materials like concrete, tarmac, and tiles. Behaving like natural water-management systems, SuDS reduce the risk of pluvial flooding while also reducing ground subsidence, observed in Tashkent's southern districts due to water abstraction through bore-wells.

ACTION 2.3.3

Prepare a resilience-led regeneration action plan for Tashkent's urban core

TIMESCALE
Medium

COST RANGE
USD 50-300K (UZS 540M-3B)

DELIVERY PARTNERS

- Department of Capital Construction
- Public Council under Municipality
- Local Mahallas
- Department of Culture
- Department of Tourism and Sports

CONTEXT

Retaining the livability, vibrancy and compactness of its urban core is key for Tashkent's resilience and sustainability, especially given the current trend of low-density expansion in the urban fringes. The urban fabric in the core is weakened by ageing infrastructure and poor maintenance of multistorey apartment buildings built in the Soviet period, as well as the neglect of public spaces between them. There are approximately 360 heritage sites in Tashkent, of which many carry deep importance for local people. The old town attracts locals and tourists, but the city's cultural and social capital is at risk from external threats like earthquakes as well as culturally insensitive urban development.

ACTION

- Prepare an inventory of brownfields and vacant sites as well as other public land and property assets with repurposing potential; map and classify 'sites' of culturally significant heritage using international definitions and standards (e.g., ICOMOS[48]), creating a classification system of heritage buildings, recording their locations and state of conservation.
- Identify sites in the urban core susceptible to earthquakes and flood damage and match with culturally sensitive retrofit and maintenance construction methods.
- Prepare a regeneration action plan supported by urban development regulations and a suite of financial and non-financial incentives targeting complex regeneration needs such as refurbishment of multi-family apartments, adaptive reuse of heritage buildings, reconversion of disused industrial assets, and the upgrade and upkeep of public open spaces.
- Designate priority areas in consultation with local Mahallas to ensure different perspectives and identities are also considered.

RESILIENCE BENEFITS

- Encouragement of compact development.
- Preservation of the rich cultural heritage of Tashkent and generating opportunities for adaptive reuse.
- Improvement of quality of life for residents and the experience for tourists.
- Safeguarding the cultural and commercial benefits of these assets.
- Prioritize the protection of buildings and sites that are most vulnerable to damage and collapse from earthquakes and flooding.

ACTION 2.3.4

Develop an integrated water management strategy prioritizing water scarcity and related flooding risks in southern Tashkent

TIMESCALE
Medium/Long

COST RANGE
USD > 50M (UZS >540B)

DELIVERY PARTNERS

- Tashkent Water and Wastewater Services (SuvSoz)
- UzGidroMet
- Department of Capital Construction

CONTEXT

Low levels of summer rainfall contribute to water supply constraints and reliance on groundwater abstraction in some parts of the city, especially in stttouthern Tashkent. Groundwater abstraction can result in localized ground subsidence which can heighten the risk of flooding in these local subsidence areas following heavy rainfall. Uncontrolled groundwater abstraction can also result in increasing concentrations of pollution and waterborne disease in the impacted aquifers. These adverse effects can lead to devaluing of property in the areas impacted. Identifying more reliable and sustainable water supply and formulating and implementing water management strategies is critical in Tashkent, particularly in southern Tashkent, an area undergoing large redevelopment, experiencing water shortages and where land subsidence due to water extraction is observed.

ACTION

- Prepare initial urban development screening tools combing criteria from SuvSoz and the Municipality's environmental agency, based upon municipal and national water management plans.
- Develop a mandatory assessment that land developers must undertake to assess their sites for water availability and potential for water management including water harvesting, ground water recharge and greywater or storm water reuse.
- Establish a Water Reuse Plan to guide requirements for all new developments and retrofits exploring the viability of water management techniques like alternative water sources and recycling to supply water. Assess the socio-economic consequences of repurposing land for water recycling.
- Mitigate potential water reuse risks including the use of organic chemicals in the water treatment process.
- Develop plans and strategies for diversifying water sources so they are grounded in comprehensive hazard identification procedures.

IMPACTS

- Strengthen awareness and early implementation of appropriate adaptation to climate change.
- Sustainability of water use in areas of need particularly in times of water scarcity.
- Testing of new circular water techniques like water recycling, harvesting, etc. to be potentially applied across the city.
- Reduce geotechnical risks from land subsidence cause by ground abstraction.

INSIGHT

Recycled water in Singapore (2009)

In the 1970s Singapore began to consider using recycled water to augment its fresh water supply and increase its water resilience. Although these early studies established that it was technically possible, the technology's high cost and unproven reliability were then insurmountable concerns. By the 1990s, however, membrane technology's cost and performance had improved considerably. Other countries such as the United States were also increasingly using it for water treatment and reclamation. Today, Singapore is one of the world leaders in this technology. The authorities have managed to overcome significant public perception issues surrounding water recycling. Water is collected from across the city to be treated in five reclamation plants serving 5 million people, supplying up to 40% of Singapore's current water needs. By 2060, this recycled water, coined 'NEWater' by Singapore's Public Utilities Board (PUB), is expected to meet up to 55% of Singapore's future water demand.

Water Recycling in Singapore

PILLAR 3

TRANSFORM

Transforming the built environment though resilience-sensitive design

GOALS

3.1 Retrofit buildings and infrastructure

ACTIONS

3.1.1 Retrofit and rebuild education, health, and emergency response facilities to be safe from earthquakes

3.1.2 Retrofit and develop a long-term strategy for maintenance of reservoirs and related infrastructure within Tashkent

3.1.3 Upgrade water supply pipeline city-wide

3.1.4 Undertake systemic design improvements of the district heating systems to be safe from earthquakes

3.2 Work with natural systems to reduce flooding risks

ACTIONS

3.2.1 Implement pilot projects for green-blue infrastructure

3.2.2 Make streets active and healthy through street design, active transport, landscaping, and sustainable urban drainage

3.3 Promote compact development

ACTIONS

3.3.1 Develop an integrated water and sewage management plan in city center and old town

3.3.2 Deliver resilience-led regeneration of the urban core and historic areas

GOAL 3.1

Retrofit buildings and infrastructure

Infrastructure of many types in Tashkent – education, health, emergency response, water, gas, electricity – require substantial upgrades to withstand the impacts of an increased intensity and/or magnitude of shocks and stresses. Embedding modern resilience thinking in the municipality's commitment to retrofitting facilities in the education and health sectors is essential to build resilience and reduce risk.

ACTION 3.1.1

Retrofit and rebuild education, health and emergency response facilities to be safe from earthquakes

TIMESCALE
Medium - Long

COST RANGE
USD > 50M (UZS >540B)

DELIVERY PARTNERS

- Department of Capital Construction
- Department of Public Education
- Department of Healthcare

CONTEXT

Education and health facilities in Tashkent are vulnerable to earthquakes. Damage and collapse of these facilities caused by an earthquake would result in loss of lives due to the large number of people these facilities accommodate. In addition, health facilities are an important component of the emergency response required to be operation in the event of an earthquake or other shock. There is a need to retrofit and, if necessary, to rebuild these facilities to reduce risk while minimizing disruption to the education and health services and improving universal accessibility.

ACTION

- Assess education, health and emergency response facilities (Action 1.2.1) to identify and categorize vulnerable assets.
- Develop a multiple-criteria analysis to identify the most appropriate retrofitting and rebuilding interventions. Criteria to include cost-effectiveness, timeline, spatial and technical feasibility, availability of materials and a skilled workforce, alignment with government priorities, consideration of climate change and other environmental impacts, engagement with the community and consideration of future demand requirements (i.e., population growth and changes in demographics).
- Consider natural hazards and climate change early in the design and planning process of any existing or future planned projects in Tashkent to avoid the need for further rebuilding or retrofitting after project completion.
- Prepare a contingency plan, where necessary, to minimize any potential disruption and ensure the facilities maintain function to avoid adverse consequences for students or for patients (for example, those with specific mobility issues such as infants in pre-schools or patients in intensive care units).
- Execute the retrofits and rebuilding implementation plan for education and healthcare facilities including the contingency plans.

RESILIENCE BENEFITS

- Avoiding cycles of lost human lives, particularly children.
- Protection of long-term human capital and development.

INSIGHT

Safety prioritization of school buildings for seismic retrofit using performance-based risk assessment in the Kyrgyz Republic (2019)

This project aimed to improve the safety and functional conditions of schools in areas of highest seismic hazard in the Kyrgyz Republic. A risk-based framework was developed to assist in establishing a prioritized list among eligible schools that were shortlisted following selection criteria established by the Ministry of Emergency Situations, Ministry of Education and State Agency for Architecture, Construction and Communal Services of the Kyrgyz Republic. The guiding objective was to maximize the benefit in terms of reducing seismic risk for students, predicated on the condition of limited funds. In the Kyrgyz Republic, as with many seismically active areas, smaller earthquakes are expected to occur at a much greater frequency than larger earthquakes. This characteristic of the hazard in a risk-based context suggests that retrofitting more buildings to resist smaller earthquakes may save more lives than retrofitting fewer buildings to resist larger earthquakes. The prioritization criteria relied on determining school seismic retrofit strategies that were most beneficial in terms of lives saved per unit of funds. The benefits were the statistical lives saved for a given retrofit. Use of performance-based seismic design allowed design of various levels of retrofit for the prevalent typologies in the Kyrgyz Republic. Up to four retrofits with increasing capacity were developed for each selected representative index building. Each of these levels of retrofit were analyzed to determine a quantifiable benefit of seismic risk reduction, and the cost of each retrofit was determined. The project has improved the safety of schools and ensured continuity of education. The cost of this project was USD 13 million (UZS 140 billion).

