JOURNAL OF DESIGN FOR RESILIENCE
IN ARCHITECTURE & PLANNING

Research Article
Online: www.drarch.org
Volume 6, Issue 1 (71-101), 2025
DOI: 10.47818/DRArch.2025.v6i1158

The importance of water-sensitive planning and design approaches for resilience to flood disaster risk in Istanbul: Evaluation of examples in Çatalca and Beykoz districts

Hale Mamunlu Kocabaş*

Abstract

Nowadays, climatic changes are coming to the forefront of the global agenda due to their significant impact. Effects can be seen on rainfall and the hydraulic cycle, the number of disasters such as landslides, floods, and flash floods, which are especially increasing in cities. In recent times, flood and flash flood events have adversely affected many settlement areas in Istanbul. Istanbul, which is the main agglomeration of the country, has expanded spatially towards the urban peripheries due to population growth. The study focuses on the innovative basic principles of water-sensitive planning and design approaches for flood risk reduction, which have gained importance in light of international debates. In this context, the study examines the conditions for developing water-sensitive planning and design approaches in Istanbul and makes recommendations. For this purpose, a comprehensive and detailed literature review was conducted and scientific documents such as articles, international-national conventions, institutional research reports and national legislation were utilized. The study aims to determine the current situation in the areas where flood disasters occur in Istanbul, to identify the causes of the disasters, to question whether the land use decisions and urban planning approaches in the existing legal-administrative structure consider the risk factors for reducing flood disasters. Çatalca district, which is located on the urban periphery of the European side of the city, is very rich in water resources and is where the highest loss of life and material damage occurred in the flood disaster of 2009, was selected as the sample area in the study. Beykoz district, which is located on the periphery of the Anatolian side of Istanbul and very rich in water resources, was selected as another sample area. Within the scope of the study, data were obtained through interviews with relevant local institutions and organizations. Previous studies and existing data on the sample areas have been compiled and evaluated. When the practices of the institutions in the sample locations are examined, it is understood that the method of protection distances determined by legislation for the prevention of flood risk in stream beds is insufficient. In areas where flood risk is experienced, it is tried to be prevented by rehabilitation of streams. There is no holistic approach with planning decisions at the basin scale. As the population, settlement area and impervious surfaces increase in the basins where stream rehabilitation is carried out at high costs, these projects will be insufficient to prevent flood risk. Water-sensitive urban planning and design approaches with participatory and collaborative processes in basin scale should be start for resilience to flood disaster risk in Istanbul.

Keywords: flood disaster risk, integrated water basin management, resilience, risk-oriented planning, water-sensitive planning and design

1. Introduction

Today, one of the leading global problems is the pressure created by human activities on the natural environment and its negative effects. Especially with the increase in impervious areas, the quality and quantity of water are changing as seen in the characteristics of water absorption by soil and drainage of water flowing over the soil. Construction conditions incompatible with nature such as paving roads with asphalt, lead to an increase in the volume and speed of water flowing over the soil; hence, the risk of flooding increases simultaneously. Due to the significant effects of climate change on precipitation and the hydraulic cycle, the number of natural disasters such as sudden

*(Corresponding author), Assist. Prof. Dr., Mimar Sinan Fine Arts University, Türkiye hale.kocabas@msgsu.edu.tr
Article history: Received 08 December 2024, Accepted 18 April 2025, Published 30 April 2025

precipitation, flooding, landslides, etc. are increasing all over the world, and their effects are felt much more in urban areas.

In 1992, the UN organized the International Conference on Water and Environment in Dublin. The principles agreed upon at the end of this conference were adopted at the United Nations Conference on Environment and Development held in Rio de Janeiro in 1992 and named as "Dublin-Rio Principles" (GWP, n.d.). Thus, the necessity of integrated management of water resources, which are the basic source of life for all living things, at the basin level with a holistic approach has been recognized on an international scale.

It was at this summit where the United Nations Framework Convention on Climate Change and the Convention on Biological Diversity were opened for signature, while the negotiation of the United Nations Convention to Combat Desertification was called for in the summit outcome - Agenda 21. These three sister conventions later collectively became known as "the Rio Conventions". The biggest overlap in the work of all three Rio Conventions is in the field of “nature-based solutions” (UN-Climate Change, n.d.). In this context, the United Nations Conference on Environment and Development in 1992 in Rio de Janeiro constitutes the cornerstone of acting together against global environmental problems.

A disaster related to either a weather, climate or water hazard occurred every day on average over the last 50 years – killing 115 people and causing US $202 million in losses daily (WMO, 2021, p.16). In 2023, the Emergency Events Database recorded 399 disasters related to natural hazards. These events resulted in 86,473 fatalities and affected 93.1 million people (Delforge et al., 2024). Climate change is primarily a water crisis, and its impact is felt through worsening floods, rising sea levels, shrinking ice fields, wildfires, and droughts. Flooding and rising sea levels can contaminate land and water resources with saltwater and cause damage to water and sanitation infrastructure, such as waterpoints, wells, toilets, and wastewater treatment facilities. However, water can fight climate change. Sustainable water management is central to building the resilience of societies and ecosystems and to reducing carbon emissions. Everyone has a role to play at the individual and household levels, and these actions are vital (UN, n.d.). Mayors and local governments are both key targets and key drivers in building urban resilience. (UNDDR, n.d.).

Flooding is very common and a devastating disaster all over the world, as well as in Türkiye. Urban areas in Türkiye face increasing flood risks due to urbanization and the climate change impacts on water resources, which lead to irregularities in flow regime. Among all natural hazards in Türkiye, flooding is the most common, and accounts for the second largest number of casualties and the highest economic damage (Republic of Türkiye Ministry of Agriculture and Forestry, n.d.). The year 2022 has been the year with the highest number of extreme events, with 1030 extreme events reported. There is an increasing trend in the number of extreme events, especially in the last two decades (see Figure 1). The extreme events recorded in 2022 were heavy rain-floods (33.6%), windstorms (21.4%), hail (18.5%), snow (11.7%), lightning (4.1%), forest fire (0.9%), frost (2.5%), landslide (2.7%), avalanche (2.1%), dust storm (0.2%) and fog (0.3%) (Republic of Türkiye Ministry of Environment, Urbanization and Climate Change, 2023, p.16).

In recent years, the rates of heavy rainfall and flooding in Istanbul have been gradually increasing. Istanbul's climatic characteristics and rugged natural structure can provide favorable environments for the occurrence of flood and inundation risks. In addition to the natural structure of the province, it shows an increasing trend due to the adverse conditions created by the built environment and impermeable surfaces formed by rapid urban development processes. The starting point of this study was a major flood disaster in Istanbul in 2009, which caused serious losses and damage, especially in Silivri, Çatalca and Büyükçekmece districts. Since then, floods have been experienced throughout the province due to sudden and heavy rainfall.

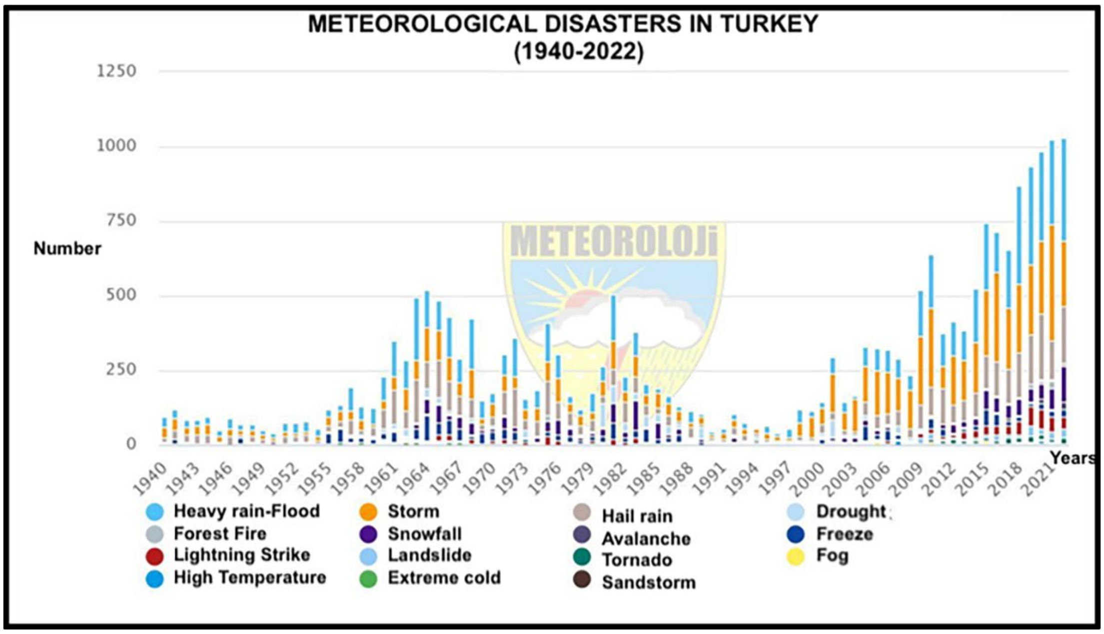

Figure 1 Annual distribution of meteorological disasters observed in Türkiye (1940-2022) (Republic of Türkiye Ministry of Environment, Urbanization and Climate Change, 2023, p.16)

In recent years, the rates of heavy rainfall and flooding in Istanbul have been gradually increasing. Istanbul's climatic characteristics and rugged natural structure can provide favorable environments for the occurrence of flood and inundation risks. In addition to the natural structure of the province, it shows an increasing trend due to the adverse conditions created by the built environment and impermeable surfaces formed by rapid urban development processes. The starting point of this study was a major flood disaster in Istanbul in 2009, which caused serious losses and damage, especially in Silivri, Çatalca and Büyükçekmece districts. Since then, floods have been experienced throughout the province due to sudden and heavy rainfall.

The floods occurring in Istanbul are the consequences of the urban development of the city. It is clearly seen by surface hydrographic analyses that the natural flow directions and natural flow accumulation characteristics are not taken into consideration in the projects implemented for urban development, and it is possible to define them as urban floods. The increase in the frequency and severity of floods occurring in Istanbul is parallel with the increased possibility of humans intervening more in natural environment features, thanks to developing technological opportunities (Istanbul Governorship of the Republic of Türkiye, n.d).

Istanbul Water and Sewerage Administration-ISKI is preparing stream improvement projects for the streams within the city, but there is no holistic approach at the basin scale. On the other hand, the spatial development of the city continues to spread rapidly towards areas with high flood risk through planning decisions. Today, the Northern Marmara Motorway Project, the 3rd Airport, the 3rd Bosphorus Bridge connections, and the Canal Istanbul Project threaten the topography, hydrological cycles, and ecosystem balance. This situation also increases the risk of flooding in these areas. By the Decision of the President of the Republic of Türkiye No. 8650 (2024) some areas in four provinces, including Istanbul (mostly in Beykoz district), were taken out of the forest border, a decision that makes it difficult to protect the Northern Forests and water sources, and will increase the pressure on flood risk areas.

In order to draw attention to this problem, the study focuses on the districts of Çatalca and Beykoz, located on the urban peripheries of Istanbul. Both districts are located in the north of Istanbul, have significant water resources, and have areas of high flood risk. These districts experience flooding events due to the high slope of the topography, the predominantly impermeable and semi-permeable soils, the development of the built environment due to the development dynamics of the city and inadequate technical infrastructure in these areas located in the north of the city.

1.1. Purpose and Method of the Study

The main aim of this study is to demonstrate the need for new approaches to flood resilience in Istanbul through theory. The study focuses on the innovative basic principles of water-sensitive planning and design approaches for flood risk reduction, which have gained importance in light of international debates. For this purpose, a comprehensive and detailed literature review was conducted and scientific documents such as articles, international-national conventions, institutional research reports, national legislation, and spatial plans were utilized.

The topography and flood risk areas for Beykoz and Çatalca districts, which were selected as sample areas under flood risk in Istanbul, were visualized using GIS - Geographic Information Systems. By compiling previous studies and existing data on these areas, it was evaluated whether land use decisions and spatial planning approaches in these areas include the "flood disaster risk phenomenon". It has been investigated whether there is integration and cooperation between the work carried out by different institutions within the framework of flood risk management and planning approaches to reduce the flood risk faced by Istanbul. In addition, field visits, observations, and interviews with local actors were conducted. In light of these examples, the concluding section assesses the potential and challenges for the application of water-sensitive planning and design principles for flood risk reduction in Istanbul.

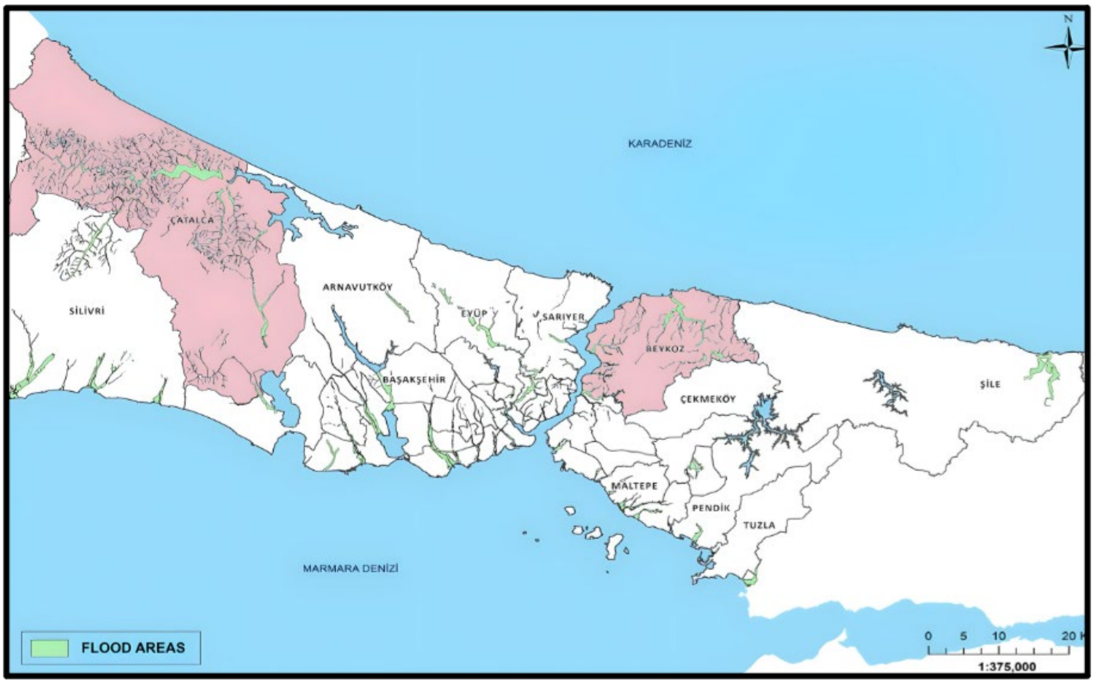

Figure 2 Flood risk areas and sample areas in Istanbul (IMM, 2017, p.32)

Çatalca district, which is located on the urban periphery of the European side of the city and is very rich in water resources and is where the most loss of life and material damage occurred in the flood disaster in 2009, was selected as the sample area in the study. The main reason for choosing this area is to understand the causes of the flood disaster, to reveal the approaches used, and to learn from these negative experiences. In this context, information was obtained through interviews with local actors. In line with the information obtained, a survey was conducted in the Akalan neighborhood, which suffered the most damage from the flood, with people living in households in the area where the flood spread.

