



City of Skopje

2019



Local Adaptation Strategy Plan of the City of Skopje: Resilience Climate Change Adaptation Plan



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Rade Rajkovchevski and Zoran Dorevski

Authors: Rade Rajkovchevski and Zoran Dorevski

Translation and Proofreading:

Design and Computer Processing: Zoran Dorevski

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Preface

The City of Skopje, as leader in organization of the local self-government in Republic of Macedonia is striving for adoption of high standards for disaster risk reduction and management, by introduction of standards and implementation of the international regulation related to urban resilience. The Local Adaptation Strategic Plan determines the decisiveness of the city for quality improvement of the citizens' life regarding the environmental safety and protection.

The plan covers directions and measures aimed at heads of the city sectors considered, practitioners of the city administration, local and central bodies, civic sector and international organisations. The mentioned target groups are expected to understand all the critical aspects deriving from the urban resilience and climate change management and challenges that might in future threaten the safety and security of the citizens. The plan is designed to give consistent response and to serve as guidebook in all the natural disasters and dangers risk management occurred as a result of human factor and climate change.

The adoption of this document should cover the period until establishment of formal urban resilience strategy, taking into account the international trends, the public policies, the dynamic for adoption of the strategic documents and their application. The plan should be document complementary to the strategic documents related to the urban resilience of the City of Skopje.

The draft version of the plan has been prepared by the the members of the Urban Resilience Strategic Team of the City of Skopje, formed for the purpose of EPICURO Project. The opinions, suggestions and notes by the project task coordinator as well as by other partner cities and organisations involved in the project have been taken into account.

The designing and implementation of the plan should provide opportunities for learning and increasing of the skills and expertise of the internal and external experts of the city, regarding the issues of environment, energy efficiency, waste management, disaster (risk) management and sustainable mobility. The idea for developing of the plan was to strengthen the intersectoral cooperation within the City of Skopje, to use the benefits from the international partnerships for introduction of innovations (initiatives and technologies) and to change the way of thinking and awareness for disaster risk management and climate change adaptation.

The plan contents present the conditions and gives recommendations for increasing of the urban resilience, through measures for traditional and contemporary risk management. For that purpose, several project activities are of special importance as they mean sharing knowledge and best practices, results from the local and international training and activities for international support.

EPICURO Project and the plan as the most significant result from the project are focused on internationalization of the efforts of the city governments and administration for building partnership with different types of local, international, state and non-state entities, bodies and



institutions. In case of EPICURO Project, those are possibilities deriving from the European Civil Protection Mechanism. The plan is not exclusive by itself, as it is product of the continuous activities of the city governments in disaster risk management, mostly related to the references the city has from its partnership with different initiatives and projects of EU, European Council and United Nations Organisation (UN) regarding reduction of disaster risks, climate change adaptation and local development.

The City of Skopje has aligned the Pact of Mayors in May 2010, at the Sustainable Energy Convention in Europe held in Brussels, and has obliged itself to: reduce the emission of CO² in the atmosphere; create and strengthen the dynamic of reduction of CO² at the area of the city and to be example for the other municipalities in the Republic of Macedonia regarding the importance of the sustainable energy as well as promotion of new sustainable energy types (City of Skopje, 17 May 2010).

In 2011 the Council of the City has adopted Action Plan for Sustainable Energy Development and made efforts to implementation of measures and activities for CO² reduction for more than 20% for the period 2008-2020. For the purpose of achieving the goal of 20% the Council has adopted Waste Management Plan 2010-2015, Local Environmental Action Plan 2, Sustainable Urban Mobility Plan and Study for determination of the potentials and possibilities for use of renewable energy sources (Bin2Grid, 2016).

AHELOUS Project (2014-2015, as first project in Republic of Macedonia funded by the Financial Instrument of the Europeans Civil Protection Mechanism), EPICURO (2016-2018, funded by the Program Europe for Citizens: Network of Towns'), the Urban Resilience Strategy – Resilient Skopje (reference document in preparation of the plan, developed through the UN Development Program – UNDP), the ongoing project activities of UNDP and the city that refer to mapping and urban heat island management and other project from the program Horizon 2020, left and still leave strong influence in the references of the city related to the urban resilience. In December 2018, the City of Skopje prepared a document entitled "Urban Heat islands - Analysis and Action Plan", which includes measures that refer to specific locations that incorporate experiences and measures resulting from the sharing of knowledge within the EPICURO project. The city for the implementation of these measures in the 2019 budget envisages financial resources in the amount of 5 million denars (81.300 EUR), a trend that should be maintained in the coming years.