School in northern Kyrgyz Republic

INSIGHT

Seismic resilience of a hospital system, Memphis USA (2007)

This case study presents a comprehensive model to quantify disaster resilience of hospital systems applied to a network of facilities in Memphis, Tennessee in the USA. Resilience was defined in this case as the capability to sustain functionality and recover from losses generated by extreme events. The model combines loss estimation and recovery models and can be applied to critical facilities (e.g., hospitals, emergency response buildings), as well as utility lifelines (e.g., electricity power systems, transportation networks, water systems) that are crucial to the response of recovery processes, decisions, and policies. The resilience framework can be used as a decision support tool to increase the resilience of systems, such as health care facilities, and reduce disaster vulnerability and consequences.

Hospitals in Memphis, Tennessee

(c) UT Bowld Hospital

(a) Methodist Central Hospital

(d) Methodist South Hospital

Hospital	ZIP	Structural Type	Hazus model type
Methodist University Hospital	38104	Concrete shear wall (Mid-rise)	C2M
Methodist North hospital	38128	Concrete shear wall (Mid-rise)	C2M
UT Bowld Hospital	38103	Concrete shear wall (Mid-rise)	C2M
Methodist South Hospital	38116	Concrete shear wall (Mid-rise)	C2M
Methodist Fayette Hospital	38068	Unreinforced Masonry Bearing Walls (Low-rise)	URML
Le Bonheur Germantown Hospital	38138	Concrete shear wall (Low-rise)	C2L

(e) Methodist Fayette Hospital

(b) Methodist North Hospital

(f) Methodist Le Bonheur Germantown Hospital

Map showing network of hospitals in Memphis, Tennessee

ACTION 3.1.2

Retrofit and develop a long-term strategy for maintenance of dams, reservoirs, and related infrastructure within Tashkent

TIMESCALE
Medium - Long

COST RANGE
USD > 50M (UZS >540B)

DELIVERY PARTNERS

- Department of Capital Construction
- Department of Operation and Maintenance of Canals
- Tashkent Water and Wastewater Services (SuvSoz)
- Department of Beautification
- Department of Transport

CONTEXT

Several water reservoirs are located within and adjacent to Tashkent's city limits. These reservoirs are connected to the canal and river system and water distribution system running throughout the city. Reservoirs and the related water infrastructure in and around Tashkent were built during the Soviet period and may not have been originally designed to modern seismic standards or have degraded over time. They are vulnerable to damage during earthquakes and, potentially, to climate change impacts with extreme rainfall leading to water overflow or drawdown due to extended periods of drought. These shocks and stresses can lead to the dams and associated structures being damaged and failing with potential flood hazards in the city and communities downstream. There is a need to retrofit and develop a long-term strategy for maintaining the reservoirs and related infrastructure.

ACTION

- Assess the condition and vulnerability of the reservoirs and related infrastructure or ensure that an assessment has been undertaken prior to any intervention to reveal the scale and nature of upgrades needed (Action 1.2.2).
- Install modern emergency notification systems to regularly monitor the safety of the facilities and alert the population and the responsible authorities in the event of the possibility of any system disruption or failure.
- Retrofit the dams, reservoirs and the related infrastructure and prepare a long-term maintenance strategy to mitigate future risks and avoid damage and disruption losses.
- Prepare contingency plans for isolating damaged infrastructure.

RESILIENCE BENEFITS

- Prevention of cascading failure in Tashkent from dam, reservoir, or related infrastructure failure.
- Protection of parts of the city and communities downstream that are at risk of flooding from dam failure.
- Preservation of water supply function across the city and continued function and operation of water features and water bodies in and around Tashkent.

ACTION 3.1.3

Upgrade water supply pipeline city-wide

TIMESCALE
Short-Medium

COST RANGE
USD 25 - 50M (UZS 270-540B)

DELIVERY PARTNERS

- Department of Capital Construction
- Tashkent Water and Wastewater Services (SuvSoz)
- Department of Beautification
- Department of Transport

CONTEXT

Around half of the water pipeline stock in Tashkent is outdated and roughly 500km of the network requires upgrading and rebuilding. Leakage is a regular occurrence, reducing the efficiency of the distribution network, increasing costs, saturating the ground, and causing geotechnical issues. The municipality is using satellite imagery to detect 'invisible' leaks along the water network, and reportedly fixing between 50 and 60 leaks per day. Cracks in the water pipeline network can also pose a contamination risk and are a public health issue.

Damage and failure of the water distribution network and associated infrastructure can also occur because of seasonal flooding. The water distribution network and associated infrastructure is also vulnerable to damage and failure from earthquakes. There is therefore a need to upgrade the water distribution network and the associated infrastructure across the city and to create a more robust water network to withstand adverse water conditions, gradual degradation, and sudden-onset emergencies like earthquakes.

ACTION

- Deploy Demand Management Area zones for estimating the water use and leakage across the city. Seismic and flooding digital models (actions 1.1.2 and 1.1.3) can help the municipality understand the direct and indirect impacts of leaks and the associated risks in the event of an earthquake.
- Develop water pipeline network and infrastructure vulnerability and risk assessment models to understand the resilience of the system to earthquakes. These models can also be used to estimate the potential level of damage, number of required repairs (including leaks and breaks) per unit length of pipeline as well as provide an estimate of the cost and benefit of undertaking the repairs or engineering work in advance to make the network more resilient to damage.
- Assess, map, and identify high risk priority zones within the water network and prioritize the interventions within these zones.
- Upgrade the water pipeline network and associated infrastructure across the prioritized intervention zones.

RESILIENCE BENEFITS

- Reduced monetary losses from leakages and frequent maintenance.
- Improved quality and reliability of water supply.
- Improved health and wellbeing of citizens.

ACTION 3.1.4

Undertake systemic design improvements of the district heating system to be safe from earthquakes

TIMESCALE
Medium

COST RANGE
USD > 50M (UZS >540B)

DELIVERY PARTNERS

- Department of Housing and Public Utilities
- Implementing bodies - TashTeploCentral (“TTC”), and TashTeploEnergo (“TTE”)
- Department of Emergency Situations

CONTEXT

Tashkent’s centralized district heating system is outdated and ageing, affecting its reliability and efficiency. The system, especially the pipelines and associated infrastructure, are vulnerable to damage from earthquakes (and associated ground shaking and ground deformation, land sliding, lateral spreading, and buoyancy due to liquefaction). As the municipality is planning to improve the district heating system, this is an opportunity to also undertake improvements to the seismic design of the system.

ACTION

- Undertake a systemic evaluation of the seismic performance of district heating systems and design improvements whilst engaging with the Ministry of Emergency Situations and emergency services.
- Ensure alignment with other existing program of work taking place such as decentralizing the heating system.
- Ensure that planned improvements to the district heating system consider seismic design issues and that these are implemented.

RESILIENCE BENEFITS

- More reliable heating supply for residents and critical services like the health sector.

GOAL 3.2

Work with natural systems to reduce flooding risks

Most districts in Tashkent have an inadequate provision of green space both in terms of usable open spaces, greenery and trees along the main streets and communal spaces such as gardens and parks. Lack of green space and the need to upgrade the drainage system have contributed to increased storm water runoff across the city, particularly in the old town. Planned initiatives[49] by the Municipality of Tashkent suggest a growing emphasis on green and open spaces and provide a case for a 'green, blue and grey [50] approach to support an integrated flood management system.

ACTION 3.2.1

Implement pilot projects for green-blue infrastructure

TIMESCALE
Medium - Long

COST RANGE
USD 25–50M (UZS 270-540B)

DELIVERY PARTNERS

- Department of Capital Construction
- Department of Operation and Maintenance of Canals
- Tashkent Water and Wastewater Services (SuvSoz)
- Department of Beautification
- Department of Transport
- Department of Investment and Foreign Trade

CONTEXT

Tashkent needs to adapt to the effects of climate change including increased temperatures, frequent droughts, decreased precipitation, and changes in weather patterns including the potential for large, more intense storms. There is an opportunity to develop sustainable urban greening solutions that can support Tashkent to address its climate change challenges while improving the city's green spaces, which were identified as an area that requires further attention. These solutions can also deliver multiple benefits including flood risk reduction, improved air quality, cooling of high urban temperatures, recharging of groundwater aquifers, enhancing biodiversity and provision of recreational space.

ACTION

- Develop an integrated plan for green and blue infrastructure in Tashkent to set a framework for valuing, connecting and restoring existing green open spaces and waterways.
- Develop and implement new guidance, regulations, and standards to include green-blue solutions within new and existing development.
- Educate and incentivize private sector and designers to design blue-green-grey infrastructure, especially its contribution to climate adaptation.
- Pilot a selection of solutions such as sustainable urban drainage, swales, re-naturalized waterways, water squares, and green roofs as demonstration projects to test the solutions and popularize nature-based solutions in Tashkent.
- Develop/support local supply of indigenous plant species that minimize the requirement for irrigation and encourage biodiversity.

RESILIENCE BENEFITS

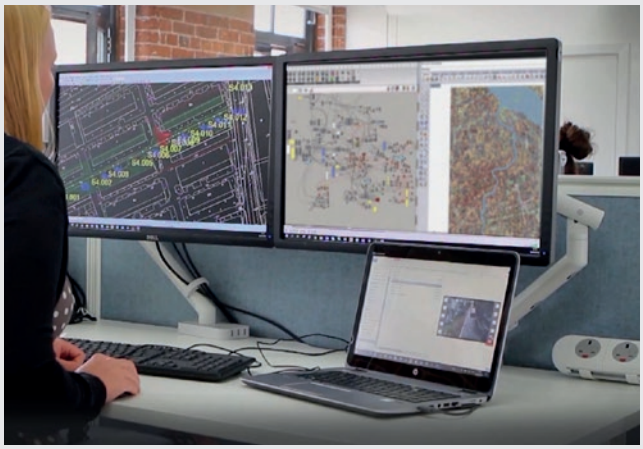
- Attractiveness of place and increased property value.
- Biodiversity, health, and well-being gains from access to nature.
- Demonstration of nature-based solutions to potentially be applied to wider urban development.
- Climate adaption benefits like improved flood management, improved air quality, and cooling of high urban temperatures.