Beykoz district, located on the periphery of the city on the Anatolian side, was selected as another sample area in Istanbul. The rapid urban development of the district due to the second and third bridges and connection roads increases the flood risk in the region. For this reason, Beykoz was selected as another prominent example area in terms of flood risk in the province. Previous studies and existing data on the sample areas were compiled and evaluated. In addition to the general assessments on the flood risk situation of Beykoz district, the flood risk situation of Göksu stream and its surroundings has been revealed.

2. Literature Review

2.1. Major International Approaches to Reduce Flood Disaster Risk

According to UN resolutions, 1990-2000 (IDNDR) was declared to be the decade of reducing the effects of natural disasters. In this period, new strategies and principles were determined with the Yokohama Conference in 1994 and the ISDR (International Strategy for Disaster Reduction) was defined as a new organ of the UN in 2000 to implement this strategy. The ISDR organized the Kobe Conference in 2005, and with the decisions taken there, a new decade of activity (2005-2015) the "Hyogo Framework for Action" was envisaged. The focal point of the new policy is the concept of "risk". As the importance of the new policies is realized in Türkiye, it should be expected that some terms such as "mitigation" and "risk reduction" will become more prevalent. Depending on the context in which the concept of risk is used, different terms can be applied. In this context, terms such as "risk", "risk management" and "mitigation plans" have entered the spatial planning literature as new concepts in protection from natural disasters and taking precautions (Balamir, 2007). Disaster risk management is the implementation of disaster mitigation policies and strategies to prevent new disaster risk, reduce existing disaster risk and manage the remaining risk, contribute to strengthening resilience and reducing disaster losses (UN-Water, n.d.).

The Sendai Framework for Disaster Risk Reduction (2015-2030) is the first major agreement of the post-2015 development agenda and provides member states with concrete actions to project development gains from the risk of disaster. The Sendai Framework works hand in hand with 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. The Sendai Framework is the successor instrument to the Hyogo Framework for Action (2005-2015): Building the Resilience of Nations and Communities to Disasters (UNDDR, n.d.).

The Sendai Framework for Disaster Risk Reduction 2015-2030 (Sendai Framework) is the roadmap for how we make our communities safer and more resilient. Considering the experience gained through the implementation of the Hyogo Framework for Action, and in pursuance of the expected outcome and goal, there is a need for focused action within and across sectors by states at local, national, regional and global levels in the following four priority areas:

- Priority 1: Understanding disaster risk
- Priority 2: Strengthening disaster risk governance to manage disaster risk
- Priority 3: Investing in disaster risk reduction for resilience
- Priority 4: Enhancing disaster preparedness for effective response and to "build back better" in recovery, rehabilitation and reconstruction (UNDDR, n.d.-a).

In the 2019 United Nations Water Report, it is noted that water is the common and intersecting point of the Sustainable Development Goals (Agenda 2030), Climate Change (Paris Agreement), and Disaster Risk Reduction (Sendai Framework) (UNESCO, 2020, p.44). Integrated planning and management of water resources has become extremely important. While the European Union previously focused on studies to prevent water and environmental pollution, since 1995, it has been seeking a holistic law that collects many scattered laws regarding the management of water resources. Such a law, the Water Framework Directive, was prepared on the water resources of the European Union in 2000. According to the information published on its official website (EU-Water, n.d.), the purpose of the EU Water Framework Directive is potable water protection and sustainable use of surface waters, transitional waters, coastal waters and groundwater, ensuring development.

In the EU directive 2000/60/EC, approved on 23 October 2000, creating "river basin management plans" to ensure sustainable development is required and ensuring its integration with land use decisions is key. Improving the content of the EU Water Framework Directive over time and in line with basin management plans, it includes the preparation of "flood risk management plans". On 6 November 2007, the "Flood "Risk Directive" was entered into force.

Green infrastructure is a strategically planned network of natural and semi-natural areas with other environmental features designed and managed to deliver a wide range of ecosystem services. It incorporates green spaces (or blue if aquatic ecosystems are concerned) and other physical features in terrestrial (including coastal) and marine areas in the EU. Green infrastructure solutions that boost disaster resilience are also an integral part of EU policy on disaster risk management (European Commission, 2011).

2.2. The Importance of Water-Sensitive Planning and Design Approaches for Flood Resilience

The "New Urban Agenda" was discussed at the HABITAT III-United Nations Conference on Housing and Sustainable Urban Development, which was first held in Vancouver in 1976, secondly in Istanbul in 1996, and thirdly in Quito, Ecuador in 2016. Being the first UN conference to be held after the 2015 Sustainable Development Goals, the Paris Climate Talks COP21 and the Sendai Disaster Risk Reduction Framework, Habitat III, held in 2016, is important in terms of bringing these issues to the new urban agenda and opening their impacts on urban areas to discussion (UN-Habitat, 2017). As sustainability thresholds are increasingly challenged around the world and the negative effects of climate change are felt, emphasis has begun to be placed on nature-based solutions. While climate change varies according to geographical characteristics, many problems such as increasing urban heat island effects, the drying up of water resources, increasing flood risk, rising sea levels, etc., can come to the fore, especially in urban areas. "Water-sensitive approaches" have gained importance at the basin scale for nature-based solutions to the increasing problems with climate change.

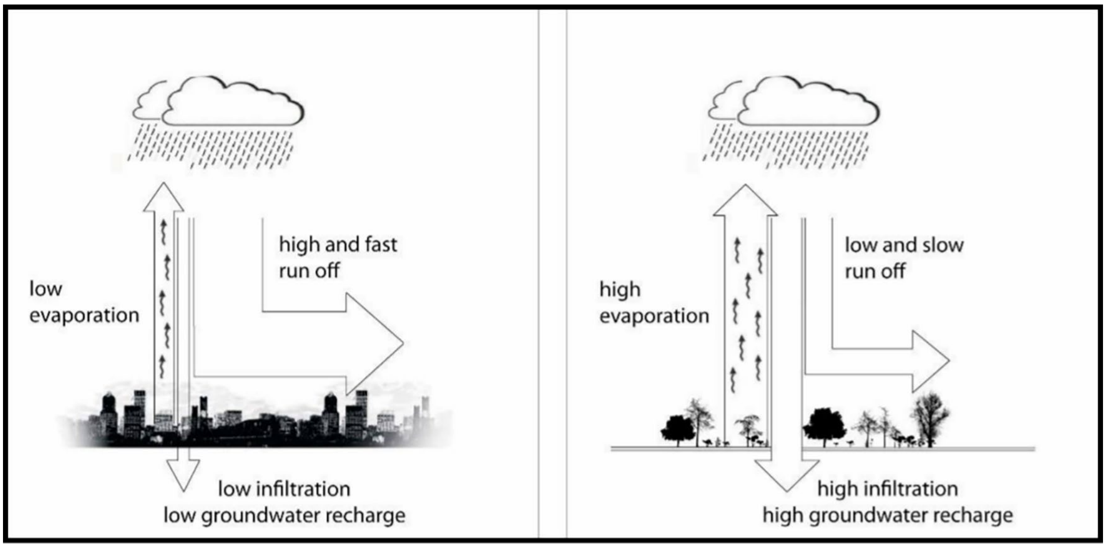

Figure 3 Rainwater cycling in urban and rural areas (Hoyer, Dickhaut, Kronawitter, Weber, 2011, p.8)

Hoyer, Dickhaut, Kronawitter, Weber (2011) visualized the movement of rainwater in urban and natural areas (see Figure 3). According to this figure, changes in topography due to anthropogenic reasons cause changes in the hydrological cycle, such as low evaporation, etc., affecting the quality and quantity of groundwater and surface water. At the same time, due to the increase in impervious surfaces in urban areas, the drainage properties of rainwater that cannot mix with groundwater change with the effect of the surface, increasing the risk of flooding.

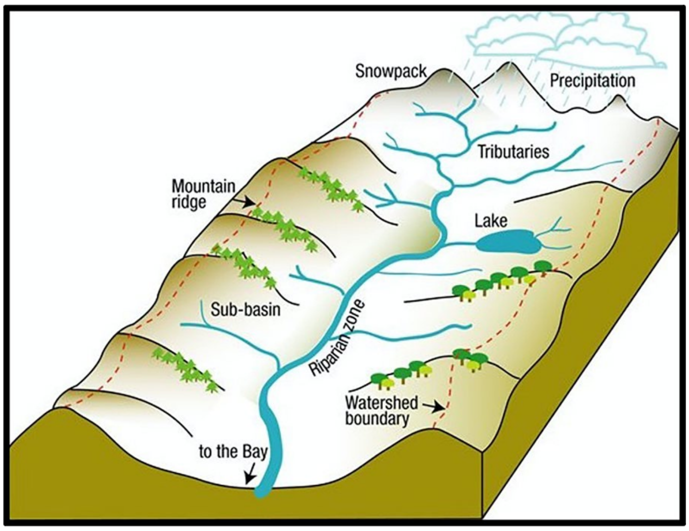

Figure 4 Water catchment (EPA, 2024)

To understand the causes of flooding, it is necessary to interpret the hydrological cycle and its factors regionally and holistically at the water basin scale. A water basin can be defined as an area, a hydrological topographical unit that sends the precipitation waters falling on it to a certain river section and which is separated from the neighboring basins by a water separation line (topographical boundary) passing through the ridges (Özhan, 2004, p.2). There is a flood-overflow-erosion relationship in the flood basin. A flood is a large mass of water coming from the side streams after rainfall and containing a large amount of solid and coarse material; a flood is the overflow of water along the valley when the water from the side streams reaches the mainstream. Erosion is not only soil erosion-transportation, but also a chain of harmful events with its share in floods, sedimentation, landslides, avalanches, etc. (Boztaş, 2016). For water, a catchment is simply defined as an area of land that drains into a river, lake, or other body of water (EPA, 2024) (see Figure 4).

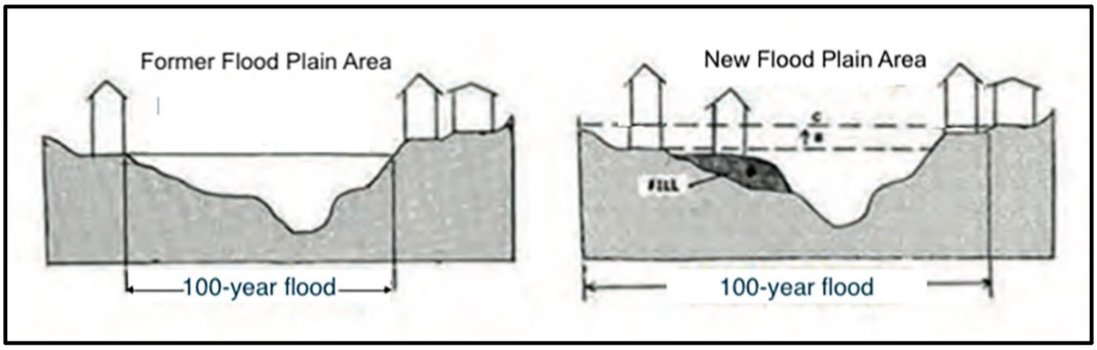

Figure 5 Changes in floodplain (Kadıoğlu, 2012, p.85)

Buildings that are exempt from flood risk according to the former floodplain are in danger together with the buildings constructed on the riverside without the necessary examination and research. No activity that will change the 100-year flood level in the basins should be allowed. For all these reasons, it is no longer possible to state flood disasters are solely due to meteorological occurrences. In particular, the diversity and intensity of human activities in various parts of the river basins disrupt the hydrological balance in the whole basin, and as a result, flood disasters which cause great loss of life and property are observed. The land structure changes with the settlements growing in the river basins, newly-opened roads, and new facilities, and under these conditions, flood disasters are gradually becoming larger and more frequent (Kadıoğlu, 2012, p. 85) (see Figure 5). With the sudden and heavy rainfall due to climate change, it is recommended to calculate a 500-year (Q 500) floodplain in developed countries.

Current trends of different driving forces and new challenges show that conventional approaches to urban water management no longer work sufficiently. The handling of wastewater, flood control, rain, and surface run-off waters should be approached with integrated solutions that consider the various uses and intrinsic value of water. Cities must transition from relying solely on engineered urban water systems to adopting integrated, adaptive, and climate-resilient water systems (EU, 2024,p). Brown, Keath, and Wong in 2008 reveals that as cities develop, urban water managers are being confronted with increasingly complex and multi-faceted challenges as societal expectations grow and natural resources reach the limits of sustainable exploitation. Given the significant climate change and population growth challenges facing cities, there is a critical need for strategic investment in solutions that will deliver long-term sustainable outcomes. The proposed urban water transitions framework is offered as a tool for assisting urban water strategists with the challenging task of identifying the attributes of more sustainable city states and the capacity development and institutional reform required to deliver Sustainable Urban Water Management (see Figure 6).