The adaptation to which the plan refers covers the most vulnerable sectors. In most part it refers to the reduction of disaster risks, in smaller part in the sectors of wood industry and water resources, and at least to the cultural heritage protection, health, biological diversity, tourism and agriculture. Therefore, the measures and recommendations from the plan act together with the approach consisted in the Third Plan for Climate Change, in the part that refers to disaster and climate change risk reduction, published by the Ministry of Environment and Spatial Planning (2014). The scope of the vulnerability is limited to biophysical (natural) vulnerability, less to socio-economic vulnerability and partially it covers the four factors of vulnerability defined by UN in 2004 and the vulnerability indicators (Zdraveva, 2014: 12, 16). In



addition, the biophysical vulnerability is conditioned by the characteristics of the natural environment, while the socio-economic vulnerability of the population depends on the economic resources and living conditions, the institutional structure, competence relations, institutions and cultural aspects.



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Introduction

As long as disasters follow the growth of civilisation, the humanity adapts to the risks that the humanity and nature cause together. In 2017, 46 natural disasters and disasters caused by man have been registered in Europe (Khan et al, 2008) that resulted in 536 victims (4.7% of the victims throughout the world)... In 2017, the economic losses from disasters in Europe were 23.7 thousand million USD, 12 thousand million US of which were compensated by the insurance industry (Swiss Re, 2018: 6, 14). In 2016, the total number of people that declared damage from disasters (93.192) is equal to only 14% of the annual average for the period 2006-2015... Among the people hit by floods, 14.481 citizens of East Europe are equal to only 6.9% of the annual average from 2006, while the number of 47.253 people in South Europe is 33.5% of the annual average, and 24 declared in West Europe resulted with small stake (of 1.2%) of the annual average. The same equivalent of 1.2% of the annual average is for 1161 people hit from wood fires in south Europe. Opposite to this, 30.273 people hit by earthquakes in the same region in 2016 are 1.48 times more than the annual average (Guha-Sapir, Hoyois, Wallemacq and Below, 2017: 5).

In 2014, the floods caused damages and losses in an amount of 2 thousand million EUR in Bosnia and Hercegovina (almost 15% of gross-domestic product (GDP) of the country) and damages and losses of over 1.5 thousand million EUR in Serbia (almost 5% of GDP). In 2017, the highest registered temperatures influenced the transport, caused ten fires via Balkan and caused drought in Serbia, thus led to fall of the agricultural production of almost 10% and forced Albania to spend 200 million UR for energy import (Gelder, 2018).

The social challenges and the climate change are more and more in the focus of the society, complementary to the traditional treats caused by natural disasters (flood, earthquake, land sliding etc.) and treats from accidents and disasters caused by man, such as terrorism, urban and wood fires, sea pollution, technological disasters, crimes, violence and other forms. The fast growth of the populations living in urban area requires more investment in measures that will make the cities more resilient to dangers and disasters in future. According to the data from the Unit for population within the United Nations Department of Economic and Social Affairs (UN), 55% of the world population lives in urban area (UN, 2018). Up to 2050, this percentage is expected to increase at 68% so it is expected that the needs consumption of food, water and energy resources will become more expressed in future and will be more frequent reasons for future crises.

From the mid of nineties of the last century, by introduction of the concept of human safety, the focus on the safety has been redirected from the state to the citizens. From seven elements of human safety, the environmental safety, as well as personal safety and community safety appear as essential in building approach for urban resilience and climate change management.

The number and intensity of the bodies, forms and initiatives within the frames of UN and the European Commission, show that there is high level of awareness for the seriousness of the



effects that may be caused by the climate changes. In the last two decades both organisations made significant progress in the terminology (UNISDR, 2009; UN General Assembly, 2016), building partnerships and structural mechanisms for cooperation among the science, private sector, practitioners and policy creators in the reduction and disaster risk management.