INSIGHT

Shanghai urban drainage masterplanning (2019)

Due to rapid urbanization and associated increases in impermeable areas for water catchments, water run offs in Shanghai have increased and contributed to serious urban flooding and river pollution. The urban drainage masterplan was based on the 'design-with-water' framework which enhances green and blue infrastructure in the city to complement the grey infrastructure, and mimic the natural water cycle. The plan was developed using machine learning technologies to categorize the study area into different development types with respective green and blue infrastructure typologies. This resulted in an integrated system bringing together urban elements above ground into storm water management functions, including roads, green spaces, rivers, and other open spaces. The masterplan enabled Shanghai to have a systemic approach to urban drainage that delivers benefits across multiple systems.

Mapping water systems in Shanghai



Using machine learning to match typology to solutions in Shanghai

Proposed water squares in Shanghai

ACTION 3.2.2

Make streets active and healthy through street design, active transport, landscaping, and sustainable urban drainage

TIMESCALE
Medium - Long

COST RANGE
USD 25–50M (UZS 270-540B)

DELIVERY PARTNERS

- Department of Capital Construction
- Department of Operation and Maintenance of Canals
- Tashkent Water and Wastewater Services (SuvSoz)
- Department of Beautification
- Department of Transport
- Department of Economy

CONTEXT

The number of private vehicles in Tashkent has increased dramatically over the past years and continues to grow, putting considerable pressure on key mobility corridors during peak hours in the morning and early evening. In addition to this, chronic flooding events from excess rainfall in Tashkent impacts transport most acutely.[51] The transport department has identified and planned road improvements to cross-roads, intersections, and parking, especially in downtown areas, which includes separate bus lanes and road landscaping. While this is encouraging, there is a need for streets to be designed for all modes of transport including buses, cars, pedestrians, and cyclists alike. Landscaping around transport corridors also provides opportunities for flood mitigation measures and improving the overall green image of the city.

ACTION

- Plan and provide safe, accessible, and inclusive pedestrian and cycle-friendly routes and related infrastructure across the city, including dedicated cycle lanes.
- Plan and implement landscape beautification and sustainable water management measures such as bio-swales and permeable paving along the transport corridors to reduce localized flooding.
- Develop a last mile strategy which considers options to incentivize cycling and walking for shorter journeys, or as part of a longer, multimodal journey, in consultation with both public and private employers. This could include behavioral change and awareness campaigns.

RESILIENCE BENEFITS

- Reduce surface water flooding.
- Manage changing weather conditions including potential impacts of climate change.
- Encourage active urban mobility and increase health and wellbeing.
- Enhance pedestrian experience and safety, reduce air pollution, enhance biodiversity, and overall image of the city.

GOAL 3.3

Promote compact development

Tashkent retains a relatively compact shape with a unique built heritage. As the increase of land consumption outpaces population growth, targeted and tangible efforts are required to promote a compact spatial pattern and preserve and leverage built heritage. Infill development in the urban core, including the repurposing of brownfield sites and the reuse of built heritage would enhance Tashkent's compactness, protecting the local population whose homes and livelihoods face multiple stresses such as vulnerability to flooding and earthquakes and poor maintenance.

ACTION 3.3.1

Develop an integrated water and sewage management plan in the city center and old town

TIMESCALE
Short

COST RANGE
USD 25-50M (UZS 270-540B)

DELIVERY PARTNERS

- Department of Capital Construction
- Tashkent Water and Wastewater Services (SuvSoz)
- Department of Beautification
- Department of Transport
- Department of Culture
- Department of Tourism and Sports

CONTEXT

Municipal infrastructure in the city center of Tashkent and some of the surrounding areas is ageing and requires development. Frequent flooding during heavy rainfall increases the vulnerability of the water supply and sewerage system, and often affects the fragile foundations of some of the historic buildings in the city center. An integrated approach to managing sewage and water in the city center is needed, that would take into consideration diverse factors that influence flooding and focusses on the preservation of Tashkent's unique built heritage.including buses, cars, pedestrians, and cyclists alike. Landscaping around transport corridors also provides opportunities for flood mitigation measures and improving the overall green image of the city.

ACTION

- Develop an integrated water and sewage management plan in the city center.
- Prepare and implement site-wide flood mitigation strategies, such as increasing ground permeability to delay entry of stormwater into the drainage system and preventing water pooling near fragile building foundations.
- Align these plans with other future planned works in the city to better coordinate and integrate the works and avoid duplicating interventions.
- Where possible, replace ageing infrastructure such as equipment, machinery, and piping, with cesspools and sewage tanks removed or re-positioned away from heritage building foundations.

RESILIENCE BENEFITS

- Preserved cultural heritage currently at risk from frequent flood damage.
- Robust and upgraded infrastructure to support inner city living.
- Urban regeneration opportunities.

INSIGHT

Bursa wastewater project, Turkey

Located in western Turkey, to the south of the Marmara Sea, Bursa is the fourth most populated metropolitan center in the country. The city was the first Ottoman capital and holds important industries and cultural heritage. The Bursa Wastewater project includes hundreds of kilometers of storm and sewerage pipelines and 22 pump stations across 10 sub-catchments of central Bursa province. The sewer system transport sewerage to eight treatment plants and prevents untreated discharge into the Marmara Sea. The project helped Bursa to effectively manage its water supply and to achieve the sustainable removal of wastewater from the city.

Infrastructure upgrade in Bursa, Turkey

ACTION 3.3.2

Deliver resilience-led regeneration of the urban core and historic areas

TIMESCALE
Medium - Long

COST RANGE
USD >50M (UZS >540B)

DELIVERY PARTNERS

- Department of Capital Construction
- Department of Culture and Tourism
- Public Council under Municipality
- Local Mahallas
- Home-owners associations
- Private sector developers

CONTEXT

The renovation of urban cores requires an integrated approach to shift the urban development trend towards a compact spatial pattern and culturally sensitive redevelopment. The interest of developers and homebuyers in the urban core needs to be encouraged and this can be done through a variety of stimuli. The municipality may consider a policy package including, for instance, buildable area bonuses determined by zoning regulations, incentives to adaptive reuse and fast-tracked construction permit processing; and an area-based approach combining interventions to strengthen the structural integrity of buildings and investments in infrastructure (for example, public transport, public spaces and streetscapes, and public lighting).

ACTION

- Develop or adjust zoning regulations to steer and encourage projects in the urban core through buildable area bonuses, transferable development rights and other mechanisms, and criteria for fast-tracking construction permitting, for projects consisting of brownfield repurposing, rehabilitation of buildings, and adaptive reuse of historic assets and new schemes that incorporate conserved historic buildings and locations
- Prepare area-based demonstration projects that increase the attractiveness of the urban core and heritage areas, through interventions that benefit from converging subsidies in the restoration of multiple buildings and the upgrade of public/common spaces at the building and area level, the development of vacant or dilapidated sites and the culturally sensitive adaptive reuse of structures.
- Establish a specific urban core regeneration unit or agency that coordinates regeneration projects and establishes clear cross-sector optimization strategies for the availability in core areas of schools, health centers and other services, in addition to the upkeep of water, sanitation, drainage and waste infrastructure, sectors that may be under the purview of entities beyond the local domain.
- Structure a regeneration fund to support urban core and heritage-led pilot projects, developing a combined subsidies package in, for example, energy efficiency, the introduction of renewables, structural integrity strengthening, as well as agile mechanisms for directing public funds including providing benefits to conservation efforts and incentivizing associations of building owners to undertake maintenance activities.
- Develop a catalogue and guidance on the redevelopment of buildings and public/communal spaces, including construction techniques, materials, and best-practice architectural conservation and the sensitive restoration of existing structures of heritage value.

RESILIENCE BENEFITS

- Compact development is encouraged through the increased attractiveness of the urban core and historic areas, which increase quality of life of residents.
- Resilience thinking is applied at a practical level, advancing the coordination of various stakeholders and government departments who work together in concrete area-based interventions.
- Urban conservation is seen as an important element for urban regeneration.
- Enhanced maintenance of infrastructure and existing built assets in the urban core including heritage buildings, increasing the protection from seismic and flooding risks.

INSIGHT

Preserving cultural heritage in Beijing, China

Beijing was characterized by conflicts between its modern vision and the preservation of its cultural heritage. While rapid economic growth benefited much of the population, it also eroded much of the city's historic urban fabric. This was particularly so in the Hutong Lanes, narrow alleyways formed by lines of ancient courtyard housing. As early as the mid-20th Century, the Beijing Hutongs were demolished to pave the way for new developments. This was met with growing concern among the local population that centuries of heritage would be destroyed forever. International and national stakeholders have developed proposals to conserve and subsequently rehabilitate the historic Hutong quarters. Some neighborhoods are under government protection because of their historical importance. Guozijian (the imperial academy), for example, has several of Beijing's oldest buildings. Other hutongs have been repurposed as shopping and tourist streets, or as trendy cafes.

This leverages their cultural heritage and combines it with modern aspects to generate tourist flows. The project supported Beijing to preserve centuries of history, reduce tensions between communities and repurposed sites to deliver economic and social benefits.

Beijing hutong lanes

SECTION IV.

Implementing the recommendations for resilience

OVERVIEW

To achieve transformative growth, the identified actions must be complemented by a feasible investment plan. This demonstrates where the city has the potential to take concrete steps so that the resilience perspective is taken up in urban development processes and implemented through specific actions in the short, medium, and long term. The following section builds on the proposed actions that will help increase Tashkent's resilience, and provides guidance on:

- The implementation timeline for the actions, highlighting the optimal sequence for addressing risks and maximizing impacts.
- The level of investment required for implementing the plan.
- Potential funding sources and strategies for mobilizing private finance.
- The structure of a monitoring and evaluation framework, which will allow the municipality to keep track of the delivery of outputs and realization of benefits.