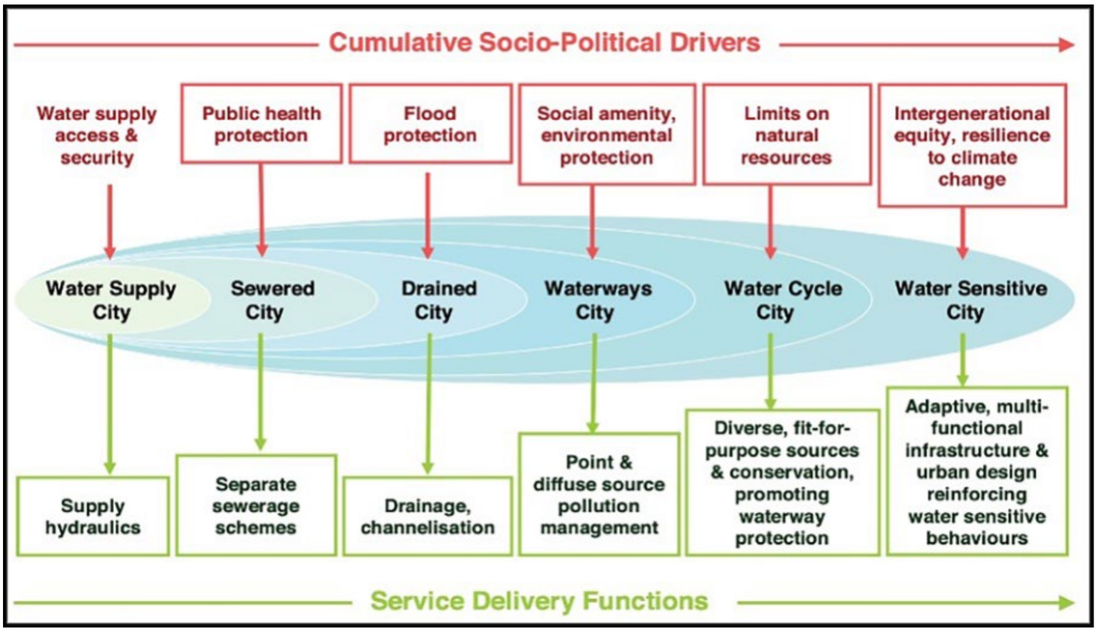

Figure 6 Urban water management transition framework (Brown, Keath, and Wong, 2008,p.5)

Today, with the discourses of resilience to climate change, water-sensitive cities have gained importance in urban water management. The Cooperative Research Centre for Water-Sensitive Cities in Australia, which develops and implements water-sensitive planning and design approaches in Australia, is a research-practice partnership supporting innovation in urban water management. The Water-Sensitive Cities goals are:

- provide water security, which is essential for economic prosperity, through the efficient use of a range of available resources
- restore and protect the health of waterways and wetlands, surrounding river basins and coasts and bays
- reduce flood risk and damage
- create public spaces that collect, clean, and recycle water (see Figure 7).

A selection of innovative interventions at a catchment scale were investigated for implementation. Interventions that acted to reduce runoff and downstream flood risk included permeable pavements, rain garden tree pits, and stormwater harvesting using large tank storage. Green roofs were also explored as a method of reducing stormwater runoff. The initiatives included in the plan are relevant and transferable to other urban areas with high imperviousness in the upper catchment and downstream flood risk (see Figure 8) (Cooperative Research Centre for Water-Sensitive Cities, 2021).

Solutions:	Benefits	Enabling Structures
Green roofs and green walls	Urban heat island mitigation	Governance and policy
Water sensitive homes and buildings	Alternative Water supplies	Leadership and influence
Rainwater and stormwater harvesting	Amenity and urban greening	Community engagement
Wastewater management and recycling	Water literacy and behaviour change	
Water sensitive parks and open spaces	Flood resilience	
Stormwater treatment	Ecosystems health	
Waterway naturalisation		
Water sensitive streets and carparks		
Water sensitive precincts		

Figure 7 Case studies on features in a water-sensitive city (Prepared from Cooperative Research Centre for Water-Sensitive Cities, 2021)

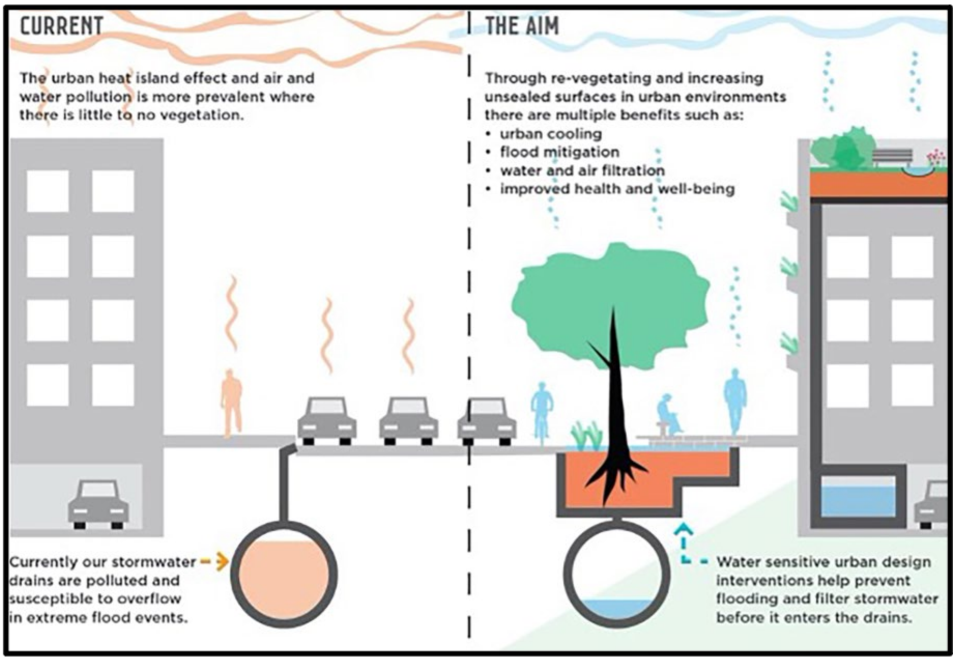

Figure 8 Elizabeth Street Catchment Integrated Water Cycle Management Plan (Cooperative Research Centre for Water-Sensitive Cities, 2021)

Floods present a growing problem in China. According to a 2021 World Bank Report, 641 of China's 654 largest cities face regular flooding. This has partly been attributed to rapid urban development, which has created sprawl that encases floodplains in impermeable concrete. Varied in form and scale, the projects create new parks, restore wetlands and install rain gardens and permeable pavements, among other measures. In Wuhan, where more than 380 sponge projects- including urban gardens, parks and green spaces- absorb and divert rainwater to artificial lakes, local air quality and biodiversity were found to have improved since they were constructed. Lower temperatures were also recorded at the city's Yangtze River Beach Park, where 45,000 trees and other vegetation utilize an estimated 724 tonnes of carbon per year (Choi, 2024).

Figure 9 The Dong'an Wetland Park in Sanya (Choi, 2024)

In recent years, the Drainage Department in Hong Kong has actively incorporated "Blue-Green Infrastructure" services into various projects. While continuing to prevent floods, it protects the ecological value of the surrounding environment, promotes biodiversity and water-friendly culture. It has incorporated the "Following Nature with Flexibility" "Sponge City" method into a series of projects to channel rainwater through natural means such as infiltration, and flood storage and retention to reduce large drainage (Drainage Services Department of Hong Kong, 2017). Today, sponge city practices are becoming increasingly common in China (see Figure 9).

3. Main Legal-Administrative Structure to Reducing Flood Disaster Risk in Türkiye

In Türkiye, Law No. 4373 on the Protection Against Flood Waters and Inundation (1943) has been in effect since 1943. However, various institutions have been commissioned regarding floods by several laws and regulations. In practice, efforts to reduce the flood risk have been carried out predominantly by the General Directorate of State Hydraulic Works (DSI), which is in 1954 with the Law No. 6200 established. According to the Metropolitan Municipality Law No. 5216 in metropolitan cities: Protecting water basins, providing drinking water, collecting, purifying, and removing wastewater and stream rehabilitation are the responsibility of municipalities.

Within the scope of the harmonization process with the European Union, the Regulation on the Protection of Water Basins and Preparation of Basin Management Plans (2012) entered into force in Türkiye and the Water Management Coordination Board was established. The Regulation on the Preparation, Implementation and Monitoring of Flood Management Plans was published in the Official Gazette on 12 May 2016 and entered into force and The Ministry of Agriculture and Forestry has been preparing Flood Management Plans for water basins in Türkiye.

The Regulation on the Basin Management Central Board, Basin Management Committees and Provincial Water Management Communiqué on the Establishment, Duties, Working Procedures and Principles of the Coordination Boards, and Basin and Provincial Level(2019) entered into force in Türkiye and basin and provincial scale institutional structuring were established. The National Water Plan (2019-2023) was prepared in 2019. The Presidential Decree on the Establishment of the

National Water Board entered into force upon publication in the Official Gazette Dated 20.11.2023 and numbered 32384.

The Ministry of Environment, Urbanization and Climate Change has made important regulations on stormwater management. In this context, the Regulation on Stormwater Collection, Storage and Discharge Systems was published in the Official Gazette dated June 23, 2017, and numbered 30105 to ensure water efficiency by collecting and reusing stormwater without mixing it with other wastewater. In 2017, the Ministry amended the Planned Areas Zoning Regulation regarding rainwater harvesting. Article 57, Paragraph 7 of the “Planned Areas Zoning Regulation” published in the Official Gazette on July 3, 2017 was amended as follows: "In buildings to be constructed on parcels larger than 2000 m2, a rainwater harvesting system project shall be added to the mechanical installation project in order to collect the rainwater on the roof surface in the rainwater collection tank to be installed under the natural ground and to filter and reuse it when necessary. The relevant administrations may also impose an obligation for smaller parcels."

Article (e) of the Decree Law No. 644 on the Organization and Duties of the Ministry of Environment and Urbanization (2011) states: “to determine and monitor the rules for the preparation and approval of risk management and avoidance plans, to conduct, have conducted and approve geological and geotechnical surveys based on the plan”. The Regulation on Spatial Plans Construction (2014), which prepared in accordance with Decree Law No. 644 (2011), requires that all studies related to “natural disasters” and in this context flood risk analyses, risk management and mitigation plans, if any, be integrated into zoning plans. Law No. 6306 on the Transformation of Areas under Disaster Risk (2012) is also one of the important legal bases for the transformation of risky areas. The legal-administrative infrastructure has begun to be built in Türkiye, which is a positive step in this regard.

3.1. Flood Disaster Risk in Istanbul

According to TUIK's data in 2024, Istanbul is the province with the highest population in Türkiye with a population size of 15,701,602 people. With a surface area of 5,313 km2, the population density of the province is 3,013 people per km2, which is much more than Türkiye's average of 111 people per km2. The population of Istanbul has increased approximately 11-fold since the foundation of the Republic. Spatially expanding due to population growth, Istanbul is the main agglomeration area of the country. With rapid population growth, urban growth and climate change impact, flash floods and flood disasters have become more frequent in Istanbul in recent years due to changes in land use.

With the mechanization of agriculture in the country since the 1950s, population movement from rural to urban areas started. Istanbul received migration in the 1950s with the presence of industrial areas, and the urban population, which was 983,041 people in 1950, reached 1,466,535 people in the 1960s. In the 1970s, with the completion of the Bosphorus Bridge and the related ring roads and the increase in accessibility, it started to spread towards Küçükçekmece on the eastern axis and Kartal on the western axis. With the construction of the second bridge (Fatih Sultan Mehmet bridge) and connecting roads in the 1990s, the urban areas merged with neighboring provinces in the east and west. In the earthquake on 17 August 1999, Istanbul experienced rather significant material and immaterial losses particularly in areas located in the southeast, which lacked appropriate conditions for construction. This drew focus to the rural areas, forests, and drinking water basins located in the north, the bases of which are more resistant against earthquakes. The legal change that shaped the recent urban development was the approval of Law No. 6360 in 2012. With the establishment of metropolitan municipalities in fourteen provinces and twenty-seven districts based on Law No. 6360, the number of metropolitan municipalities in Türkiye was increased to 30, special provincial administrations were abolished in these areas, and villages were transformed into neighborhoods as in Istanbul.

Today, despite the fact that they were not included in the decisions of the 1/100,000 scale Istanbul Environmental Plan (2009a), and despite all the objections made by non-governmental organizations (NGOs), various professional chambers, academics and citizens, the construction of the new Istanbul airport, the 3rd bridge, and the Northern Marmara Motorway (O7) have been completed in a short period (see Figure 10). The construction of the Northern Marmara Motorway constitutes the 3rd bridge and connecting roads, and destroys the Northern Forests, which are highly sensitive ecosystems. However, in 2020, the 1/100,000 scale Istanbul Environmental Plan (2009a) was revised and amended to include the Canal Istanbul Project. These projects threaten the hydrological structure and ecosystem balance and increase the pressure on flood risk areas.

Istanbul's land value, which was measured at 9.4 trillion liras in 2018, had increased by 149 percent as of the end of 2020. The districts with intense land trade in Istanbul were Silivri, Çatalca, Arnavutköy, Şile, Büyükçekmece, Beykoz, Tuzla, Ümraniye, Beylikdüzü, and Pendik. It was noteworthy that Esenler and Güngören, where construction has been completed, have almost no vacant land. The increase in demand, especially for rural and agricultural land and fields, due to the pandemic, was reflected in prices. This situation stood out as the most important factor triggering the upward movement of real estate, especially in the land category (Independent Newspaper, 2021).

Figure 10 Aerial photograph of Istanbul and connection roads of 3rd bridge (07) (Google Earth Maps, n.d.-a)

With a surface area of 534,300 hectares, the drinking water basin areas (see Figure 11) in Istanbul are under pressure from urban development. Urban development and construction create serious negative changes in topography and hydrological cycles. Established by Law No. 2560 for Istanbul Water and Sewerage Administration General Directorate Establishment and Duties (1981) under the supervision of the Governorship of Istanbul, Istanbul Water and Sewerage Administration (ISKI) was incorporated into Istanbul Metropolitan Municipality (IMM) in 1984. With Law No. 5216 on Metropolitan Municipality (2004) ISKI's area of responsibility was expanded to include the provincial borders of Istanbul. During the preparation stages of the 1/100,000 scale Istanbul Environmental Plan approved in 2009, the ISKI regulation was revised. For the first time in this plan, "areas to be rehabilitated within the basin" were decided to protect drinking water basins in Istanbul.

Akbulut and Güzel (2022) studied the absolute protection area and the short distance protection area of seven catchment areas (Darlık, Ömerli, Sazlıdere, Elmalı, Büyükçekmece, Alibeyköy, Terkos) within the borders of Istanbul province and analyzed the existing building stock within these areas (see Table 1).