The urban resilience is defined as: Capacity of the system, community or society exposed to dangers to oppose, absorb, adapt and recover from the effects of the danger in time and efficiently, including the protection and return of the necessary basic structures and functions through risk management (UN General Assembly, 2016).

The resilience is defined as 'capacity for envisaging, preparation, reaction and recovery from the effects of the dangers with minimum damage towards the social welfare, economy and environment' (EPA, 2018), as 'capacity of the community, its members and systems enabling their normal activities to adapt to the ways that maintain functional relations in conditions of significant disorders' (Paton, 2007) and as 'capacity of the countries, communities and households to manage the changes, through maintenance or transformation of the living standard in conditions of serious disorders without endangering their long-term perspectives' (DFID, 2011: 6).

Because the resilience and adaptation are closely connected, some solutions and suggested measures are combination of both approaches. The resilience refers to almost all aspects of human life, quality of life and achievement of economic and social development and cohesion. Even though the definition and concept are simple, still the resilience is complex and it is considered as equal for all types of cities, no matter of their size. The small and medium size cities have difficulties to provide resources, optimal financial autonomy (recognized as very important while planning of the scope and implementation of the urban resilience measures), the time required for achievement of the goal from the implemented measures and so called „know how“. The medium size cities must make balance among the factors for success taken from different initiatives for resilience and autochthonous (local) characteristics of the city. It is something that most often influences the resilience of the suggested solution and is often connected to the meaning of the English neologism 'local ownership'. The Province Potenza – project partner, in the last 15 years shows that it works on achievement of one hard goal (always the result is partial, always is trying to achieve the end goal), but the fact that their governments are not devoted shows that there is no other alternative.

The key is to understand the meaning of risk management - defined as: Potential loss of life, wound or ruined or damaged means that may appear in system, society or community in certain time period, determined as probability of the functional dependence between the danger, exposure, vulnerability and capacity (UN General Assembly, 2016).

but as well the meaning and singularity of each of the noted four elements determining the disaster risk in special local context.



UN through UNISDR (The Secretary of the International Strategy for Disaster Reduction, formed in 1999) facilitates the implementation of the disaster risks, while the efforts of UNDP for disaster risk reduction are aimed at national and subnational policy, legal and institutional support, in all phases of disaster management and in accordance with the Framework from Sendai for disaster risk reduction and the aims for sustainable development (UNDP, 2018). Moreover, in the last decade two key initiatives are noticeable and influent based on the concept of resilient cities, where apart from UNIDR as main driver appears Rockefeller Foundation as well (100 Resilient Cities). In the frames of the project consortium, the Province Potenza (Italy) is member of UNISDR initiative, while Municipality of Vejle (Denmark) is member of the Rockefeller Foundation initiative. In that way the City of Skopje had possibility to exchange experiences with two very relevant partners in the field of urban resilience. The goal of the approach of UNISDR is to help the cities to establish basic measurement at current level of resilience, to identify the investment priorities and to follow their progress in increasing of their disaster resilience by time. It means accomplishment of 85 criteria for disaster resilience that refer to the following areas research, organisation, and infrastructure, capacity of response, recovery and environment.

At EU level, the Civil Protection mechanism (established 2001) serves for encouraging the cooperation among the European national bodies for civil protection, while in 2015 the Disaster Risk Management Learning Centre was opened for the purpose of helping the improvement of the disaster resilience of EU and Member States, and their capacities for prevention, preparedness and response in emergency situations as forced platform for cooperation among all relevant subjects.

The City of Skopje, as partner in EPICURO Project (2017-2019), funded by the Financial Instrument of the European Civil Protection Mechanism, obtained possibility to maintain continuity in implementation of the urban resilience strategies and to introduce new trends deriving from European practices.

The role and the contribution of the City of Skopje in the project takes into account the characteristics related to its history, development, demography, urban planning, and socio-political, natural and unnatural disasters.