IMPLEMENTATION TIMELINE

The implementation timeline reflects an incremental approach. Key for implementing resilience actions in Tashkent is establishing phased objectives to enable the implementation of the strategy to gain momentum and visibility while staying on course to generate transformative impact. This is informed by an appraisal of implementation readiness which will enable Tashkent to prioritize actions or packages of actions that could be implemented early in the process without the need of significant investment or radical changes to the existing governance and regulatory framework. The timeframe is underpinned by the following advancing objectives:

- In the **short term** the main objective should be to enable resilience by delivering diagnostic studies and selected reforms, to develop the design, and to secure funding for major capital investments. Quick wins will help achieve immediate outcomes and demonstrate the value of the strategy.
- In the **medium term** the municipality should be in the position of securing funding for more ambitious projects and kick-start the implementation of transformative actions that will tackle priority shocks and stresses, as well as to begin yielding additional benefits.
- In the **long term** the city should have built a case to replicate pilots for the biggest transformative projects, deliver complementary actions and reassess the need to launch a new cycle of enabling actions (e.g., the update of mapping and baselining initiatives).

The sequence is informed by how each action enables the delivery of other actions. Within the initial package of recommended actions in this report, each action has a concrete role in the overall implementation process. Understanding the connections between actions, and the extent of their inter-connectivity, informs an implementation sequence where the output of some actions feeds into other actions. However, there is flexibility in this sequence, which is often dependent on immediate funding availability or urgency of the actions. The different roles of the actions in the implementation process are:

- **Enabler actions.** Enabler actions are prerequisites for delivering multiple other actions and addressing different types of risks, and thus should be prioritized in the implementation timeline. These actions typically consist of 1) policy tools that support resilient investments, 2) robust diagnostic studies and tools which will inform the design of complex capital projects, and 3) building confidence for prospective investors. An example of an enabler action is "1.1.1 Create a 3D digital model of buildings, infrastructure and population density", which can facilitate other actions.
- **Quick wins.** Quick win actions combine a relative low cost of implementation and high implementation readiness. These can be, for instance, actions that are wholly owned by the Municipality of Tashkent (i.e., "2.1.2 Establish a Resilience Team to lead and coordinate the implementation of the resilience strategy"). The benefit of prioritizing such initiatives is to generate momentum and start delivering resilience dividends from the early implementation stages of the strategy.
- **Transformative actions.** Transformative actions are defined by their ability to deliver multiple impacts that not only mitigate key risks, but also yield additional benefits to a large part of the city (i.e., job creation, health benefits, amenity value). Most transformative actions tend to be capital-intensive and require longer implementation timeframes (i.e., "3.2.2 Make streets active and healthy through street design, active transport, landscaping, and sustainable urban drainage"). The successful implementation of transformative actions is often dependent on the completion of a related enabler (as shown in the timeline).

However, the city may opt for rapid assessments or preparatory actions if deemed necessary. In this scenario, for instance, the retrofit or rebuild of schools could rely on a rapid engineering inventory.

- **Complementary actions.** Complementary actions are resilience-building actions that address a specific part of an infrastructure system or have a limited geographic scope. This could be the case, for instance, of action "3.1.2: Retrofit and develop a long-term strategy for maintenance of reservoirs and related infrastructure within Tashkent". Complementary actions are still an essential part of a wider portfolio of projects that mitigate key risks for the city of Tashkent (in this case, seismic).

The implementation timeline illustrates the recommended sequencing of the proposed actions and indicates the strongest linkages between them. The timeline can be used by the municipality as a tool for planning resilience building activities according to distinct time horizons; ensuring actions are implemented in the correct sequence; and identifying potential packages of actions for funding and financing instruments. The timeline specifically helps to:

- **Visualize the critical role played by key enabler actions,** namely the creation of a full probabilistic model for seismic shocks in Tashkent, and the design of an integrated digital flood and drainage infrastructure model. Both actions can lay the groundwork for additional capital investments. The timeline also communicates the need to promote, from the early stages of implementation, innovation in policy and governance (i.e., "2.2.1 Include resilience investment measures into the city's budgets").
- **Identify the enabling actions that are required to deliver cross-sector transformative actions.** For instance, the selection of pilots for green and blue infrastructure should succeed a city-wide feasibility study, the definition of which will be informed by the insights offered by the digital flooding and drainage infrastructure model.
- **Reinforce the importance of adopting an integrated approach to planning for infrastructure investment,** stressing the importance of complementing major capital projects with actions delivering advisory services, capacity building, and policy making. Feasibility and pre-feasibility studies for transformative capital projects do also play a crucial role in securing funding and finance, demonstrating their market potential to the private sector (see Insight on following page).
- **Guide how actions are packaged for investment.** These can follow two approaches: the first, aims at grouping transformative actions with their direct enabler action (e.g. "1.2.1 Undertake a baseline seismic risk assessment of all education and health facilities" and "3.1.1 Retrofit and rebuild education and health facilities to be safe from earthquakes"); the second, focuses on promoting interventions that aim at upgrading standards and practices around resilience (such as "1.1.1 Create a 3D digital model of buildings, infrastructure and population density" and "2.1.1 Undertake digital skills training and capacity building to manage seismic risks"). The former type of packaging has been utilized frequently in financing from multilateral development banks, where grants and loans often fund a bundle of project components.

INSIGHT

The World Bank / IDA-supported project "Enhancing Resilience in Kyrgyzstan" financed the following components within one package.

1. **Strengthening Disaster Preparedness and Response Systems**: Improve emergency warning and notification systems (such as TV and radio systems), upgrading platforms that monitor hazard information, install search and rescue equipment, and developing e-learning outreach.
2. **Improving Safety and Functionality of School Infrastructure**: Capital works to retrofit school buildings, support preparation of national intervention and investment plan, and design of web-based module to help the Ministry of Education in managing assets.
3. **Enhancing Financial Protection:** Capacity building for the State Insurance Organization, reviewing and optimizing operations and procuring equipment and regional offices.

Action		short term	medium term	long term
1.1.1	Create a 3D digital model of buildings, infrastructure and population density			Update
1.1.2	Develop a full probabilistic model for seismic shocks			Update
1.1.3	Develop an integrated digital flood and drainage infrastructure model			Update
1.2.1	Undertake a baseline seismic risk assessment of all education, health and emergency response facilities			Update
1.2.2	Prepare multi-hazard assessments for reservoirs and related infrastructure			
1.3.1	Institute risk and resilience knowledge transfer across sectors and to citizens			Update
1.3.2	Conduct a Gender Equality and Social Inclusion baseline assessment at city and district level			Update
2.1.1	Undertake digital skills training and capacity building to manage seismic and flooding risks			
2.1.2	Establish a resilience team to lead and coordinate the implementation of the resilience strategy			
2.2.1	Include resilience investment measures into the city's budgets			
2.2.2	Screen prospective investments for their contribution to resilience			
2.3.1	Embed resilience into policies, plans and zoning regulations for new or upgraded urban development			
2.3.2	Develop a citywide feasibility study for enhancing natural and semi-natural urban areas			
2.3.3	Prepare a resilience-led regeneration action plan for Tashkent's urban core			
2.3.4	Develop an integrated water management strategy prioritizing water scarcity and related flooding risks in southern Tashkent			
3.1.1	Retrofit and rebuild education, health and emergency response facilities to be safe from earthquakes			
3.1.2	Retrofit and develop a long-term strategy for maintenance of dams, reservoirs, and related infrastructure within Tashkent			
3.1.3	Upgrade water supply pipeline city-wide			
3.1.4	Undertake a systemic design improvements of the district heating system to be safe from earthquakes			
3.2.1	Implement pilot projects for green-blue infrastructure			Pilot1
3.2.2	Make streets active and healthy through street design, active transport, landscaping and sustainable urban drainage			Pilot1
3.3.1	Develop an integrated water and sewage management plan in the city center and old town			
3.3.2	Deliver resilience-led regeneration of the urban core and historic areas			

Enabler action Transformative action Quick win Complementary action

LEVEL OF INVESTMENT REQUIRED FOR FUNDING AND FINANCE

The indicative level of investment required for delivering the initial set of actions identified in this report is in the range of USD 500-600 million (USZ 5.4-6.4 trillion). Each action and package of related actions will require further refinement as they reach maturity to provide accurate illustration of the investment required and feasibility vis a vis available or attainable resources. For illustrative purposes, the below table offers indicative estimates of funding needs. This should be considered a lower end estimate, as it is reliant on benchmarks, and the spatial extent of many of the recommended actions is approximate.

While the level of investment required is substantial, actions can generate significant benefits over the long term. If action is taken, Tashkent will be able to avert, at least in part, significant economic losses, including an estimated annual flood damage related to pluvial flooding of around USD 40.3 million (UZS 433 billion) per year, and risk of losses of USD 243 million (UZS 2.6 trillion) from a 5.0 Mw earthquake or USD 16 billion (UZS 172 trillion) from a 6.7 Mw earthquake. The implementation of the proposed resilience-building actions will yield benefits for the whole of Tashkent beyond avoided damage, which include increased productivity and health and wellbeing benefits.

SOURCES OF FUNDING AND FINANCE

The Municipality of Tashkent can mobilize several funding and financing options to implement actions, including external funders, public sources, and private investors. While many actions – or packages of actions – will likely source capital from a blend of these sources, the appropriateness or make-up will depend on ability of investments to generate market returns (private sector), below-market returns (external funders), or little to no obvious returns, with, however, economic internal rate of returns (or benefit-cost ratios) above certain thresholds (public sector). While both external funders and public government sources are currently active in investing in resilience and infrastructure related initiatives in Uzbekistan, there is lack of available information on the level of private investment in Tashkent.

External funders

External funders are a key source of financing for resilience and infrastructure projects. Major investors in the country include the Asian Development Bank (ADB), the European Bank for Reconstruction and Development (EBRD), the Islamic Development Bank (IDB), Japan International Cooperation Agency (JICA), and the World Bank (WB). Together, these actors have sponsored dozens of capital projects and invested over USD 10 billion (UZS 107.5 trillion) in sovereign loans, official loans, and grants over the last 10 years in the country (for a list of projects examined, see Appendix C). Other players include UNDP, Green Climate Fund (GCF), and bilateral donors.