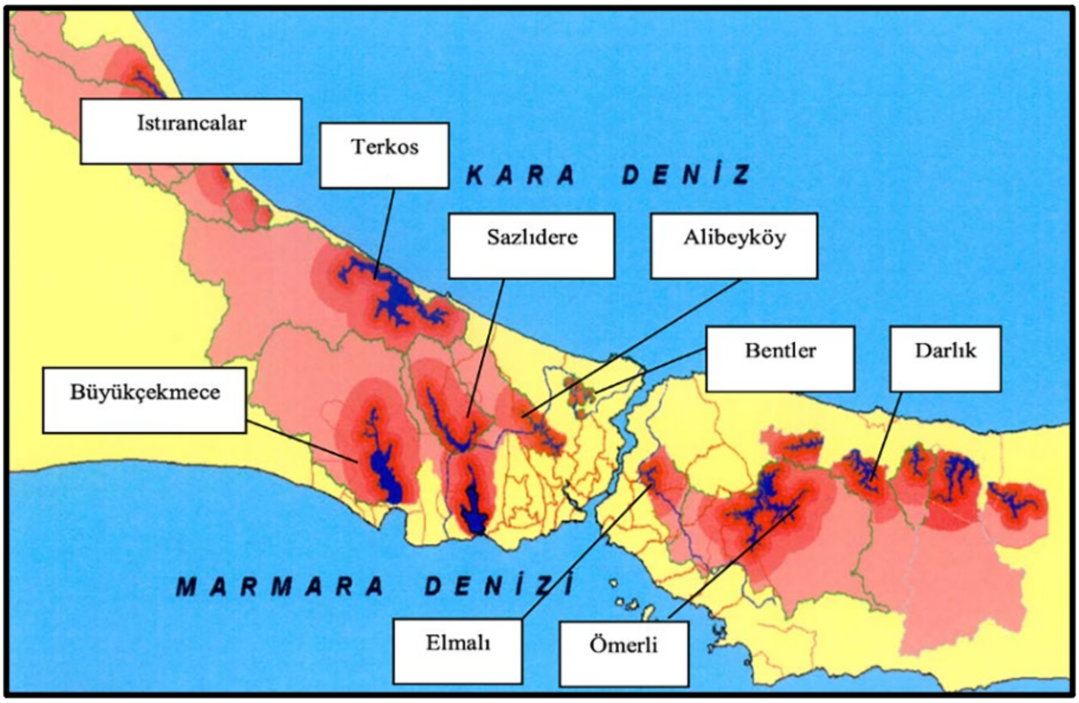

Figure 11 Drinking water basins in Istanbul (IMM, 2009, p.150)

Table 1 Percentages of Structures in the Absolute Protection Area and Short Distance Protection Area of Seven Drinking Water Basin Areas within the Borders of Istanbul Province (Akbulut & Güzel, 2022)

Protection Area	Absolute Protection Area		Short Distance Protection Area	
Basin	Number	Percentage (%)	Number	Percentage (%)
Darlık	3	0.07	0	0
Ömerli	178	4.31	1,362	9.23
Sazlıdere	468	11.34	1,783	12.1
Elmalı	584	14.15	2,105	14.27
Büyükçekmece	965	23.39	2,864	19.42
Alibeyköy	638	15.46	2,999	20.33
Terkos	1,291	31.28	3,635	24.65
Total	4,127	100	14,748	100

ISKI General Directorate Drinking Water Basins Regulation (2011) was amended on 16.01.2013 and stated that "In the drinking water basins, in the parts of the streams named in Annex-1, except for forest areas and areas to be protected in terms of agricultural quality; in accordance with the improvement project, on both sides of the improvement section of these streams; zoning for the purpose of cleaning, maintenance and repairs. At least 10 meters of "stream operation band" is allocated in the plans. The stream rehabilitation area and stream operation bands are expropriated by the administration".

In many districts of Istanbul, floods occur with every heavy rainfall, flooding houses, workplaces, and roads and causing material and mortal damage. Kasımpasa, Alibeyköy, Küçükköy, Maltepe, Kartal, Bağcılar (Otocenter Region), Esenler Çinçin Stream, Bayrampaşa, Zeytinburnu, Sarıyer Tarabya, Beşiktas Ihlamur Region, Bahçelievler (Tavukçu stream), Silivri, Selimpaşa and Çatalca regions are flood zones affected by heavy rains. After the droughts in Istanbul in 2007, Tavukcu stream in October 2007, floods were experienced across the city, for instance, on the Anatolian side of Istanbul in September 2008, Silivri, Selimpaşa, and Çatalca regions, and Ayamama stream in received excessive rainfall September 2009 (Demir, 2013). 85% of Istanbul streams have lost their natural structure due to pollution, occupation, and false land use decisions. The upper surface of the streams, enclosed in a closed section, are used as highways. These streams are Rumeli Kavağı, Kalender, Büyük Bebek-Küçük Bebek, Ortaköy, Ihlamur, Ambarlı, Islambey, 10. Yıl streams on the European side and Turşucu, Istavroz streams on the Asian side (Dinc & Bolen, 2014). Istanbul's climatic characteristics and rugged natural structure can provide favorable environments for the occurrence of floods. The adverse effects of the built environment created by rapid spatial development processes are showing an increasing trend.

According to Turoğlu (2011): the roughly north-south oriented flow directions of surface waters in Istanbul and its immediate surroundings are due to the natural slope characteristics of the region. The E80 and D100 Highways in the east-west direction cross these valleys and drainage systems, while the valley floors are generally preferred for their connection roads. Highways crossing river valleys play a role in preventing surface runoff and increasing the amount of water flowing (as in the Silivri-Selimpaşa in 2009 example). On the other hand, connecting roads that use valley floors in the downstream direction act as drainage channels during extraordinary rainfall.

In 2009, the flood disasters in Istanbul increased the need for stream rehabilitation projects. In this context, a protocol was signed in 2009 between General Directorate of State Hydraulic Works (DSI), IMM and ISKI for the improvement of streams. Although streams have been identified in the division of responsibilities; streams located in rural areas and flowing into Büyükçekmece Lake and to the north are under the responsibility of (DSI) and streams located in the urban and flowing to the south are under the responsibility of ISKI. The main problem areas for stream reclamation in flood-prone areas are expropriation, which requires compromise and high costs.

The rivers of Istanbul flow into the Black Sea, Bosphorus and Marmara Sea. The total length of Istanbul's streams is 2,540,688 km. Of the streams flowing into the Marmara Sea in Istanbul, 297,245 km have been rehabilitated and 651,660 km have not been rehabilitated. In the Büyükçekmece basin, 4,334 km has been rehabilitated and 363,040 km have not been rehabilitated. In the Terkos basin, 658 m was rehabilitated, and 372,813 km was not rehabilitated. In Ömerli basin, 43,562 km was rehabilitated, 154,092 km was not rehabilitated. Of the streams flowing into the Bosphorus, 805 km were rehabilitated and 40,810 km were not rehabilitated. Of the streams flowing into the Black Sea, 5,228 km were rehabilitated, and 925,977 km were not rehabilitated (Istanbul Governorship of the Republic of Türkiye, n.d, p.39).

The Marmara Basin Flood Management Plan for the Marmara Basin, which includes Istanbul, was most recently approved in the Official Gazette on January 17, 2025. In the study covering the years 2023-2027, flood risk analysis was conducted for all streams of Istanbul, and necessary interventions and responsible organizations were identified. In this context, while IMM is the responsible organization under Law No. 5216, IMM and DSI are defined as the relevant organizations under Law No. 6200.

3.1.1. Flood Disaster Risk in Çatalca District

According to the land use data of IMM Urban Planning Directorate (IMM, n.d.), which is the most recent study, Çatalca district has the largest surface area of Istanbul at 111,513 hectares and is in the Thrace sub-region of the Marmara region. Forest areas within the borders of the district total 72,191 hectares, which corresponds to 65% of the district, agricultural areas total 32,765 ha., which corresponds to 29% of the district, and residential areas in the district total 4,302 km2, which corresponds to 9% of the district (see Figure 12). The population of the district, which has the lowest population and density in Istanbul, increased from 62,001 persons in 2010 to 80,399 persons in 2024 (TUIK, 2024). Demand for second houses is rising along with land prices in the district due to its increased accessibility. In terms of environmental sustainability, it is also considered critical. Although Çatalca district has extremely fertile agricultural lands in general, the number of residences, especially summer houses, has started to increase throughout the district with the accessibility of III. Bridge connection roads.

In the northern part of Çatalca on the Black Sea coast, there are elevations covered with forests, which are the continuation of the Yıldız Mountains. In the south of these, fertile plains begin. 97% of Çatalca district is within the basin boundaries. The district is within the Büyükçekmece and Terkos basin borders. The 3% of the district that is not within these basin boundaries is in the Küçükçekmece water basin area, which is removed from the basin boundaries. 90% of Çatalca's surface area is within the ISKI protection basins. Most of Istanbul's drinking water is supplied from Durusu Lake and Büyükçekmece reservoir, which are located near the district borders. There are many large and small streams that carry water to other dams (IMM, 2010, p.II).

The Istranca Mountains and streams, where Istanbul's water has been supplied from since ancient times, are the site of historic waterways. In the 1/100,000 scale Istanbul Environmental Plan Decisions (2009a), it is proposed to create areas in Çatalca district (Muratbey, Izzettin, and the north of Çatalca Center) whose natural and rural character will be preserved. In the plan, recreation areas are proposed in Çatalca to meet the recreation needs of the urban dwellers for daily use in and around the urban areas, especially the need for green areas. Ecological tourism areas are proposed in the north of Çatalca. For the first time in this plan, “areas to be rehabilitated within the basin” were decided to protect drinking water basins in Istanbul. In this context, Çatalca district is also within the scope of the area to be rehabilitated within the basin.

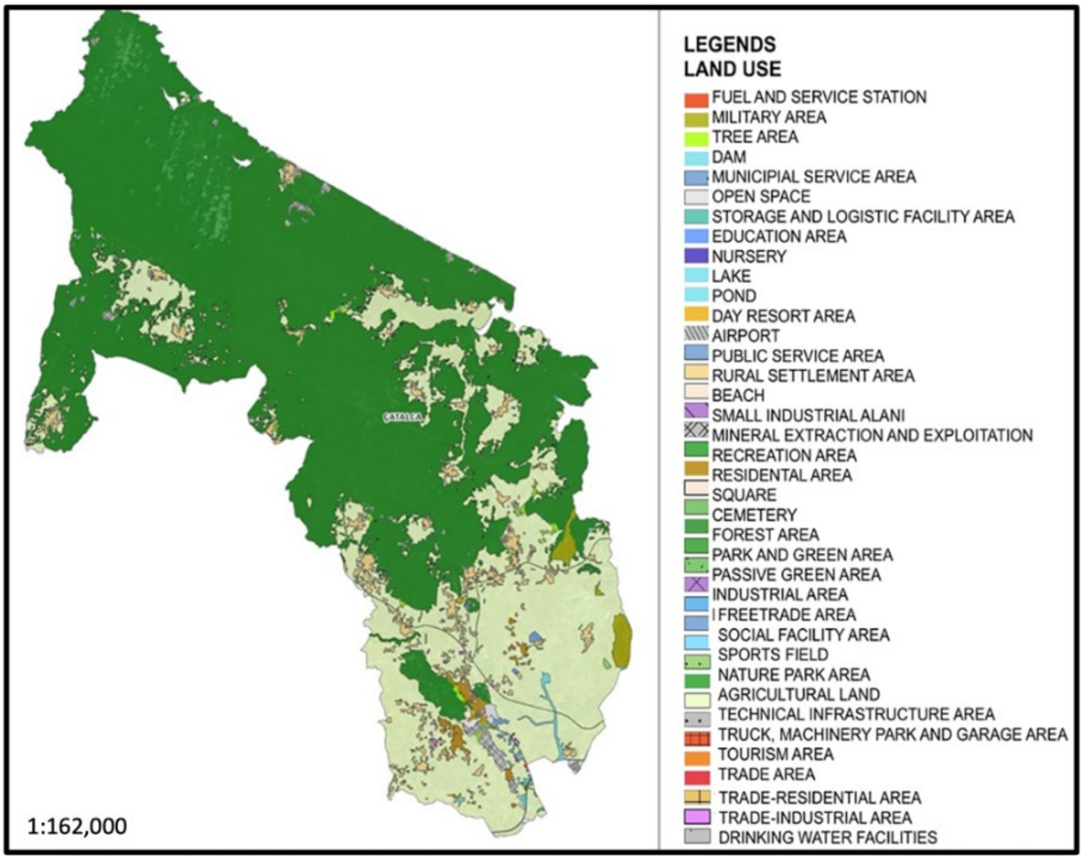

Figure 12 Land use in Çatalca District (IMM,n.d)

Çatalca Center has a topography that is partially suitable for settlement in terms of slope. The average slope in the built-up area of Kaleiçi and Ferhatpaşa neighborhoods is between 2-10%. The slope increases towards the west from the built-up area and rises to 40% (IMM, 2010, p.II). In terms of the morphological structure of the district, there are areas with flood risk in Çatalca district, which has a sloping structure reaching up to 40% in places, in the Black Sea and Marmara climate transition zone and is rich in water resources and contains (high flow) rivers (see Figure 13).

In the flood disaster on September 8-10, 2009, as a result of the general inspection, it was observed that most of the bridges connecting the surrounding villages to Çatalca were destroyed and the houses in front of the narrow and high sloping valleys were flooded. In addition to the flooding in a wide area, waterways were formed from fields and forested ridges. It can be said that the greatest disaster impact was in the valley beds flowing into Çatalca and Büyükçekmece (IMM, 2009b, p.43) (see Figure 14).