In Republic of Macedonia, the main natural disasters (Zdraveva, 2014: 15) are:

1. extreme climate conditions in summer: high temperatures, dry and reduced water availability;
2. Extreme climate conditions in winter (low temperatures, ice, snow etc.);
3. fires at open and wood fires with high intensity;
4. heavy rains and hail, causing floods, land sliding and damages on the infrastructure and agriculture;
5. earthquakes with serious consequences;
6. land sliding, erosion and tectonic disorders



Regarding the dangers characteristic for Republic of Macedonia, the Strategic Team of the City of Skopje has identified five characteristics for the City of Skopje – floods, urban heat islands, urban fires, earthquakes and air pollution. After consulting with the task coordinator, the first three were selected due to their connection with the climate change. The selected dangers are explained as historic-graphic and proven analyses contained in the national and local strategic documents (first of all in the Assessment). The threat from floods exists because of the high levels of underground waters and insufficient capacity and the condition of the infrastructure to receive atmospheric waters and drifts deriving from heavy rains. Land sliding, characteristic for the surrounding mountain regions is result of long-term erosion, improper urban planning and absence of proper application of so called green policies. The last two factors increased the possibilities of heat waves and islands in summer period.



1. Conditions and approach of the city governments in risk management and disaster danger management

The issues related to reduction and disaster risk management are legally superposed obligations and are part of the responsibilities of the city governments. The approach of the city policy creators towards reduction of the disaster risk and management covers adoption of measures, defining of strategies and legal establishment. If taken into account the fact that in this area there are seventy legal acts, then the conclusion is that there is a real challenge for defining and division of the competences between different local and central subjects, and the issues regarding coordination and implementation of the urban resilience measures become complex. Apart from the deficit in understanding of the urban resilience, there are many terminological and operative understatements between the disaster management and disaster risk management.

Having regard that it is about the project that requires multisectorial cooperation, with expressed role of the departments for protection and rescue, environment and urban planning, the approach of the city regarding the urban resilience is mainly determined by several key strategic documents of the city administrations that refer to defining of the risks and danger as well as manner of action during danger and disaster management.

The biggest part of the risks, measures and activities are or should be part of the Assessment of vulnerability of the City of Skopje from natural disasters and other disasters (2008) and the Plan for Protection and Rescue of the City of Skopje from natural disasters and other disasters (2010). Having regard that it is about multidisciplinary in the approach in drafting of the plan, the same takes into account the following documents as reference strategic documents: The third plan for Climate Change from 2014 (2014), Report including recommendation for the City of Skopje derived from AHELOUS¹ Project and from the implementation of the exercise "VARDAR 2015" for flood management in urban zone a the territory of the city, Climate Change Strategy 'Resilient Skopje' drafted in cooperation with UNDP (2017) and the materials published on the website of the Department for Environment of the City of Skopje (City of Skopje, 2018). 'The Analysis of good practices' (EUC, 2018) – document drafted within the project activities by the partner from Cyprus is of great support in identification of the good

¹ AHELOUS Project (ref. ECHO/SUB/2013/661051) was funded by the Financial Instrument of the European Civil Protection Mechanism of the European Commission in duration from 1.1.2014 to 31.12.2015, and the City of Skopje was partner together with eight partners from six countries (Italy, Croatia, Romania, Hungary, Bulgaria and Greece).



practices and measures for improvement of the urban resilience. The document provides good insight in the good practices in the filed referring to the urban resilience.

It is necessary to seriously update and upgrade the assessment. The assessment drafted by the Regional Centre for Crisis Management does not contain all the provisions and key points in the assessment of the City of Skopje. The contents of the assessment in great measure influence to the local plans form disaster and climate change management.

The plan is legal obligations deriving from several laws related to the risks, dangers and disasters, as follow: Law on Protection and Rescue (Official Gazette of Republic of Macedonia, No36/2004), Law on Crisis Management (Official Gazette of Republic of Macedonia, 29/2005) and other. The plan is too general and does not correspond to the local and current circumstances that happen in the last 10-15 years in the City of Skopje and the entire Skopje Region. Apart from that, due to the interdependence of the dangers at regional and European level, the introduction of proper standards and procedures being already implemented and recommended by the bodies of EU and UN in the local and national legal frame is more than welcomed. It is necessary to divide the action from the logistic part of the plan, due to technical and other objective reasons.