In the last decade, multilateral development banks and bilateral donors have focused on funding projects in energy (JICA, ADB, EBRD, IDB, WB), water and sanitation (ADB, EBRD, IDB, WB), transport (ADB, WB) and other infrastructure sectors predominantly on the regional or country scale in Uzbekistan. Entities like IDB and EBRD have also financed city-level projects in Tashkent in water, wastewater, and heating sectors.

These entities represent potential sources of funding and financing, including to complement existing sectors of interest and expertise. For example, actors like the GCF and the World Bank have previously supported early warning systems and resilience screening and may be in position to partner on related actions. Actions proposed around water and sanitation management may explore partnerships with organizations like EBRD and ADB, which have already invested in water and sewerage improvement in Tashkent. Actions within these sectors may find natural alliance. In other areas, there are some gaps that have not been covered by external funders in recent years, such as investment in building and green infrastructure.

Public sources

Several departments and ministries are well positioned to support and fund actions. For example, the Ministry of Emergency Situations is positioned to support actions related to understanding resilience risk. For similar projects, the Government has contributed co-financing through the Ministry of Emergency Situations and Uzhydromet, including USD 30 million (UZS 322.6 billion) to develop a multi-hazard early warning system. For capital projects funded by external funders, the government has contributed on average 15-20% of total project costs.

Private investment

While there is limited data on private investments into resilience in Tashkent (a challenge observed in many developing contexts), there is opportunity to catalyze additional funding from the private sector. Recent reforms have added greater flexibility for investors, and new financial instruments, such as the country's first issuance

of Eurobonds or the ability for Tashkent to issue bonds, can bring in more investment capital.

MOBILIZING FUNDING

To best mobilize funds, projects should be packaged in a way that they are "bankable". There are several barriers to unlocking capital for resilience projects, including lack of public capacity, private sector confidence, adequate project preparation, and access to financing.[52] There are several steps that the municipality can take to prepare actions to address these barriers, including:

- **Identify stable revenue streams for actions and conduct market sounding.** To maximize outside investment, the municipality should structure actions to deliver stable and measurable streams of revenue (e.g., upgrades to water pipelines may help ensure user fees; dam protections may double as tourist infrastructure). Actions with market potential should undergo a pre-feasibility and feasibility stage to assess risk and return on investment, possible cash flow, and market testing with private stakeholders. Through this process, actions can be restructured in a way to prove technical and financial feasibility and increase attractiveness to the private sector. Actions with low-yield revenue streams can be blended with related actions with higher yields (e.g., developing a flooding model enables upgrading of water pipelines and may be packaged together with capacity building efforts). Pilot projects can be explored to demonstrate revenue and build confidence for the market.
- **Engage multiple stakeholders from the start.** Typically, the private sector is not engaged until the end of initiative design and development, thereby limiting influence in shaping projects. A multi-stakeholder, cross-sector approach in the planning process from the start will help to guide design and structuring of projects in a way that is more palatable to the private sector and can attract investment, while more directly communicating the municipality's own plans and requirements to the market.
- **Explore financing mechanisms that de-risk investment.** For actions that do not have obvious or stable returns on investment, the municipality can help to de-risk resilience projects to make them more attractive to private markets. De-risking tools include finance instruments such as blended finance, government guarantees, tax benefits, and risk-sharing mechanisms. The municipality can also engage multilateral development banks, bilateral donors, or others to provide technical assistance to offset initial project costs, offer project structuring support, advise on project de-risking, and potentially act as co-financer.
- **Communicate resilience risks in a way the market understands.** A lack of compelling risk data poses a barrier to private investment.[53] Many of the proposed actions, such as development of probabilistic models, can help address this gap. In addition, the municipality can accurately price resilience risks while conducting outreach in language that is tailored to a business audience.[54]
- **Improve the enabling investment environment.** This includes clearly articulating public plans, goals, and timelines for investment as signals for the market, thus improving clarity for private sector participation. The municipality can also help to coordinate stakeholder efforts and encourage knowledge-sharing between local departments, central government, and external investors. The Municipality of Tashkent might also investigate changes to any policies, regulations, or incentives that might improve credit worthiness, increase budgetary certainty, or spur additional private sector investment.

INSIGHT

Upgrading utilities in Johannesburg

Facing significant service backlogs and deferred maintenance, the city of Johannesburg needed to upgrade its utilities, including water, urban streets, and electricity infrastructure. However, because the local government's borrowing needs were too large for a traditional commercial loan (and because it needed to retire existing high-cost debt), the local government developed a central treasury bond with a credit enhancement. The bond was backed by aggregate revenues and a negative pledge cause on major assets. This alternative financing scheme was successful, with the bond oversubscribed on the market and saw a credit rating above the city's standalone rating. The experience of Johannesburg demonstrates the potential of alternative financing mechanisms in de-risking and accessing additional capital

MONITORING AND EVALUATION

Building resilience is a long-term process and it is important to constantly monitor the impacts of an action. As the success of an action cannot be realistically estimated at the moment its execution is completed, an action's immediate and long-term impacts should be assessed in a way to ensure that it delivers anticipated outcomes, and, crucially, it does not have adverse and unintended consequences.

For effective implementation, it is critical that a robust Monitoring and Evaluation (M&E) framework is adopted for each action in this report. The framework will help to assess improvements in resilience and anticipate how a project's implementation might need to adapt to accommodate changing circumstances and needs. In Tashkent, an effective M&E framework can be used to:

- Establish a baseline of urban resilience using and expanding on existing data collected by the Municipality of Tashkent.
- Monitor the impact of the resilience strategy's implementation, with actions updated and revisited to respond to immediate needs and priorities.
- Demonstrate value and support the business case for additional funding for future resilience-building actions, submitted to the Cabinet of Ministers and Tashkent's Department for Finance.

The M&E framework should be developed in line with other globally applicable frameworks and indices, such as the City Resilience Index (CRI),[55] to establish baseline metrics and measure progress against a set of relevant indicators, both qualitatively and quantitatively. For example, indicators on dam and reservoir performance might correspond to guidance from the International Commission on Large Dams and decrees passed by the Cabinet of Ministers, for example the 2019-2030 Sendai Action Plan.

The table below outlines an approach towards conceiving relevant KPIs for the actions.

KPI attributes	Description	What it means for Tashkent / Strategy
Meaningful	Represents a key dimension of resilience	KPIs that support actions to identify risk, prepare and reduce risk for the economy, infrastructure, and population
Actionable	Provides insight that helps steer corrective action	KPIs that leverage the data and research capabilities in the Department for Emergency Services, the Center for Seismic Forecasting, and others
Accessible	Is available within the municipality departments, representatives or local stakeholders without substantial cost or effort	KPIs that leverage readily available information in the Department for Emergency Situations
Comparable	Allows benchmarking with other (similar) cities	KPIs that are similar and comparable with actions in other major cities in the country (if available)
Time-bound	Captures improvements within short timeframes (from 6 months to 5 years)	KPIs that align with political cycles, national development strategies, monitoring cycles and departmental funding windows

To build accountability in the M&E framework, it is important to identify actors who will be responsible for different parts of the M&E process. This makes it easier to track progress and ensure that a project's impact is being assessed correctly. It also reduces the likelihood of data gaps, poor reporting, and inadequate information. The table below presents examples of possible indicators for each of the actions.

Actions	Indicator	Metric	Unit	Responsibility	Frequency
Retrofit and rebuild education and health facilities to be safe from earthquakes	Robust social infrastructure	# of criteria included in identifying and selecting solutions	Number	Departments for Education, Health, Construction & Emergency Situations	Once at each project's definition stage
	Robust social infrastructure	# of facilities rebuilt or retrofitted within 24 months	Number	Departments for Education, Health, Construction & Emergency Situations	Quarterly
	Robust social infrastructure	% of most vulnerable facilities retrofitted within 24 months	Proportion	Departments for Education, Health, Construction & Emergency Situations	Quarterly
Prepare multi-hazard assessments for reservoirs and related infrastructure	Resilient water infrastructure	# of visits to each reservoir	Number	Center for Seismic Forecasting, Departments for Water and Emergency Situations	Periodically depending on lifecycle of project
	Resilient water infrastructure	# of reservoirs included in assessment	Number	Center for Seismic Forecasting, Departments for Water and Emergency Situations	Periodically depending on lifecycle of project
Deliver resilience-led regeneration of the urban core and historic areas	Urban regeneration	% of land use and zoning plans subjected to formal consultation with minority communities	Proportion	Department for Mahalla and Family Support, Department of Capital Construction	Quarterly
	Urban regeneration	# or rebuilds or retrofits completed within 24 months	Number	Department for Mahalla and Family Support, Department of Capital Construction	Quarterly
	Urban regeneration	# of community engagement meetings held	Number	Department for Mahalla and Family Support, Department of Capital Construction	Monthly

SECTION V.

Way forward

TOWARDS A RESILIENCE JOURNEY

A resilience approach is a key enabler for Tashkent's sustainable urban development journey. Embedding a resilience approach in analytics, urban development instruments and infrastructure investments provides opportunities not only for identifying, preparing for, and reducing the specific risks described in this report, but also provide the framework for improving Tashkent's livability. As the resilience approach brings whole systems thinking, municipal urban development processes and operations will benefit from a holistic view that can make the city stronger in the face of future uncertainties more effectively than dealing with components of city systems one by one.

Resilient Tashkent serves as a first step in Tashkent's resilience journey and an input to a wider resilience-informed operational effort. The initial set of investments presented in this report can be developed into a policymaking and project preparation process, adapting and expanding the portfolio of resilience-building initiatives. Institutionalizing resilience, creating spaces for resilience dialogue and engaging stakeholders to coordinate across various sectors like water, transport, and housing, as well as developing strong links at the national level and local levels are crucial steps to take the identified actions to an operational level.

An incremental approach to implementation will contribute to maximize the impact of transformative actions. An initial step, the implementation of key enablers such as embedding a resilience approach into urban development processes and regulatory instruments and the construction of a robust knowledge and diagnostic layer, can be developed in parallel to quick wins that demonstrate practical resilience benefits. Together, these lay the ground for ambitious, transformative actions that will not only address key shocks and stresses but yield additional dividends and ultimately contribute to Tashkent's prosperity and wellbeing.