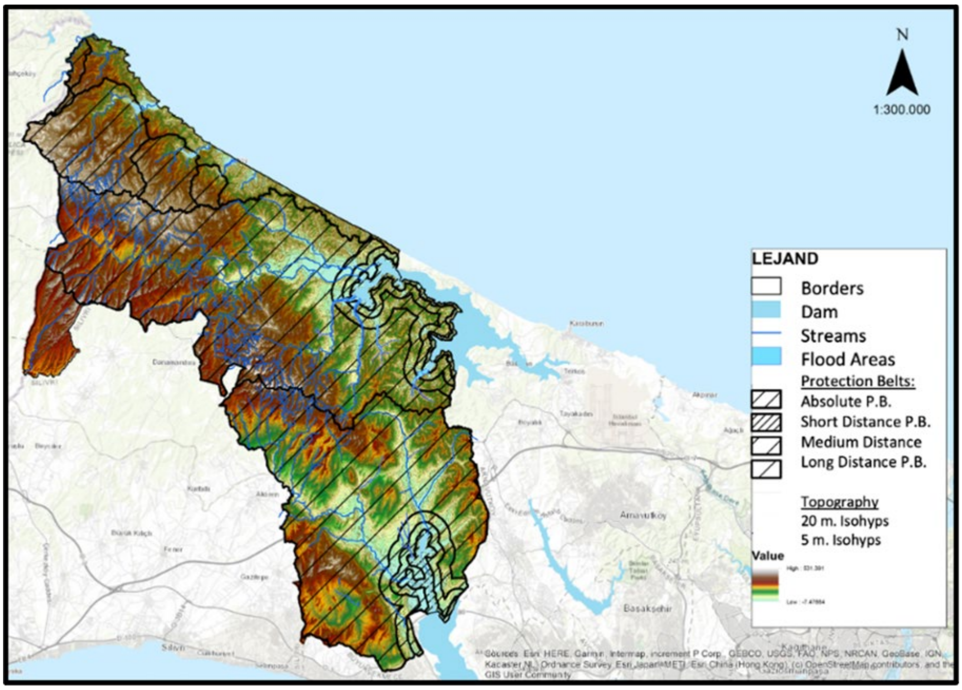

Figure 13 Topography and flood areas of Çatalca district. Prepared for this study with data of IMM (n.d.) and ISKI (2024)

According to the information obtained from Çatalca Municipality, in the 2009 flood disaster, seven people lost their lives, 298 houses and 113 workplaces were damaged. Ferhatpaşa Bayırı, where the flood disaster occurred in the city center, is 40-50 meters high, extending southwestward from the intersection of the gently sloping Ferhatpaşa and Kaleiçi neighborhoods in the center. There were squatter settlements in an area with a 25-40% slope between two hills close to each other.

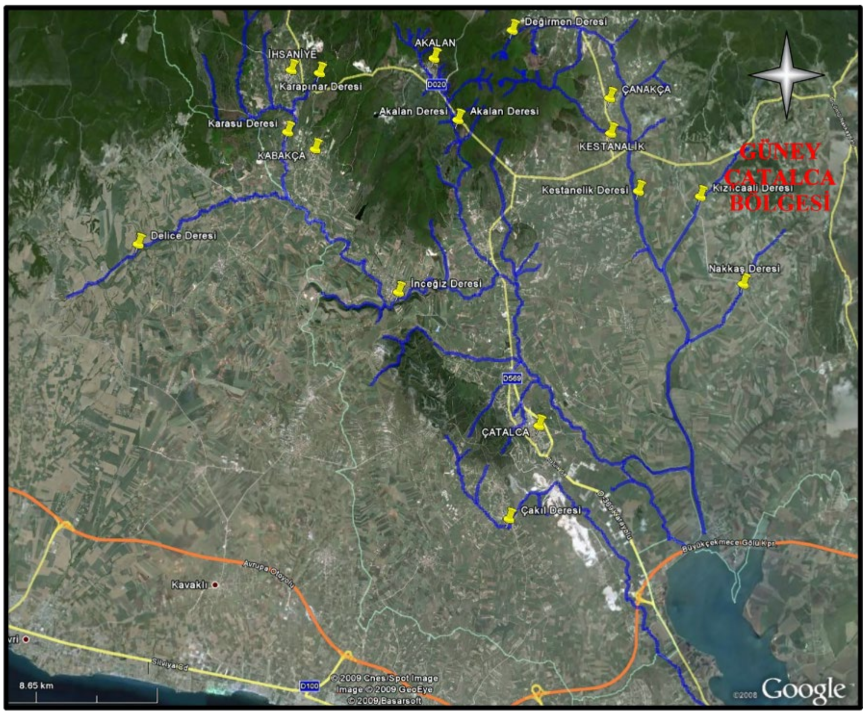

Figure 14 Flood areas in the southern part of Çatalca district in 2009 (IMM, 2009b, p.10)

75 families affected by the flood disaster were placed in temporary prefabricated containers on the initiative of Çatalca Municipality (Milliyet Newspaper, 2013). The area where the houses were located in Ferhatpaşa Bayırı was declared a Slum Prevention Zone. The Housing Development Administration (TOKI) and Çatalca Municipality signed a protocol in 2009. On September 1, 2016, the houses built for the victims of the 2009 flood disaster were inaugurated. Çatalca district is still experiencing floods and meteorological disasters. In the Marmara Basin Flood Management Plan (2024), which was approved and entered into force on January 17, 2025, and establishes the rules to be implemented under the responsibility of (DSI and IMM) between (2023-2027) regarding streams at risk of flooding, flood hazard maps were prepared for all streams in Çatalca (see Figure 15).

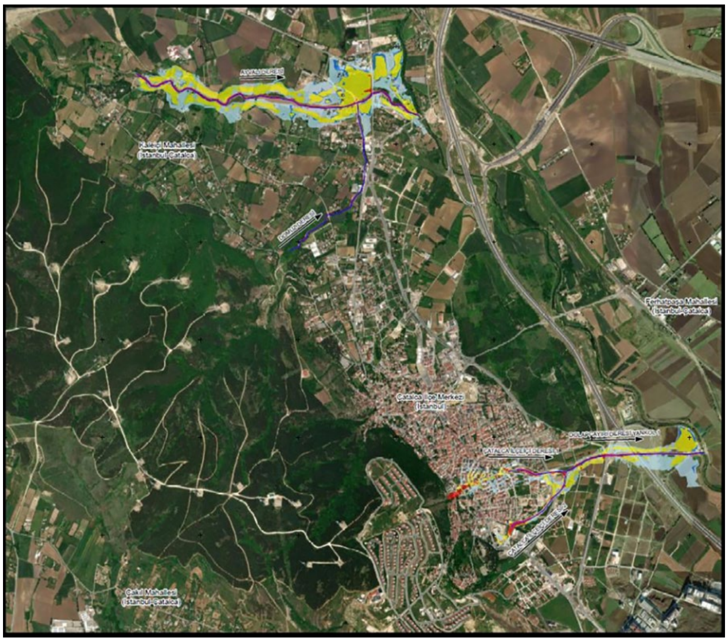

Figure 15 Flood hazard map for Çatalca central district (Q500) (Republic of Türkiye Ministry of Agriculture and Forestry, 2024, p.321)

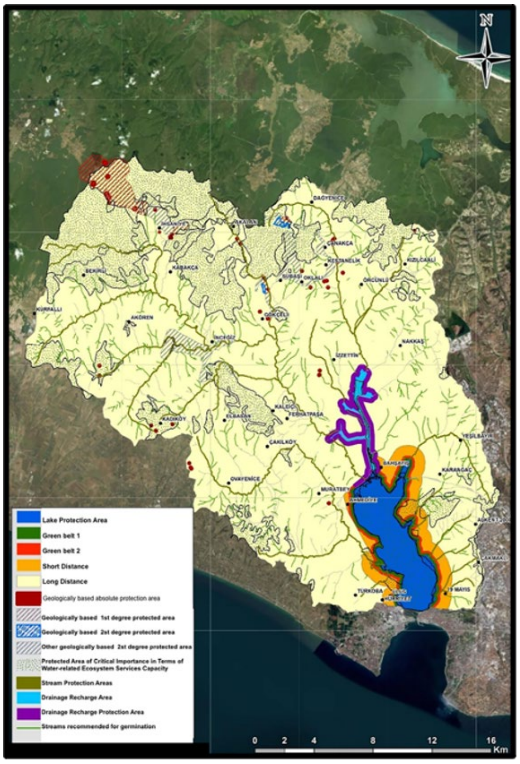

Figure 16 Büyükçekmece Basin Protection Plan (Republic of Türkiye Ministry of Agriculture and Forestry, 2019)

The Büyükçekmece Basin Protection Plan prepared by the General Directorate of Water Management of the Ministry of Agriculture and Forestry in Istanbul entered into force on March 20, 2019 (see Figure 16). This plan was prepared within the scope of the Regulation on the Protection of Drinking and Potable Water Basins (2017) and is important in that it specifies that geologically permeable surfaces and the drainage supply areas should be protected.

3.1.1.1. Example of Flood Disaster Risk in Akalan Neighborhood

The population of Akalan was 981 persons in 1985 and in 2017 there were 1,085 persons, with a population density of 29 persons/hectare. The number of inhabitants in 2024 was 1,169 persons (TUIK, 2024). In the 1/100,000 scale Istanbul Environmental Plan (2009a), Akalan settlement is in the long-distance protection area in the water basin of Büyükçekmece Dam. When the historical development process of Akalan settlement is analyzed, it is found to have been established in 1924 by the Muhajirs who came from Thessaloniki. Akalan Stream is a tributary of Karasu Stream and is within the Büyükçekmece drinking water basin boundary. Although there are no industrial or other production or polluting facilities in the Akalan neighborhood, most of the predominantly residential area falls within the 200-meter stream approach boundary set by ISKI. Akalan settlement (see Figure 17), where there are approximately 450 households today, is predominantly on fertile agricultural class soils.

Figure 17 Akalan neighborhood (Google Earth Maps, n.d.-b)

According to the information obtained from Çatalca Municipality, in the disaster in Akalan Neighborhood on September 8, 2009, 53 households were damaged, but there were no casualties. In the flood disaster on September 8-10, 2009, many houses in the village center were flooded, and some agricultural lands were damaged as a result of the overflow of the Akalan Stream. In addition, the culverts on the stabilized roads on the stream and the bridge on the former Istanbul-Edirne highway were also destroyed because of the flood. The sewage line passing through the village was also damaged. Due to the high slope in the upper basin and low slope in the lower basin, the water velocity increases in the lower basin during flooding and flood damages increase. The reclamation project based on Q500 calculations prepared by DSI for the Akalan stream started to be implemented in September 2013 with public funding (see Figure 18).

In Akalan, the survey was conducted within the flood extent area in the center of the settlement in 2016. Of the 32 buildings in this area, 26 are residences, one is a barn, and the others are not in use. 20 of the buildings have one storey, seven have two storeys and two have three storeys. According to the results of the survey, it was learned that 83% of the people interviewed in the households in the flood-prone area where the survey was conducted did not have flood insurance when the disaster occurred in 2009, 11% had flood insurance, 6% had disaster-related insurance and the insurance did not cover the cost because it did not cover the flood disaster. 78% of the people surveyed did not previously know that they lived in a flood risk area.

Figure 18 Rehabilitation Project of Akalan Stream (Author's own Archive, 2016)

In the 1/5,000 scale Master Plan of Akalan, which was prepared in line with the decisions of the 1/100,000 scale Istanbul Environmental Plan (2009a) and approved on 25.06.2009, Precautionary Areas-1, Precautionary Areas-2 and Areas Requiring Detailed Geotechnical Investigation were defined according to the settlement suitability assessment map and soil survey report. The 1/1,000 scale Implementation Plan of Akalan was prepared in 2014. It includes the decisions of the 1/5,000 Master Development Plan, and in line with the opinion of DSI after the flood disaster in 2009, the details "Approach Boundary of Stream Structure with Flood Risk and Precautionary Area-3: Areas where precautions should be taken in terms of flood risk" were added (Çatalca Municipality, 2014) (see Figure 19).

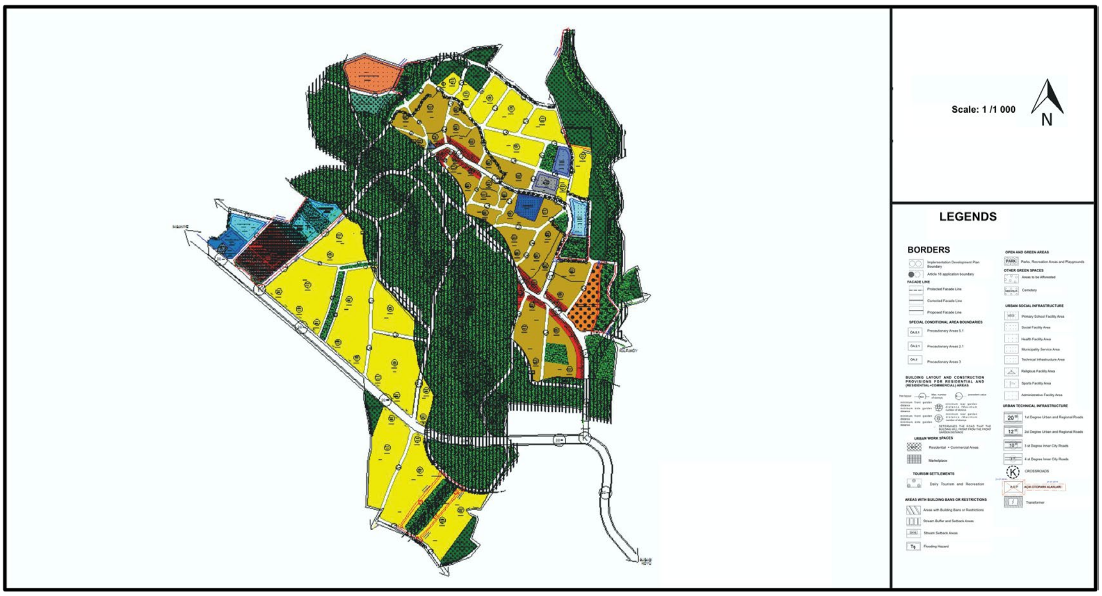

Figure 19 1/1,000 Akalan Implementation Plan (2014) (Çatalca Municipality, 2014)

3.1.2. Flood Disaster Risk in Beykoz District

According to TUIK's data, the population of Beykoz district was 58,317 persons in 1960, 58,317 persons in 1990 and 245,440 persons in 2024. 10% of the population lives in rural areas. Kavacık neighborhood, which developed after the 1990s, is the neighborhood with the fastest growing and highest population in the district, with 22,138 persons in 2024. According to the land use data of IMM Urban Planning Directorate (IMM, n.d.-a), which is the most recent study, forest areas within the borders of the district total 22,109 ha., which corresponds to 71.2 % of the district, agricultural areas total 1,817 ha., which corresponds to 5.9 % of the district, and residential areas in the district total 5,110 ha., which corresponds to 16.5 % of the district (see Figure 20)