The local governments are involved in the obligations of the state regarding the ratification and harmonisation with the international agreements and standards and have possibilities deriving from the appointing of the National coordinator (who should initiate and strengthen the processes of disaster risk management). The City of Skopje is considered as subject that is relatively well connected to the European and global initiatives in different fields. Based on the impressions acquired from the implementation of EPICURO Project, the opinion prevails that the city has not good strategy for dissemination of the results related to the urban resilience. Moreover, the manner for motivation of the city administration for more active inclusion in the project structure and activities misses.

The recent experiences and the current activities of the city that refer to the urban resilience are performed monosectorial and without real coordination. It essentially influences on the level of implementation and coordination. As conclusion, 'the blind adoption' of the recommendations from projects and initiatives does no result in creation of safer and more resilient communities, because of the absence of the understanding of the topic and political will and vision. More concretely, this conclusion refers to the Sendai Framework (2015-2030).

Several other factors as well complement the view of the city regarding disaster risk management, disaster management and building measures for urban resilience.

1. Inconsistency in implementation of the city policies, conditioned by the absence of defined direction by the city policy creators regarding to urban resilience. Having regard to the fact that UNDP has recently drafted climate change strategy entitled 'Resilient Skopje' (UNDP and the City of Skopje, 2017), the city got an opportunity to have first multidisciplinary reference document as guide-post in risk identification and implementation of the suggested measures for urban resilience increase, based



on several field. According to the first results from the dissemination of this document, there is deficit of understanding (even at national level) about the climate change and their risks towards the populations, cities and environment. Moreover, it is good to mention that several representative of the city administration were part of the development of the strategy, and their knowledge and experience are of priceless value in building future strategies and plan for urban resilience. The city should expand the roster of internal experts and to invest in their language skills and technical equipment of the sectors. This is for now serious barrier for knowledge exchange and for networking with relevant partners.

2. Deficit of volunteering, motivation and mobilization of the citizens in the key areas focused on the civil protection and danger and disaster management. As the city in 1980 in former Yugoslavia experienced concept management 'All in protection, all in defence' (for the purpose of civil protection and emergency case management), nowadays the city is in a condition where it is hard to indirectly or directly may build volunteering spirit among the citizens. The Law on Protection and Rescue is unsuccessful try for reestablishment of the concept 'All in protection, all in defence', but in different context (timely, political, socio-economic and similar).
3. Safety culture and self-awareness of the local population regarding disaster danger. Activities for bigger inclusion of the citizens in disaster risk reduction and their mobilisation in cases of disasters are of special importance. In Skopje Region with land where there was a marsh before and /or at places located under the level of River Vardar, flooding of the urban zone appears very often, but most often because of absence of self-awareness of the population (that regularly throws waste and organic garbage in the sewage channels which causes damage later), because of the unsteady penalty policy of the inspectional service and because of a series of other objective reasons that in major part are result of the weak coordination between the municipalities and the City of Skopje and between the central and local governments.



2. Review on the risks, dangers, challenges and possibilities related to the urban resilience

Skopje, as capital city of Republic of Macedonia covers an area of 1818 km² (225m² of which are urban city area), spreading at 23 km in length and 9km in width (Mining Institute Skopje, 2014: 17). According to the last census (from 2002), there are half million citizens in the City of Skopje and 200.000 in the surrounding 7 municipalities that belong to the Skopje Region. The City of Skopje has dominant position that makes it main socio-political and economic centre in the city. The City has faces with more serious earthquake in 1963 resulting with 1.070 dead people and 4.000 wounded, and 120.000 to 200.00 people left homeless and with 75-80% damage of the buildings (Milevski, 2017: 8-9). After Skopje earthquake in 1963, the city was drastically expanded and in many cases without concrete plan and assessment for the population and spatial planning. The floods from 1962 and 2016 as a result of the heavy rains from over 95 l/m² resulted in more than 20 human victims in both cases, and the flood from 1979 may as well be mentioned as important one.