As a high-level baseline, the assumed investment required for delivering the resilience actions identified are in the indicative range of at least USD 500-600 million (USZ 5.4 to 6.4 trillion). The level of investments will be dependent on the scale and geographic extent of actions, as well as refinement from additional planning, costing, and feasibility analyses. There are several sources of potential funding, including public sources, external funders, and private investment. Structuring and packaging actions to appeal to the relevant needs and return expectations for each source will be important to maximize investment and reduce funding gaps.

Building resilience requires starting to take urgent steps towards execution. Given Tashkent's exposure to shocks and stresses, and the opportunity to capitalize on the urban growth that is expected in the near future, it is important to instill a sense of urgency in the uptake of a resilience perspective in urban development processes and spearhead its implementation through preparing and delivering concrete actions for the benefit of Tashkent and its people.

APPENDIX A.

MUNICIPAL STAKEHOLDERS

Members from the Municipality of Tashkent were engaged at key stages listed below:

- Inception workshop (February 2020)
- Diagnostic workshops (June 2020 and January 2021)
- Vision workshop (January 2021)
- Follow-up meetings (February 2021)
- Local expert interviews (February 2021 – May 2021)
- Strategy workshop (May 2021)
- Public Council of Tashkent City Administration Meeting (October 2021)

Name	Position	Department
B. Rakhmonov	First Deputy Mayor (current)	Municipality of Tashkent
D. Khidoyatov	First Deputy Mayor (previous)	Municipality of Tashkent
B. Khodjaev	Chairman of the Hokimiyat Public Council	Hokimiyat Public Council
T. Akhmedov	Member	Public Council of Tashkent City Administration, Founder of the NGO "Council for Ecological Construction of Uzbekistan"
R. Baratov	Head of Department	Chamber of Commerce and Industry of Tashkent
S. Nasirov	Leading specialist	Civil Protection Department of the Tashkent city Gas Supply Department
A. Khen	Department Head	Digital Development
K. Fayzullaev	Department Head	Digital Development
U. Shermanov	Head of GIS	Digital Development
B. Adilov	Head of Division	Ecology and Environmental Protection of Tashkent
M. Tuychiev	Head of Division	Economy of Tashkent
Sh. Shukurov	First Deputy Head	Economy of Tashkent
K. Usmanov	Department Head	Emergency Situations of Tashkent

Name	Position	Department
S. Kasimov	Department Head	Emergency Situations of Tashkent
A. Avanov	Head of Division	Emergency Situations of Tashkent
S. Turgunov	Department Head	Investments and Foreign Trade Department
B. Isroilov	Chief Specialist	Investments and Foreign Trade Department
O. Shermukhamedov	Lead Specialist	Investments and Foreign Trade Department
A. Akhmadjanov	Department Head	ICT
A. Melnikov	Inspector	JSC "ToshIssiqquvati" (Heating Company) of Tashkent city
E. Khusanova	Inspector	JSC "ToshIssiqquvati" (Heating Company) of Tashkent city
K. Rikhshiev	Department Head	Motor Transport Division
A. Saidakhmedov	Department Head	Second department of "Water Supply" company of Tashkent city
U. Jumabaev	Department Head	Second department of JSC "ToshIssiqquvati"(Heating Company) of Tashkent city
A. Mirzazhalilov	Head of Division	Sports and Tourism of Tashkent
K. Alimov	Chief Engineer	Tashkent Water and Wastewater Services (SuvSoz)
A. Samatov	Department Head	Technical Safety Department of "Water Supply" company of Tashkent city
Kh. Musaev	Department Head	Technical Safety Unit of Tashkent city Gas Supply Department
E. Nabiev	Head of Coordination	Tourism Infrastructure
J. Musaev	Lead Specialist	Design Institute "ToshkentboshplanLITI" (Tashkent Master Plan)
M. Kuziev	Deputy Department Head	Main Department of Housing and Communal Services of Tashkent

Involvement of representatives from:

- "Tashteploenergo" State Unitary Enterprise (heat supply)
- "Tashelectroset" JSC (power supply)
- "Tashkent shakar suv taminoti" LLC (water supply)
- "Poytakht Khududgaz Taminoti" JSC (gas supply)

APPENDIX B.

GLOSSARY OF TERMS

Term	Definition
Build Back Better	A holistic concept using post-disaster reconstruction and recovery as an opportunity to improve a community's physical, social, environmental and economic conditions to create a more resilient community in an effective and efficient way.
Capacity	The combination of all the strengths, attributes and resources available within a community, society or organization that can be used to achieve agreed goals. Capacity may include infrastructure and physical means, institutions, societal coping abilities, as well as human knowledge, skills and collective attributes such as social relationships, leadership and management. Capacity also may be described as capability. Capacity assessment is a term for the process by which the capacity of a group is reviewed against desired goals, and the capacity gaps are identified for further action.[56]
Climate change	The Inter-Governmental Panel on Climate Change (IPCC) defines climate change as: "A change in the state of the climate that can be identified (e.g., by using statistical tests) by changes in the mean and/or the variability of its properties, and that persists for an extended period, typically decades or longer. Climate change may be due to natural internal processes or external forces, or to persistent anthropogenic changes in the composition of the atmosphere or in land use".
City Resilience	Capacity of individuals, communities, and systems to adapt, survive, and grow in the face of stress and shocks, and even transform when conditions require it.[57]
Disaster	A serious disruption of the functioning of a community or a society involving widespread human, material, economic or environmental losses and impacts, which exceeds the ability of the affected community or society to cope using its own resources. Disaster impacts may include loss of life, injury, disease and other negative effects on human physical, mental and social well-being, together with damage to property, destruction of assets, loss of services, social and economic disruption and environmental degradation.[58]
Disaster Risk Management	The systematic process of using administrative directives, organizations, and operational skills and capacities to implement strategies, policies and improved coping capacities in order to lessen the adverse impacts of hazards and the possibility of disaster.[59]
Disaster Risk Reduction	The concept and practice of reducing disaster risks through systematic efforts to analyze and manage the causal factors of disasters.[60]
Epicentre	Point of the Earth's surface vertically above the focus of the earthquake.
Exposure	People, property, systems, or other elements present in a specified area.[61] Measures of exposure can include the number of people or types of assets in an area as well as element characteristics such as typology or value.
Flooding	A flood is an overflow of a large amount of water beyond its normal limits, especially over what is normally dry land.
Fluvial flooding	A fluvial, or river flood, occurs when the water level in a river, lake or stream rises and overflows onto the surrounding banks, shores and neighbouring land. The water level rise could be due to excessive rain or snowmelt.
Hazard	A dangerous phenomenon, substance, human activity or condition that may cause loss of life, injury or other health impacts, property damage, loss of livelihoods and services, social and economic disruption, or environmental damage.
Intensity	Normally a twelve-point scale to measure of the effects of an earthquake at a particular place. Commonly used scales to specify intensity are the European Macroseismic Scale (EMS), Medvedev-Sponheuer-Karník (MSK) or Modified Mercalli.
Magnitude	A logarithmic scale of earthquake size based on seismograph records. A number of different magnitude scales exist, including Richter or local (ML), surface wave (MS), body wave (mb) and duration (Md) magnitudes. The most common magnitude scale now used is moment magnitude (MW), which measures the size of earthquakes in terms of the energy released.

Mahalla	The word ‘mahalla’ refers broadly to a neighbourhood or local community. Meaning ‘local’ in its Uzbek derivation of the Arabic term, mahalla are residential community associations that were once common throughout the Islamic world but now, outside of Uzbekistan, they are a vanishing institution.
Mitigation	The lessening or limitation of the adverse impacts of hazards and related disasters. The adverse impacts of hazards often cannot be prevented fully, but their scale or severity can be substantially lessened by various strategies and actions. Mitigation measures encompass engineering techniques and hazard-resistant construction as well as improved environmental policies and public awareness.[62]
Pluvial flooding	A pluvial flood occurs when an extreme rainfall event creates a flood independent of an overflowing water body. Pluvial flooding can happen in any location, urban or rural; even in areas with no water bodies in the vicinity. There are two common types of pluvial flooding, surface water floods and flash floods. Surface water floods occur when an urban drainage system is overwhelmed, and water flows out into streets and nearby structures. Flash floods are characterized by an intense, high velocity torrent of water triggered by torrential rain falling within a short amount of time within the vicinity or on nearby elevated terrain. They can also occur via sudden release of water from an upstream levee or a dam. Flash floods can be very dangerous.
Preparedness	The knowledge and capacities developed by governments, professional response and recovery organizations, communities and individuals to effectively anticipate, respond to, and recover from, the impacts of likely, imminent or current hazard events or conditions.[63]
Propiska	The word propiska means "inscription", alluding to the inscription in a state internal passport permitting a person to reside in a given place.
Recurrence	The relation between magnitude and the logarithm of the annual rate of exceedance of an earthquake of that magnitude. It is often expressed by the Gutenberg-Richter law.
Replacement Cost	The actual cost to replace an item or structure at its pre-loss condition.
Return period	A return period, also known as a recurrence interval or repeat interval, is an average time or an estimated average time between events such as earthquakes, floods, landslides, or a river discharge flows to occur.
Risk	The combination of the probability of an event and its negative consequences.
Risk assessment	A methodology to determine the nature and extent of risk by analysing potential hazards and evaluating existing conditions of exposure and vulnerability that together could potentially harm or cause loss to exposed people, property, services, livelihoods and the environment on which they depend.[64]
Sendai Framework	The Sendai Framework for Disaster Risk Reduction 2015-2030 (Sendai Framework) was the first major agreement of the post-2015 development agenda and provides Member States with concrete actions to protect development gains from the risk of disaster. The Sendai Framework works hand in hand with the other 2030 Agenda agreements, including the Paris Agreement on Climate Change, the Addis Ababa Action Agenda on Financing for Development, the New Urban Agenda, and ultimately the Sustainable Development Goals.[65]
ThinkHazard!	hinkHazard! (http://thinkhazard.org/en/) is a GFDRR-managed resource which provides a general view of the natural hazards, for a given location, that should be considered in project design and implementation to promote disaster and climate resilience. The tool highlights the likelihood of different natural hazards affecting project areas (very low, low, medium and high), provides guidance on how to reduce the impact of these hazards, and where to find more information. The hazard levels provided are based on published hazard data, provided by a range of private, academic and public organizations.
Vulnerability	Vulnerability can be envisaged as the level of potential damage, or degree of loss, of a particular asset subjected to a hazard of a given intensity.[66]

APPENDIX C.