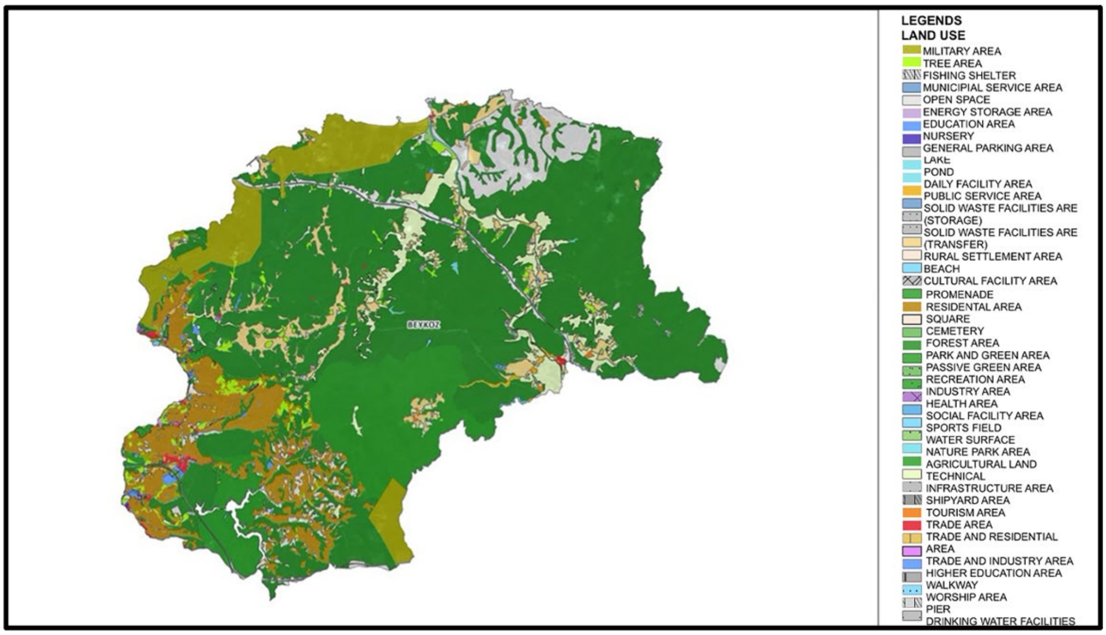

Figure 20 Land use in Beykoz district (IMM, n.d.-a)

The district, which was known to have been used mostly as a hunting and recreation area due to the presence of Riva, Küçüksu and Göksu streams during the Ottoman period, carries the traces of the industrial city with now-closed industrial premises (Paşabahçe Glass, Beykoz Sümerbank, Shoe Factory, and Tekel Factory) in the Early Republican Period. Beykoz District, where nature parks and natural sites such as Polenezköy and civil architecture works subject to cultural heritage and natural beach areas such as Riva are intertwined, developed the Kavacık center with the 2nd Bosphorus crossing (F. Sultan Mehmet Bridge) in the 1990s. New residential areas have emerged in Kavacık and Göksu (Hisar Evleri, Göksu Evleri etc.). Very close to Kavacık on the Riva Road examples of gated communities (Acarkent, Beykoz Konakları) have developed. In 2017, with the 3rd Bosphorus Highway crossing (Yavuz Sultan Bridge), the settlement in Beykoz district expanded north and northeast towards natural and rural areas.

The entire Beykoz district is a protected area. There are 56 natural and natural-historical protected areas covering an area of 31,301 hectares in Beykoz district. 89% of the protected areas are "natural protected areas" registered with the decision dated 15.11.1995 and numbered 7,755, and 11% of the protected areas are "natural-historical protected areas" consisting of the Bosphorus foresight and outlook zones registered with the decision dated 14.12.1974 and numbered 8,172 (Dinçer, Enlil, Evren, 2009). The 1980s were the years when the urban development dynamics of Istanbul gained momentum in the most striking way. Since then, the process of urban development and sprawl has accelerated. In this development process, to prevent the destruction of natural, cultural, and historical assets in urban areas and to protect its original structure, Law No. 2960, the Bosphorus Law (1983), which covers the settlements in the Bosphorus, entered into force. This is an important and positive law in preventing the Bosphorus, with its unique location and values, from being negatively affected by the uncontrolled development of the urban area. Beykoz district has a topography that is partially suitable for settlement in terms of slope and flood areas (see Figure 21).

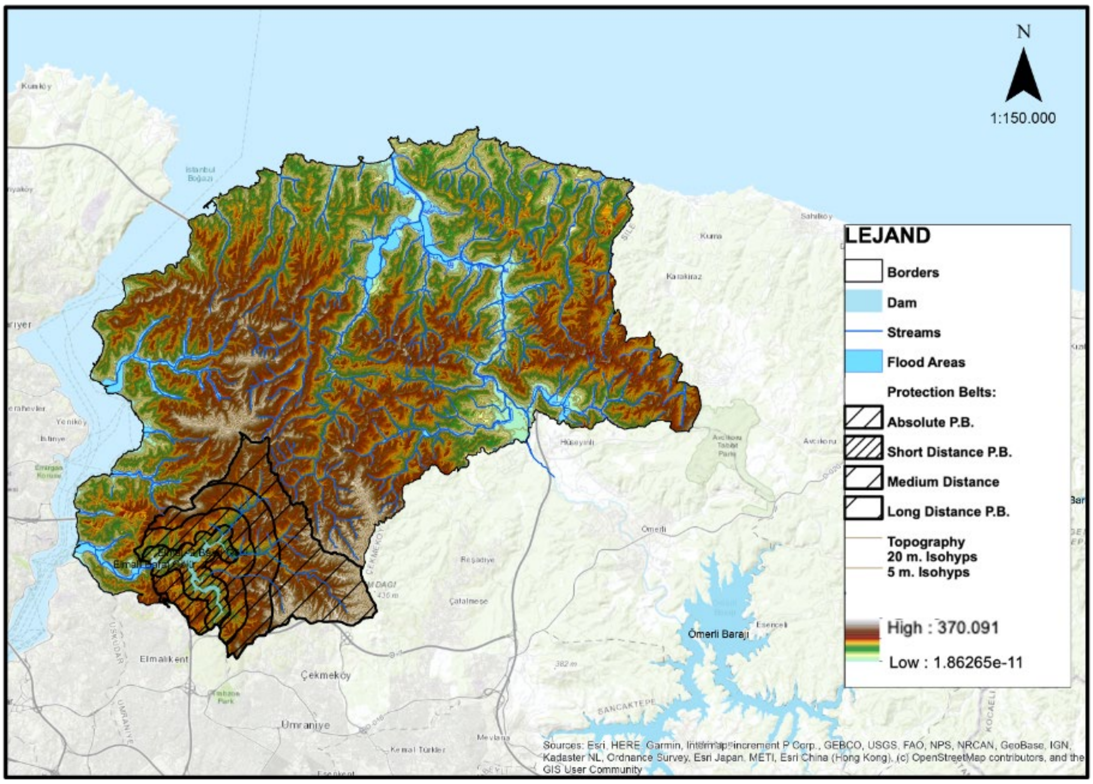

Figure 21 Topography and flood areas of Beykoz district. Prepared for this study with data from IMM (2017 (n.d.-a) and ISKI (2024)

In 2014, the Ministry of Environment, Urbanization and Climate Change started to prepare an Ecologically Based Scientific Research Report (ETBAR) for 506 natural protected areas in Istanbul, including Beykoz. Beykoz district in Istanbul has a sloping topography and is one of the largest districts (31,036 ha.) in Istanbul. The priority issues of the planning agenda for Beykoz are title deed problems and unplanned construction, destruction, and danger of loss of protected areas such as forest areas, streams, agricultural areas, and Elmalı Water Basin, and the protection of the Bosphorus Region. The 1/25,000 scale Conservation Master Development Plan was completed by the Istanbul Metropolitan Municipality Urban Planning Directorate in January 2023. With the Assembly Decision dated September 12, 2024, it was returned to Directorate for the opinion of Beykoz Municipality (IMM, n.d.-a).

The Elmalı Basin Protection Plan, prepared by the General Directorate of Water Management of the Ministry of Agriculture and Forestry in Istanbul entered into force on March 20, 2019. It is important that the Ministry of Agriculture and Forestry has prepared the Elmalı Basin Protection Plan (2019) and the Marmara Basin Flood Risk Management Plan (2024); according to these plans, land use decisions need to be revised in Beykoz.

3.1.2.1. Flood Disaster Risk of Göksu Stream in Beykoz District

Within the scope of Preparation of Microzonation Reports and Maps for Anatolian Side "Flood Hazard" has been investigated, analyzes have been made to select the areas subject to flooding that may occur as a result of the realization of three main hazards: excessive precipitation, dam damage caused by earthquake, and tsunami effects, and a Flooding Hazard Map has been prepared (IMM, 2009). In this project, the area where the Göksu stream flows into the Bosphorus is identified as the riskiest area in the case of a possible flood due to the damage to Elmalı Dam II in Istanbul (see Figure 22). The impacts that will occur because of the failure of Elmalı Dam II due to a possible earthquake were analyzed, and the results of the analysis were shown with the maximum depth map, maximum flow velocity map, and arrival time map. The water flow's arrival time due to dam damage will be about 10 minutes under the highway bridge (TEM Molla Gürani Viaduct) and about 40 minutes at the seaside (where Göksu stream joins the Bosphorus). In the case of flooding due to dam damage, the worst-case scenario is assumed, but the probability of occurrence is very low. In this study, the boundaries of the risky area in the Preparation of Microzonation Reports and Maps for the South of the Anatolian Side of Istanbul" (IMM, 2009) and the 1/5,000 scale Master Plan for Natural and Historical Values of the Bosphorus (1983) are overlapped (see Figure 22).

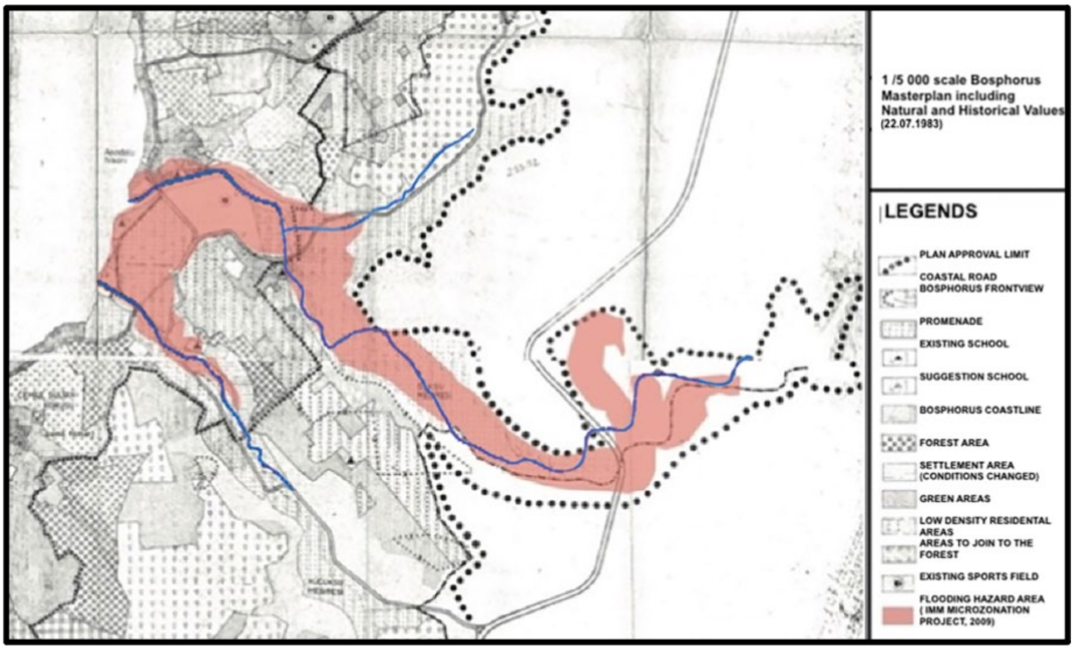

Figure 22 Flood hazard area. Flood hazard area in IMM (2009) overlapped with 1/5,000 scale Bosphorus Natural and Historical Values Master Plan (1983)

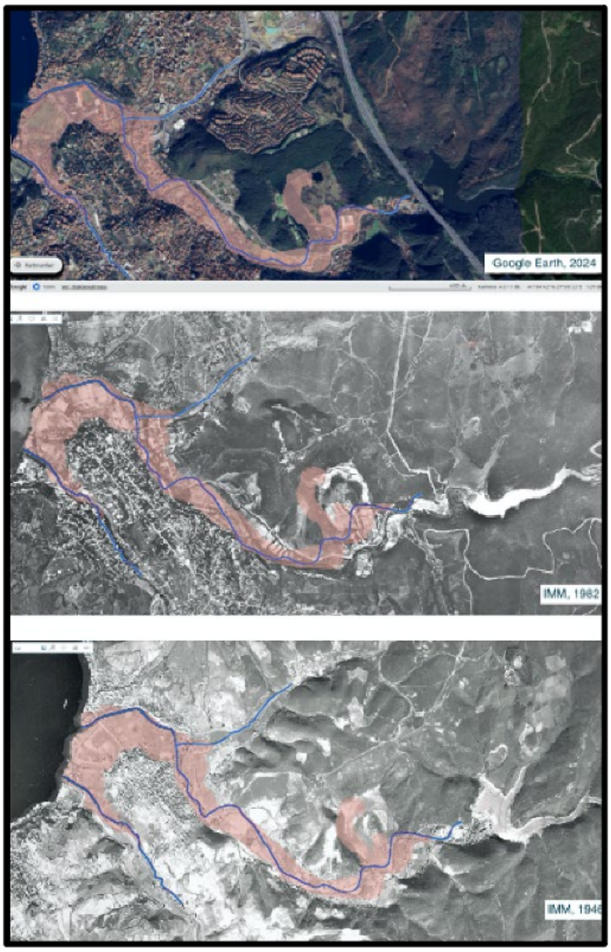

Figure 23 Flood hazard area in 1946, 1982 and 2024. Flood hazard area in IMM (2009) overlapped with satellite images

In recent years, population and construction have been increasing in the Kavacık, Yenimahalle and Göztepe neighborhoods, which are new settlement areas outside the foreground zone according to Bosphorus Law No. 2960 (1983). After the 1990s, Hisar Evleri, Göksu Evleri, etc. mass housing projects and Medipol University campus can be given as the main examples of the built-up area in the upper basin of Göksu stream (see Figure 24 and Figure 25).

Figure 24 View from the tributary of Göksu Stream towards Medipol University in Kavacık (Authors Archive,2025)

Figure 25 New settlements in the upper basin of the tributary of Göksu Stream (Authors Archive, 2025)

According to TUIK's data, in 2024, the population of Kavacık was 22,138 persons, the population of Yenimahalle was 19,200 persons and population of Göztepe was 9,388 persons. The Hekimbaşı neighborhood of Ümraniye district, located in the upper basin of the Göksu stream, has 7,411 inhabitants. The population of Göksu neighborhood, which is predominantly a coastal settlement within the scope of Bosphorus protection, is 2,320 persons. Urban development with population growth will lead to high imperviousness in the upper basin and increase flood risk in the lower basin. Reclamation works in the Göksu and Küçüksu streams are carried out by ISKI in a process where compromise is difficult and public costs are high. However, allowing new settlements to develop in the upper basin throughout the region will still increase the flood disaster risk. Nowadays, flood events are increasing in the region (see Figure 26).

Figure 26 Satellite image (3D) of the flood hazard area and its surroundings (Google Earth Maps, n.d.-c)

In the Marmara Basin Flood Management Plan (2024), which was approved and entered into force on January 17, 2025, and establishes the rules to be implemented under the responsibility of DSI and IMM between (2023-2027); regarding streams at risk of flooding, flood hazard maps were prepared for all streams in Beykoz. Intervention methods for Göksu stream, which is among the streams at risk of flooding in Beykoz, and decisions for strengthening Elmalı Dam are shown in Figure 27.

Figure 27 Decisions for Göksu Stream and Elmalı Dam in the Marmara Flood Management Plan (2024)

4. Results and Conclusions

Istanbul, which has a significant weight in the Turkish economy, is the main urban agglomeration area of the country. Due to the rapid population growth in Istanbul, the urban macroform has expanded, encroaching on forests and watersheds, and destroying rural settlements. In this urbanization process of Istanbul, sensitive ecosystems and stream basins have been opened for settlement due to the lack of a holistic planning and management approach, lack of coordination, and confusion over authority. It is imperative to preserve the natural and rural qualities on the periphery of the city. In Istanbul, water basins are not protected by protection belts according to certain distances determined by ISKI legislation.

When the flood risk problems experienced in the sample areas in Çatalca and Beykoz are examined, it is understood that there are legal or illegal constructions that have chosen a location in areas with flood risk without being aware of the risk. The protection distances determined by ISKI legislation for Istanbul's streams are insufficient to prevent flood risk. When the practices of the institutions for the prevention of flood risk are examined, it is understood that the prevention of flood risk is attempted by the rehabilitation of the streams occurring in the area where the built environment is located. There is no holistic approach at the basin scale.

As examined in the sample locations, in sloping areas, due to the high slope in the upper basin and low slope in the lower basin, the water velocity increases in the lower basin during flood times, and flood damage may increase. Highways crossing river valleys also play a role in preventing surface runoff and increasing the amount of water flowing. Further, connection roads that use valley floors in the downstream direction act as drainage channels during extraordinary rainfall. As long as construction and population increase continue in the basins where stream rehabilitation is carried out at high costs, these projects will be insufficient to prevent flood risk. With developing technological possibilities, the predictability of floods will decrease as human beings intervene more in natural environmental features. Due to its close location, the Canal Istanbul Project is a particular threat to the Çatalca area. With the 3rd Bridge and its connection roads, it is necessary to increase resilience against flood risk against the increasing urban development pressure.

Today, water-sensitive urban planning and design approaches that support integrated watershed management studies have become extremely important in order to adapt to climate change on a global scale, protect and increase the efficiency of water resources, and reduce flood disaster risk. Adopting this approach would also be in line with the key principles of the Sendai Framework for Disaster Risk Reduction (2015-2030) on how to make our societies safer and more resilient (understanding disaster risk, strengthening disaster risk governance to manage disaster risk, investing in disaster risk reduction for resilience and enhancing disaster preparedness for effective response, and "building back better" in recovery, rehabilitation and reconstruction) also overlap with focused actions at local, national, regional, and global levels and across governments and sectors.

When examples from the developed world are examined, it is important to produce nature-based solutions such as the creation of green infrastructure, stormwater management, sustainable urban drainage systems, landscape planning and design within the scope of stream improvement projects proposed for settlements and to integrate them with spatial planning and design decisions, and these will provide long-term permanent and cost benefit solutions. By increasing permeable surfaces, rainwater harvesting, and the selection of appropriate landscape elements, it is possible to slow down the flow of water in urban areas and prevent its spread to the environment. In this context, for example, in China, the importance of producing nature-based solutions has been emphasized with "sponge-city" concept projects that include rainwater harvesting and rainwater management to protect water basins, improve water quality, and reduce flood disaster risk.

The Turkish Republic Ministry of Agriculture and Forestry works on flood management plans in line with the development of water basin management plans for reducing flood risk. The Marmara Basin Flood Management Plan for the Marmara Basin, which includes Istanbul, was most recently approved in the Official Gazette on January 17, 2025. In the study covering the years 2023-2027, flood risk analysis was conducted for all of Istanbul's streams, and necessary interventions and responsible organizations were identified. These interventions are generally annual cleaning and flood rehabilitation of the streams. In this context, while IMM is the responsible organization under Law No. 5216, IMM and DSI are defined as the relevant organizations under Law No. 6200.

Preparation of flood hazard maps, flood risk maps, and evacuation plans within the scope of the Marmara Basin Flood Management Plan is valuable. These studies should be developed with multiple risk analyses that take into account other risk factors, especially the earthquake risk in Istanbul. The Ministry of Agriculture and Forestry should guide spatial planning approaches for local actors by combining the Elmalı Basin Protection Plan (2019), Büyükçekmece Basin Protection Plan (2019), and the Marmara Basin Flood Risk Management Plan (2024) prepared for drinking water basins in the sample area. Protection plans prepared for drinking water basins should also be prepared for groundwater and surface water basins that do not have drinking water quality.

In this context, spatial planning studies and land use decisions at all scales should be revised and implemented in a participatory manner with water-sensitive planning and design principles in line with flood hazard maps, flood risk maps, and flood management plans in the light of scientific data for Istanbul's water basins. More detailed and comprehensive studies should be carried out by shifting from macro scale to micro scale and using locally specific analyses (climate, topography, hydrology [the natural flow directions and natural flow accumulations], the hydrogeology, soil structure and permeability, etc.). The process of water-sensitive planning and design should be a collaborative effort of all stakeholders (planners, architects, engineers, technical experts, practitioners, environmental groups, NGOs, etc.) and local communities. This process should also be supported by a flood disaster risk management process that includes the awareness and participation of all actors on risk issues.

Acknowledgements

In this study, the preliminary findings of Çatalca and Beykoz case studies of the Scientific Research Project titled "The Relationship of Flood Risk with Planning: The Case of Istanbul Province" supported by Mimar Sinan Fine Arts University are presented. The study has been theoretically developed and updated.

References

Akbulut, B., & Güzel, A. İ. (2022). Watershed areas under urbanization pressure: The case of Istanbul. *Journal of Environmental and Natural Studies*, *4*(3), (pp.207–224). https://doi.org/10.53472/jenas.1148604 (Date of Access: 01.09.2023).

Balamir, M. (2007). Afet politikası, risk ve planlama. *TMMOB Afet Sempozyumu*, (pp.31 43). http://www.imo.org.tr/resimler/ekutuphane/pdf/3887.pdf (Date of Access: 01.06.2014).

Boztaş, İ. (2016). Yukarı Havza Sel Kontrolü Eylem Planı ve Uygulamaları. *4. Ulusal Taşkın Sempozyumu Panel Sunuları ve Tebliğler Kitabı* (23 25 Kasım 2016). https://cdniys.tarimorman.gov.tr/api/File/GetFile/425/KonuIcerik/745/1093/DosyaGaleri/4-ulusal-ta%C5%9Fk%C4%B1n--sempozyumu-sonuc-bildirgesi-ve-tebligler.rar.rar (Date of Access: 01.06.2017)

Brown, R., Keath,N., & Wong,T. (2008). Transitioning to Water Sensitive Cities:Historical, Current and Future Transition States. *Proceedings of the 11th International Conference on Urban Drainage,* 2008, Edinburgh, Scotland, UK. https://collaboration.worldbank.org/content/usergenerated/asi/cloud/attachments/sites/collaboration-for-development/en/groups/tdlc-technical-deep-dive/groups/iuwm-south-south-knowledge-exchange/documents/_jcr_content/content/primary/blog/general_iuwm-WqPt/7.%20Transitioning%20to%20Water%20Sensitive%20Cities%20(Rebekah%20Brown,%20Nina%20Keath%20and%20Tony%20Wong,%202008).pdf (Date of Access: 14.04.2025).

Choi, C. (2024). Why turning cities into 'sponges' could help fight flooding? *CNN Style.* https://edition.cnn.com/2024/08/13/style/china-sponge-cities-kongjian-yu-hnk-intl/index.html (Date of Access: 11.04.2025).

Cooperative Research Centre for WaterSensitive Cities. (2021). *Case Studies*. https://watersensitivecities.org.au/solutions/case-studies/ (Date of Access: 10.04.2025).

Çatalca Municipality. (2014). *1/1,000 Akalan Implementation Plan Report*. Çatalca Municipality. Istanbul.

Decision of the President of the Republic of Türkiye No.157, Official Gazette no: 32384 on 29.11.2023. (2023). https://www.resmigazete.gov.tr/eskiler/2023/11/20231129-17.pdf (Date of Access: 04.04.2024).

Decision of the President of the Republic of Türkiye No. 8650, Official Gazette no: 32566 on 28.06.2024. (2024). https://www.resmigazete.gov.tr/eskiler/2024/06/20240628-2.pdf (Date of Access: 04.07.2024).

Decision of the President of the Republic of Türkiye No. 9419, Official Gazette no: 32785 on 17.01.2025. (2025). https://www.resmigazete.gov.tr/eskiler/2025/01/20250117-10.pdf (Date of Access: 04.04.2025).

Decree No. 644 on the Organization and Duties of the Ministry of Environment and Urbanization, Official Gazette on 04.07.2011. (2011). http://www.resmigazete.gov.tr/eskiler/2011/07/20110704M1-1.htm (Date of Access: 04.07.2020).

Delforge, D., Below, R., Speybroeck, N., & Van Loenhout., J. A. F. (2024). Disaster year in review 2023. *EM-DAT_The CRED/UCLouvain International Disaster Database*, Issue 74. https://files.emdat.be/2024/04/CredCrunch74.pdf (Date of Access: 19.06.2024).

Demir, A. (2013). İstanbul'da yaşanan taşkınlar ve taşkın önleme çalışmaları. *3. Ulusal Taşkın Sempozyumu* (29-30 Nisan 2013). http://www.dsi.gov.tr/faaliyetler/sempozyum-ve-sergiler/3-ulusal-taskin-sempozyumusunulari (Date of Access: 07.07.2016).

Dinç, H., & Bölen, F. (2014). İstanbul derelerinin fiziki yapısı. *Journal of Planning*, *24*(2), (pp.107–120). https://doi.org/10.5505/planlama.2014.97269 (Date of Access: 04.07.2020).

Dinçer, İ., Enlil, Z., & Evren, Y. (2009). İstanbul'un koruma alanlarının değerlendirilmesi. *Megaron*, *4*(1), (pp. 5–15). https://megaronjournal.com/jvi.aspx?pdir=megaron&plng=eng&un=MEGARON-42275&look4= (Date of Access: 19.06.2024).

Drainage Services Department of Hong Kong. (2017). *Sustainability Report 2016_2017*. https://www.dsd.gov.hk/Documents/SustainabilityReports/1617/en/director_statement.html (Date of Access: 10.04.2025).

EPA-United States Environmental Protection Agency. (2024). *Watershed-Based Plans in New England. What is a Watershed?* https://www.epa.gov/tmdl/watershed-based-plans-new-england (Date of Access: 01.045.2025).

EU Directive 2000/06/EC, Directive 2000/60/EC of the European Parliament and of the Council of 23 October 2000. (2000). *Official Journal of the Communities on 22.12.2000*. https://eur-lex.europa.eu/resource (Date of Access: 01.05.2020).

EU Directive 2007/60/EC, Directive 2007/60/EC of the European Parliament and of the Council of 23 October 2007 on the assessment and management of flood risks (text with EEA relevance). (2007). *Official Journal of the European Union.* https://eur-lex.europa.eu/eli/dir/2007/60/oj/eng (Date of Access: 01.05.2020).

European Commission. (2011). *Green infrastructure.* https://environment.ec.europa.eu/topics/nature-and-biodiversity/green-infrastructure_en (Date of Access: 01.11.2024).

EU-European Union-Water. (n.d). *Water Framework Directive.* Directorate-General for Environment. https://environment.ec.europa.eu/topics/water/water-framework-directive_en (Date of Access: 01.06. 2024)

EU-European Union (2024). *Water Sensitive City. Ex-ante assessment of the "Water Sensitive City" thematic area under the Urban Agenda for the EU. Final Report.* https://www.urbanagenda.urban-initiative.eu/sites/default/files/2024-08/EAA_Water%20Sensitive%20City_FINAL.pdf (Date of Access: 14.04.2025).

Google Earth Maps. (n.d._a). [Istanbul Aerial Photograph]. https://earth.google.com/web/search/istanbul/@41.21134426,28.77253132,107.62993. (Date of Access: 01.07. 2024)

Google Earth Maps. (n.d._b) [Akalan settlement]. https://earth.google.com/web/search/Akalan,+%c3%87atalca%2f%c4%b0stanbul/@41.25566998,28.41522081,155.39043459a,3800.30636425d,35y,0h,0t,0r/data=CigiJgokCfQKmGEOm0RAEYIzsmYMm0RAGQiZqzLJxTxAIVde4BDAxTxA (Date of Access: 01.07. 2024)

Google Earth Maps. (n.d._c) [The Satellite image (3D)]. https://earth.google.com/web/search/g%c3%b6ksu+deresi/@41.0753107,29.07787756,2.32447224a,3195.40958848d,35y,77.06652078h,59.96723495t,-0r/data=CigiJgokCWp34UkpokRAEfTH9htKn0RAGb7eVqnscDxAIWREGCmrYzxA (Date of Access: 01.07. 2024)

GWP_Global Water Partnership. (n.d). *Dublin_Rio Principles.* https://www.gwp.org/contentassets/05190d0c938f47d1b254d6606ec6bb04/dublin-rio- principles.pdf (Date of Access: 01.06. 2024)

Hoyer, J. D, Dickhaut, W., Kronawitter, L., Weber, B. (2011). *Water Sensitive Urban Design-Principles and Inspiration for Sustainable Stormwater Management in the City of the Future.* Projectreport.018530-SWITCH Sustainable Water Management in the City of the Future- Integrated Project Global Change and Ecosystems. https://www.hcu_hamburg.de/fileadmin/documents/Research/Forschungsgruppen/REAP/WD_Publikationen /Hoyer_Dickhaut_Kronawitter_Weber_Manual_WSUD_2011.pdf (Date of Access: 04.06.2024)

IMM-Istanbul Metropolitan Municipality. (2009). *Anadolu Yakası Mikrobölgeleme Rapor ve Haritalarının Yapılması İşi.* Earthquake and Ground Investigation Department. https://depremzemin.ibb.istanbul/calismalarimiz/tamamlanmis_calismalar/istanbul_ili_mikrobolgeleme_projeleri/ (Date of Access: 04.07.2020).