INVESTMENT PROJECTS

Project	Sector	Location	Scale
Rehabilitation of water and wastewater infrastructure, increasing coverage to 98%	Water / Sanitation	Tashkent	City
Uzbekistan Water Supply and Sanitation Development Program	Water / Sanitation	Multiple sites	Country
Western Uzbekistan Water Supply and Sanitation Development Project	Water / Sanitation	Multiple sites	Regional
Namangan Regional Water and Wastewater Project	Water / Sanitation	Namangan Province	Regional
Khorezm Regional Water and Wastewater Project	Water / Sanitation	Khorezm Province	Regional
Water Services and Institutional Support Project	Water / Sanitation	N/A	Country
Tashkent Province Water Supply Development Project	Water	Tashkent Province	Regional
Tashkent Water Transformation Plan	Water	Tashkent	City
UZB Second Tashkent Province Water Supply Development Project	Water	Tashkent Province	Regional
Climate Resilience Water Supply Project	Water	Multiple sites	Country
Improve drinking water quality	Water	Tashkent Province	Regional
Syrdarya Water Supply Project	Water	Syrdarya Province	Regional
Alat and Karakul Water Supply Project	Water	Bukhara Province	Regional
Uzbekistan Integrated Urban Development Project	Urban Development	Multiple sites	Country
CAREC Corridor 6 Railway Electrification Project	Transport	Multiple sites	Regional
Railway modernisation in eastern Uzbekistan	Transport	Fergana Valley	Regional
Pap-Angren Railway Project	Transport	Fergana Valley	Regional
CAREC Corridor 6 Railway Electrification Project	Transport	Multiple site	Regional
Construction of sustainable urban drainage throughout the whole city	Sanitation	Tashkent	City
Improvement of sewerage systems and sanitary purification	Sanitation	Tashkent	City

External Funder	Primary Funder Share	Secondary Funder Share	Government Contribution	Total Cost	Year	Time-line
EBRD	USD 30M			USD 30M	2018	3
ADB	USD 200M					
ADB				USD 120M	2017	
EBRD	USD 70M		USD 14M	USD 84M	2020	
EBRD	USD 70M					
World Bank, Swiss State	USD 239M	USD 0.7.8M		USD 246M	2020	
ADB	USD 121M		USD 23M	USD 144M	2016	6
				USD 185M	2020	
ADB				USD 170M	2019	4
EBRD	USD 200M	Not known	Not known	USD 400M		
ADB	USD 160M		USD 25M	USD 185M	2019	
World Bank	USD 88M		USD 12M	USD 100M	2011	
World Bank	USD 82M		USD 31M	USD 113M	2013	
ADB	USD 200M			USD 200M		
ADB	USD 100M		USD 76M	USD 176M	2012	4
ADB	USD 121M				2020	
World Bank	USD 195M	USD 350M	USD 1,000M	USD 1,634M	2015	
ADB	USD 0.4M		USD 0	USD .4M	2014	
IDB				USD 35 M	2010	7
IDB	USD 35M		USD 3M	USD 38M	2010	2

Project	Sector	Location	Scale
Uzbekistan Solid Waste Management Development Project	Sanitation	Multiple sites	Country
UZB Tashkent Region Sanitation System Development Project	Sanitation	Tashkent Province	Regional
Second Solid Waste Management Project	Sanitation	Multiple sites	Country
Djizzak Sanitation System Development Project	Sanitation	Djizzak	City
Kashkadarya Regional Road Project	Roads	Kashkadarya Province	Regional
Second Central Asia Regional Economic Cooperation Corridor 2 Road Investment Program - Tranche 2	Roads	Multiple sites	Regional
Regional Roads Development Project	Roads	Multiple sites	Regional
"Digital Tashkent" program	ICT	Tashkent	City
Retrofit and upgrade of district heating network	Heating	Tashkent	City
Improvement of district heating in Sergeli district	Heating	Multiple sites	City
Multi-hazard early warning systems for climate change-induced hazards	EWS	N/A	Country
Adaptation Fund project	EWS	N/A	Country
Modernisation of hydro power station in Tashkent, Shakhrikhan and Kadriya Cascades (2013, Islamic Development Bank). (9a)	Energy	Multiple sites	Regional
Economic Infrastructure project	Energy	Tashkent	City
Advanced Electricity Metering Project	Energy	Multiple sites	Country
Energy Efficiency Facility for Industrial Enterprises	Energy	N/A	Country
Kadyrinskaya hydropower modernisation	Energy	Kadyrinskaya Province	Regional
Promoting Energy Efficiency in Public Buildings in Uzbekistan	Energy	N/A	Country
Northwest Region Power Transmission Line Project	Energy	Karakalpakstan & Khorezm Province	Regional
Power Generation Efficiency Improvement Project	Energy	N/A	Country
Nijne-Bozsu HPS Cascade Modernization	Energy	Tashkent Province	Regional

External Funder	Primary Funder Share	Secondary Funder Share	Government Contribution	Total Cost	Year	Time-line
ADB	USD 150M					
				USD 143M	2018	
ADB				USD 100M	2018	
ADB	USD 81M		USD 15M	USD 96M	2012	9
ADB				USD 266M	2017	
ADB				USD 265M	2017	
World Bank	USD 200M			USD 400M	2015	
British Embassy in Uzbekistan					2019	
EBRD	USD 150M		USD 0	USD 150M	2018	5
World Bank	USD 140M			USD 140M	2018	6
UN	USD 10M		USD 30M	USD 40M	2021	6
UN	USD 0.2 M			USD 5.6M	2014	6
IDB	USD 100 M				2013	5
JICA	USD 107M			USD 167M	2017	2
ADB; IDB	USD 150M	USD 100M	USD 50M	USD 300M	2015	8
World Bank	USD 324M			USD 324M		
Eximbank	USD 9M		USD 17M	USD 27M	2017	3
UNDP				USD 3M	2009	6
ADB	USD 150M				2015	5
ADB	USD 450M				2017	5
IDB	USD 100M				2012	4

Project	Sector	Location	Scale
Uzbekistan Electric Power Sector Capacity Development Project	Energy	N/A	Country
Talimarjan TPP-Sogdiana Substation overhead transmission line	Energy	Kashkadarya Province	Country
	Regional	World Bank	USD 110M
Electicity transmission system upgrades	Electricity	Multiple sites	Country
Retrofit of gas-fired power plants	Electricity	Navoi Province	Regional
Retrofit of gas-fired power plants	Electricity	Multiple sites	Country
Retrofit of gas-fired power plants	Electricity	Karakalpakstan Province	Regional
Turakurgan Combined Cycle Power Plant Block I and II	Electricity	Fergana Province	Regional
Sustainable Energy Access – Distribution Network Modernization Program	Electricity	Multiple sites	Country
Pskem Hydropower plant	Electricity	PskemTashkent Province	Regional
UzbekEnergo Muruntau Substation	Electricity	Navoi Province	Regional
GCF proposal for benefits to Uzhydromet	Awareness/	N/A	Country
Embedding	N/A	Country	GCF
UNDP multi-country program on climate risk management	Awareness/	N/A	Country
Embedding	N/A	Central Asia	
Uzbekistan Climate Data Restoration project	Awareness/ Embedding	N/A	Country
Climate Adaptation and Mitigation Program for Aral Sea Basin	Awareness/ Embedding	N/A	Central Asia
Supporting Uzbekistan in Transition to Low-Emission Path	Awareness/ Embedding	N/A	Country
Power Sector reform loan	Awareness/ Embedding	N/A	Country
Medium-size Cities Integrated Urban and Territorial Development Project	All	Multiple sites	Country

External Funder	Primary Funder Share	Secondary Funder Share	Government Contribution	Total Cost	Year	Time-line
JICA	USD 26M				2017	2
World Bank	USD 150M		USD 46M	USD 196M	2016	
	USD 93M	USD 203M	2011	3	2014	
World Bank	USD 150 M		USD 46 M	USD 196M	2016	
JICA	USD 360M		USD 160 M	USD 520M	2014	
ADB				USD 300M		
ADB	USD 300M		USD 130M	USD 430M	2014	5
JICA, UFRD, Uzbenegro				USD 1,200M		
ADB				USD 300M		
Export-Import Bank of China				USD 800M		
EBRD	USD 85M					
Korea Meteorological Administration	USD 0.65M		USD 0	USD 0.65M	2015	2
USD 1M			USD 1,7M	2018	2.5	6
UNDP				USD 1M	2011	4
USD 0.8M			USD 0.8M	2011	4	
Korea Meteorological Administration	USD 0.65M			USD 0.65M	2015	2
World Bank; GCF	USD 38M	USD 19M	USD 11M	USD 58M	2015	6
UNDP				USD 1M	2011	4
ADB; AFD	USD 200M	USD 150M				
World Bank; AIIB	USD 100M	USD 100M	USD 40M	USD 240M	2017	

APPENDIX D.