IMM-Istanbul Metropolitan Municipality. (2009a). *1/100,000 scale Istanbul Environmental Plan Revision*. Urban Planning Department. https://sehirplanlama.ibb.istanbul/ust-olcekli-planlar/ (Date of Access: 04.07.2024).

IMM-Istanbul Metropolitan Municipality. (2009b). *Istanbul European Side (Silivri-Selimpasa-Çatalca-K.Çekmece-Kilyos) September 2009 Flood Disaster Investigation Report.* Earthquake Risk Management and Urban Renovation Directorate, Earthquake and Ground Investigation Department. https://depremzemin.ibb.istanbul/wp-content/uploads/2020/04/Sel-Felaketi-Rapor.pdf (Date of Access: 06.06.2024).

IMM-Istanbul Metropolitan Municipality. (2010). *1/5,000 Çatalca Urban Center and Environment Revision Plan Report.* Urban Planning Department. Istanbul.

IMM-Istanbul Metropolitan Municipality. (n.d). *Land use in Çatalca*. Urban Planning Department. https://sehirplanlama.ibb.istanbul/catalca-ilcesi/ (Date of Access: 10.06.2024).

IMM-Istanbul Metropolitan Municipality. (n.d.-a). *Land use in Beykoz*. Urban Planning Department. https://sehirplanlama.ibb.istanbul/beykoz-ilcesi/ (Date of Access: 10.06.2024).

IMM-Istanbul Metropolitan Municipality. (2017). *1/25, 000 Scale Geological Survey Report for Land use.* Earthquake Risk Management and Urban Renovation Directorate, Earthquake and Ground Investigation Department. https://depremzemin.ibb.istanbul/wp-content/uploads/2020/04/iSTANBUL-iLi-1-25000-oLcEKLi-ARAZi-KULLANIMINA-ESAS-JEOLOJiK-ETuD-RAPORU.pdf (Date of Access: 20.06.2024).

Independent Newspaper. (2021). İstanbul'un arsa değeri yüzde 149 arttı: İşte en değerli ilçeler. https://www.indyturk.com/node/372306/ekonomi%CC%87/i%CC%87stanbulun-arsa-de%C4%9Feriy%C3%BCzde-149-artt%C4%B1-i%CC%87%C5%9Fte-en-de%C4%9Ferli-il%C3%A7eler (Date of Access: 15.05.2024).

ISKI- Istanbul Water and Sewerage Administration General Directorate (2011), Drinking Water Basins Regulation, https://www.iski.gov.tr/web/assets/SayfalarDocs/Mevzuat%20ve%20Y%C3%B6netmelikler/ISKI-ICMESUYU-HAVZALARI-YONETMELIGI-29092017.pdf (Date of Access: 10.08.24)

ISKI-Istanbul Water and Sewerage Administration. (2024). *Streams and Flood Areas.* Digital Data. Unpublished.

Istanbul Governorship of the Republic of Türkiye. (n.d). *Istanbul Provincial Disaster Risk Reduction Plan Report.* Provincial Disaster and Emergency Directorate. https://istanbul.afad.gov.tr/kurumlar/istanbul.afad/PDF-Dosyalar/irap_istanbul.pdf (Date of Access: 04.07.2020).

Kadıoğlu, M. (2012). Climate Change Risk Management in Türkiye. *Paper for the Project of Preparation of 2nd National Declaration on Climate Change of Türkiye* (ISBN:978_605_52912_0). https://www.researchgate.net/profile/Mikdat_Kadioglu/publication/258108645_Turkiye%27de_Iklim_Degisikligi_Risk_Yonetimi/links/02e7e526fa28021a95000000/Tuerkiyede-Iklim-Degisikligi-Risk-Yoenetimi.pdf (Date of Access: 17.06.2024).

Law No. 4373 on the Protection Against Flood and Inundation (1943). Official Gazette of the Republic of Türkiye. No:5310 on 14.01.1943. Retrieved from http://www.mevzuat.gov.tr/MevzuatMetin/1.3.4373.pdf (Date of Access: 17.06.2024).

Law No. 2560 for Istanbul Water and Sewerage Administration General Directorate Establishment and Duties, Official Gazette no:17523 on 23.11.1981. (1981). https://www.mevzuat.gov.tr/mevzuat?MevzuatNo=2560&MevzuatTur=1&MevzuatTertip=5 (Date of Access: 17.06.2024).

Law No. 2960 for Bosphorus. Official Gazette no:18229 on 18.11.1983. (1983). https://mevzuat.gov.tr/mevzuat?MevzuatNo=2960&MevzuatTur=1&MevzuatTertip=5 (Date of Access: 17.06.2024).

Law No. 5216 on Metropolitan Municipality. Official Gazette no:18229 on 18.11.1983. (2004). http://www.mevzuat.gov.tr/MevzuatMe tin/1.5.5216.pdf (Date of Access: 17.06.2024).

Law No. 6200 on Organization and Duties of the General Directorate of State Hydraulic Works (1953). Official Gazette no:8592 on 25.12.1953. http://www.mevzuat.gov.tr/MevzuatMetin/1.3.6200.pdf (Date of Access: 05.01.2024).

Law No. 6306 on Transformation of Areas at Risk of Natural Disaster (2012). Official Gazette no:28309 on16.05.2012. http://www.mevzuat.gov.tr/MevzuatMetin /1.5.6306.pdf (Date of Access: 05.01.2024).

Law No. 6360 on the Establishment of Metropolitan Municipalities and Twenty-seven Districts in Fourteen Provinces and Amendments to Certain Laws and Decree Laws, Official Gazette no:28489 on 12.11.2012.(2012). https://www.mevzuat.gov.tr/mevzuat?MevzuatNo=6360&MevzuatTur=1&MevzuatTertip=5 (Date of Access: 05.05.2024).

Milliyet Newspaper. (2013). Bu kış da efkarlıyız. https://www.milliyet.com.tr/gundem/bu-kis-da-efk-rliyiz-1770330 (Date of Access: 01.06.2024).

Özhan, S. (2004). *Havza Amenajmanı.* İstanbul Üniversitesi Rektörlük Yayını, No: 4510, Or. Fak. Yay. No:481.

Prime Ministry Circular No. 2010/5 on Rehabilitation of Streams and Creek Beds, Official Gazette no: 28444 on 17.10.2012. (2012). http://www.resmigazete.gov.tr/eskiler/2010/02/20100220-17.htm (Date of Access: 04.07.2024).

Republic of Türkiye Ministry of Agriculture and Forestry. (2019, March 20). Büyükçekmece Basin Protection Plans. https://www.tarimorman.gov.tr/SYGM/Belgeler/%C4%B0%C3%87ME%20SUYU%20KORUMA%20PLANLARI%2028.12.2022/B%C3%BCy%C3%BCk%C3%A7ekmece%20Baraj%20G%C3%B6l%C3%BC%20%C3%96zel%20H%C3%BCk%C3%BCmleri.pdf (Date of Access: 01.07.2024).

Republic of Türkiye Ministry of Agriculture and Forestry. (2019). *National Water Plan.* https://www.tarimorman.gov.tr/SYGM/Belgeler/NHYP%20DEN%C4%B0Z/ULUSAL%20SU%20PLANI.pdf (Date of Access: 07.08.2024).

Republic of Turkiye Ministry of Agriculture and Foresty. (n.d.). Flood issues in the basin. *In Technical Assistance to Prepare Flood Risk Management Plan for Meriç-Ergene River Basin (TR2018 ESOP MI A1.17/SER/28) Project*. https://floodmerg.tarimorman.gov.tr/en/flood-issues-in-the-basin (Date of Access: 04.04.2024).

Republic of Türkiye Ministry of Environment, Urbanization and Climate Change. (2023). *Meteorological Characteristic Disaster Evaluation Report for 2022.* General Directorate of Meteorology. https://www.mgm.gov.tr/FILES/genel/raporlar/2022afet.pdf (Date of Access: 04.07.2020).

Republic of Türkiye Ministry of Agriculture and Forestry. (2024). *Marmara Waterbasin Flood Management Plan.* Ankara.https://www.tarimorman.gov.tr/SYGM/Belgeler/Ta%C5%9Fk%C4%B1n%20Y%C3%B6netim%20Planlar%C4%B1%2026.12.2022/MARMARA%20HAVZASI%20TASKIN%20YONETIM%20PLANI.pdf (Date of Access: 10.04.2025).

The Regulation on Protection of Water Basins and Preparation of Management Plans (2012), Official Gazette no:28444 on 17.09.2012. http://www.resmigazete.gov.tr/eskiler/2012/10/20121017-2.htm (Date of Access: 05.05.2024).

The Regulation Spatial Plans Construction (2014), Official Gazette no:29030 on 14.06.2014. (2014). http://www.resmigazete.gov.tr/eskiler/2014/06/20140614-2.htm (Date of Access: 05.05.2024).

The Regulation on the Preparation, Implementation and Monitoring of Flood Management Plans (2016), Official Gazette no: 29710 on 12.05.2016. (2016). https://www.resmigazete.gov.tr/eskiler/2016/05/20160512-6.htm (Date of Access: 05.05.2024).

The Regulation on Stormwater Collection, Storage and Discharge Systems (2017) , Official Gazette no:30105 on on 23.06.2017. https://www.resmigazete.gov.tr/eskiler/2017/06/20170623-8.htm. Date of Access: 16.04.2024).

The Regulation on Planned Areas Zoning (2017), Official Gazette no: 30113 on 03.04.2017. https://www.mevzuat.gov.tr/mevzuat?MevzuatNo=23722&MevzuatTur=7&MevzuatTertip =5 (Date of Access: 06.07.2024)

The Regulation on the Protection of Drinking and Potable Water Basins (2017), Official Gazette no:30224 on 28.10.2017. (2017). https://www.mevzuat.gov.tr/mevzuat?MevzuatNo=24036&MevzuatTur=7&MevzuatTertip=5 (Date of Access: 01.06.2024).

The Regulation on the Basin Management Central Board, Basin Management Committees and Provincial Water Management Communiqué on the Establishment, Duties, Working Procedures and Principles of the Coordination Boards, and Basin and Provincial Level (2019), Official Gazette no:30659 on 18.01.2019. https://istanbul.tarimorman.gov.tr/Belgeler/SolMenu/RESMI%20GAZETE2019-2019/TEBLIGLER/HavzaYonetimiTebligi2019.pdf (Date of Access: 01.05.2024).

TUIK-Turkish Statistical Institute. (2024). *Adress-Based Population Registration System Results.* https://data.tuik.gov.tr/Bulten/Index?p=Adrese-Dayali-Nufus-Kayit-Sistemi-Sonuclari-2024-53783 (Date of Access: 04.04.2025).

Turoğlu, H. (2011). İstanbul'da meydana gelen sel ve taşkınlar. *Fiziki coğrafya araştırmaları; sistematik ve bölgesel*, (pp. 411–430). Babil Basım. https://avesis.istanbul.edu.tr/yayin/69c8eec2-3fc3-4727-8da5-352728868778/istanbulda-meydana-gelen-sel-ve-taskinlar (Date of Access: 01.04.2019).

UN-Habitat (2017). *New Urban Agenda. HABITAT III- United Nations Conference on Housing and Sustainable Urban Development Report.* https://habitat3.org/wp-content/uploads/NUA- English.pdf (Date of Access: 10.06. 2024)

UN-United Nations Water. (n.d.). *UN Water and Climate Change.* https://www.unwater.org/water-facts/water-and-climate-change (Date of Access: 01.06.2024).

UNDDR-United Nations Office for Disaster Risk Reduction. (n.d.). *MCR 2030 Making Cities Resilience*. https://mcr2030.undrr.org/join (Date of Access: 01.07.2024).

UNDDR-United Nations Office for Disaster Risk Reduction. (n.d.-a). *Implementing the Sendai Framework.* https://www.undrr.org/implementing-sendai-framework/what-sendai-framework#priorities (Date of Access: 10.04.2025).

UNESCO-United Nations Educational, Scientific and Cultural Organization. (2020). *The United Nations World Water Development Report 2020: Water and Climate Change.* In United Nations Educational, Scientific and Cultural Organization Digital Library. https://unesdoc.unesco.org/ark:/48223/pf0000372985.locale=en (Date of Access: 02.07.2024).

WMO-World Meteorological Organization (2021). *Atlas of Mortality and Economic Losses from Weather, Climate and Water Extremes (1970_2019) WMO_No. 1267.* (No. 978_92_63_11267_5). https://library.wmo.int/viewer/57564/download?file=1267_Atlas_of_Mortality_en.pdf&type=pdf&navigator=1 (Date of Access: 01.06.2024).

Resume

Hale Mamunlu Kocabaş received her BSc (1998), MSc (2001), and PhD (2009) degrees from Mimar Sinan Fine Arts University (MSFAU), Faculty of Architecture and Department of Urban and Regional Planning. She studied at ETH Zurich-Swiss Federal Institute of Technology Zurich, Department of Civil, Environment and Geomatic Engineering, in 2002-2003 (with Swiss Government Excellence Scholarships). She conducted her research studies under Prof. Dr. Willy Schmid's supervision for her dissertation and attended educational programmes at ETHZ, Institute for Spatial and Landscape Development, during her stay between 2003-2004. She was a member of the Turkish National Delegation of ISOCARP- International Society of City and Regional Planners-from 2006-2009. She has been working as a lecturer at Mimar Sinan Fine Arts University (MSFAU), *Faculty of Architecture and Department of Urban and Regional Planning since 2000. Between 2000 and 2010, she worked as a Research Assistant at MSFAU, and since 2010 she has been working as an Assistant Professor. She currently gives courses at the undergraduate and graduate level at MSFAU. Her main fields of interest and research are: ecological planning, environmental management, water basin planning and management, flood risk management, and rural planning. As Representative of MSFAU of UN SDSN-Sustainable Development Solutions Network Türkiye and Water Efficiency Coordinator since 2023, and Sustainable Green Campus Coordinator since 2024 at Mimar Sinan Fine Arts University, she has been working to raise awareness by providing various trainings, organizing events and workshops on environmental sustainability issues.*