REFERENCES

1. In 2020. Source: Government of Uzbekistan, State Committee on Statistics
2. World Bank (2017) Europe and Central Asia: Country Risk Profiles for Floods and Earthquakes. https://www.worldbank.org/en/region/eca/publication/europe-and-central-asia-country-risk-profiles-for-floods-and-earthquakes
3. World Bank, 2021, Tashkent Urban Resilience Diagnostic, Uzbekistan
4. How to issue a green city bond: The green city bonds overview. https://www.climatebonds.net/files/files/How-to-Issue-Green-City-Bonds.pdf
5. The Permanent Mission of the Republic of Uzbekistan to the United Nations (2018) 'Address by the President of Uzbekistan Shavkat Mirziyoyev to Oliy Majlis'. December 20th. Available: https://www.un.int/uzbekistan/news/address-president-republic-uzbekistan-shavkat-mirziyoyev-oliy-majlis
6. World Bank (2017) Europe and Central Asia: Country Risk Profiles for Floods and Earthquakes. https://www.worldbank.org/en/region/eca/publication/europe-and-central-asia-country-risk-profiles-for-floods-and-earthquakes
7. World Bank, 2021, Tashkent Urban Resilience Diagnostic, Uzbekistan
8. World Bank Climate Knowledge Portal accessed 09/2020. https://climateknowledgeportal.worldbank.org/country/uzbekistan/climate-data-projections
9. https://www.gfdrr.org/en/region/uzbekistan & https://www.gfdrr.org/en/publication/central-asia-and-caucasus-disaster-risk-management-initiative-cac-drmi
10. Resilient Cities Network. https://resilientcitiesnetwork.org/urban-resilience
11. World Bank Group, *ThinkHazard!* Available: https://thinkhazard.org/en/
12. European Commission, INFORM Index for Risk Management. Available: https://drmkc.jrc.ec.europa.eu/inform-index
13. Asian Development Bank (2021) A Road Map for Shymkent-Tashkent-Khujand Economic Corridor Development. Available https://www.adb.org/sites/default/files/publication/671571/road-map-shymkent-tashkent-khujand-corridor.pdf.
14. Based on the Arup Tashkent City Model
15. Ibid.
16. Mavlyanova, et al., (2004). Seismic Code of Uzbekistan. In 13th World Conference on Earthquake Engineering (Vol. 1611).
17. The 'building series' refer to specific standard building designs that were developed in the Soviet and Post-Soviet Central Asian Republics. References: Mavlyanova, N., Inagamov, R., Rakhmatullaev, H., & Tolipova, N. (2004, August). Seismic Code of Uzbekistan. In 13th World Conference on Earthquake Engineering (Vol. 1611). Rashidov T., Plotnikova L., Khakimov S. "Seismic hazard and building vulnerability in Uzbekistan" King S.,Khalturin V. and Tucker E. Editors. Seismic hazard and building vulnerability in Post-Soviet Central Asian Republics. Kluwer Academic Publishers, 1999,p.147-181.
18. World Bank (2020) *Earthquake Risk in Multifamily Residential Buildings Europe and Central Asia*
19. In the urban primacy model, the predicted size of city is the number of residents expected to live in a city based on national gross domestic product per capita, total land, total population, urban share, and share of arable land.
20. World Bank (2021, draft) Making the most of a historic opportunity - How can Uzbekistan leverage urbanization as a driver of sustainable development?

21. Administrative area in 2020. Source: The State Committee of the Republic of Uzbekistan on Statistics. http://web.stat.uz/open_data/ru/13.1%20Administrative-territorial%20division%20of%20the%20Republic%20of%20Uzbekistan_rus.pdf
22. Considering only legal expansion; actual urban growth may be greater. Source: UNECE (2015) Country Profiles on Housing and Land Management: Uzbekistan , citing data from the Tashkent Master Plans of 1988 and 2013 which consider only legal expansion; actual urban growth may be greater.
23. Florczyk, Aneta; Corbane, Christina; Schiavina, Marcello; Pesaresi, Martino; Maffenini, Luca; Melchiorri, Michele; Politis, Panagiotis; Sabo, Filip; Freire, Sergio; Ehrlich, Daniele; Kemper, Thomas; Tommasi, Pierpaolo; Airaghi, Donato; Zanchetta, Luigi (2019): GHS Urban Centre Database 2015, multitemporal and multidimensional attributes, R2019A. European Commission, Joint Research Centre (JRC) [Dataset] PID: https://data.jrc.ec.europa.eu/dataset/53473144-b88c-44bc-b4a3-4583ed1f547e
24. World Bank (2021) The Time is Now. How can Uzbekistan leverage urbanization as a driver of sustainable development? Draft
25. ADB (2021) Harnessing Uzbekistan's Potential of Urbanization
26. UZ Daily. 2018. "Tashkent receives right to issue bonds, https://nuz.uz/obschestvo/1202452-v-kazhdom-rajone-stoliczy-budut-sozdany-mini-parki-bez-attrakczionov.html
27. ThinkHazard! https://thinkhazard.org/en/report/261-uzbekistan
28. Tashkent City Department of Statistics (2021) Gross Regional Product Volume, https://www.toshstat.uz/uz/rasmiy-statistika/national-accounts-2
29. Ibid.
30. Olimov, U. & Fayzullaev, Y. (2011) Assessing Development Strategies to Achieve the MDGs in The Republic of Uzbekistan. United Nations Department for Social and Economic Affairs. Available: https://www.un.org/en/development/desa/policy/capacity/output_studies/roa87_study_uzb.pdf
31. World Bank (2016) Systematic Country Diagnostic for Uzbekistan. Available: https://openknowledge.worldbank.org/bitstream/handle/10986/24588/Uzbekistan000S0c0country0diagnostic.pdf?sequence=1&isAllowed=y
32. Yakvalkhodjieva, E. (2020) 'In 2020, Strides and Setbacks in Uzbekistan's Battle Against Poverty'. The Diplomat, November 14th.
33. President of the Republic of Uzbekistan, On Measures to Radically Increase the Efficiency of the System of Prevention and Response to Emergencies. No. 5066.
34. UNDRR (2015) Sendai Framework for Disaster Risk Reduction 2015-2030. Available: https://www.undrr.org/publication/sendai-framework-disaster-risk-reduction-2015-2030
35. World Bank. 2019. Uzbekistan Public Expenditure Review. https://openknowledge.worldbank.org/bitstream/handle/10986/33371/Uzbekistan-Public-Expenditure-Review.pdf
36. World Bank. 2018. Disaster Risk Finance Country Note: Uzbekistan. World Bank, Washington, DC. https://openknowledge.worldbank.org/handle/10986/33884 License: CC BY 3.0 IGO
37. Fitch Ratings. 2019. "Fitch Rates City of Tashkent BB Outlook" https://www.fitchratings.com/research/international-public-finance/fitch-rates-city-of-tashkent-bb-outlook-stable-14-06-2019
38. World Bank. 2019. Uzbekistan Public Expenditure Review. https://openknowledge.worldbank.org/bitstream/handle/10986/33371/Uzbekistan-Public-Expenditure-Review.pdf

39. UZ Daily. 2018. “Tashkent receives right to issue bonds.” http://uzdaily.com/en/post/45349
40. UZ Report. “Tashkent receives its first credit rating from Fitch Ratings.” https://uzreport.news/economy/tashkent-receives-its-first-credit-rating-from-fitch-ratings
41. UNDP Uzbekistan. March 2021. “Agreement between UNDP and the Ministry of Finance to better align Eurobonds with SDGs.” https://www.uz.undp.org/content/uzbekistan/en/home/presscenter/pressreleases/2021/03/undp-and-the-ministry-of-finance-of-the-republic-of-uzbekistan-s.html
42. Ibid.
43. World Bank (2021) Investment in Disaster Risk Management in Europe Makes Economic Sense
44. Ibid.
45. For example, the new Situational Management Center, a central facility for all digital information in Tashkent being developed by the Municipality. This facility will have various capabilities, including the management of utilities during emergencies.
46. The World-Bank’s Handbook for Gender-Inclusive Urban Planning can provide guidance for this.
47. https://jncc.gov.uk/our-work/blue-green-infrastructure/#:~:text=BGI%20is%20a%20defined%20by,wide%20range%20of%20ecosystem%20service'
48. The interdependency of the tangible and intangible Cultural heritage http://openarchive.icomos.org/id/eprint/468/1/2_-_Allocution_Bouchenaki.pdf and for more information on ICOMOC: https://www.icomos.org/en
49. A number of initiatives underway in Tashkent can be capitalized on, for example the Municipality has committed to a ‘landscaping of district centers’ program throughout 2021, the construction of a public gym in Uchtepa (completion estimated in 2021), and the reconstruction of the School of Football (completion estimated in 2021)
50. Here, grey infrastructure refers to hard engineering solutions to manage ecosystems like water. This involves the construction of new man-made features, usually from water-tight concrete.
51. Shipilova, K. (2020) Land use by transport infrastructure in Tashkent City. IOP Conference series: Materials Science and Engineering 883, 012067. https://iopscience.iop.org/article/10.1088/1757-899X/883/1/012067/pdf.
52. GFDRR and World Bank. “Investing in Urban Resilience.” https://www.gfdrr.org/sites/default/files/publication/Investing%20in%20Urban%20Resilience%20Final.pdf
53. World Bank. “Enabling Private Investment in Climate Adaptation and Resilience.”
54. PWC. “Stimulating private sector engagement and investment in building disaster resilience and climate change adaptation.” https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/305412/stimulating-private-sector-engagement-climate-disaster-resilience.pdf
55. Arup & Rockefeller Foundation (2013) City Resilience Index. Available: https://www.cityresilienceindex.org/#/
56. UNISDR (2009) Terminology on Disaster Risk Reduction. Available: https://www.unisdr.org/files/7817_UNISDRTerminologyEnglish.pdf
57. Arup & Rockefeller Foundation (2013) City Resilience Index. Available: https://www.cityresilienceindex.org/#/.
58. UNISDR (2009) Terminology on Disaster Risk Reduction. Available: https://www.unisdr.org/files/7817_UNISDRTerminologyEnglish.pdf
59. Ibid
60. Ibid
61. Ibid
62. Ibid
63. Ibid

64. Ibid

65. Ibid

66. Fell, R. (1994) Landslide risk assessment and acceptable risk. Canadian Geotechnical Journal 31, 261-272


THE WORLD BANK
IBRD • IDA | WORLD BANK GROUP
GFDRR
Global Facility for Disaster Reduction and Recovery