Moreover, the City of Skopje is subject to vulnerability from social risks, something which is characteristic form medium and bigger cities. According to the data by the Environmental Department of the city, the daily migration in the city is 35.000 vehicles and 100.000 people. This created compact traffic bustle, influence the enormous air pollution (in particular in winter period) with rally unfavourable ecological impact (8.1gha) and dynamic safety problems. The daily migration growth in correlation with the fast growth of the population creates difficulties in controlling of the safety risks in the field of classical, property, violence and non-ethic crime.

2.1 FLOOD DANGERS

According to the geographic position of the city, the statistical data and the natural characteristics of the riverbed, of the river and channel network, the city and its surrounding are continuously exposed to risk from flood (City of Skopje, 2010: 4). The main focus of the assessment and the plan is put on the flood risks from Vardar River and its tributaries i.e. from risk of danger of hydraulic nature as a result of the increasing of the water level of the rivers. The River Vardar which is the longest river in Macedonia passes through many municipalities of the City of Skopje, as well through the central city area. Vardar has 37 tributaries, 15 of which are on its left and 22 on its right side. Several rivers, as well pass through the territory of the City of Skopje and through Skopje Region, presented in their upper courses, and enter in the Vardar River. The length of the River Vardar through Skopje Valley is 55km and riverbed width from 40 to 80m and depth from 1.2 to 2.5m. The average speed of the river is 2m/s and the maximum watercourse is 3.5m/s.



Table 1: Characteristics of the bigger rivers in Skopje Region (National Strategy for Waters (2012-2042), 2012: 11)

River	Water shed area (km ²)	Length (km)	Average flow (m ³ /s)
Vardar	20.661	301	63-145 (a)
Treska	2.068	139	24,2 (b)
Lepenec	770	75	8.7
Pchinja	2.841	137	12,6 (b)

*Explanation: a) 63 in Skopje, 145 in Gevgelija; b) at the entry in the River Vardar; c) in Katlanovska Banja

The City of Skopje is in unfavourable position regarding the treats from big waters. Namely:

1. In the area of the city there is fast increase of the water shed from 1580 km² to 4625 km², thus causing great concentration of the surface waters and creates danger from forming waves from big waters.
2. The medium fall of the river water sheds is very big, which is as well reason for fast concentration of the surface waters.

In case of occurrence of big waters and the present construction of the water resource management protection objects around 8730ha in Q=1200m³/s would be flooded. This area mainly covers agricultural land and part of the city settlements, as well as villages in the flat part (City of Skopje, 2010: 8). Moreover, the riverbed of River Vardar in the central city area is subject to architectural changes in the last several years. It refers to construction works at the riverbed itself and to regulation of the waste waters by establishment of systems for their procession and disposal in the riverbed. Two footbridges were built after 2010 ('The Bridge of Art' and the bridge 'Eye'), but as well in accordance with the statements by the official governments of the city two bridges are planned to be built that will have significant role in the facilitation of the traffic network of the city.

According to the document of the city for risk management (City of Skopje, 2010: 7), there is reduced penetration power of the riverbed from 10 to 16%. The data from 1979 show that the reduced flow of Vardar resulted to increase of the level of the river up to the lower edge of the bridges Goce Delchev and the Stone Bridge, while the water flooded the footbridge neat the fortress Kale. Regarding other bridges, the water came near their lower edge. Seen from present perspective, two relatively new HC/reservoirs near Skopje – Kozjak and Sv. Petka have significant influence on the River Vardar water management and flood risk management. There are several reservoirs and dams in the City of Skopje as follows: HEC Matka and Treska reservoir.



Even though the riverbed of Vardar is partially regulated after the flood in 1962 and the catastrophic earthquake from 1963, and additionally upgraded in 1979, there are still two weak points in the regulation that should be fixed downstream the city. These weak points should be fixed in cooperation with the local municipalities, some of which are part of the City of Skopje. There is partial regulation of the riverbed in length of about 30km, 10 km of which upstream and 20 km downstream from Skopje. In total there are 15 bridges on the River Vardar. Most of them are located in the central part of the City of Skopje and in the area around the village Saraj (City of Skopje, 2010:4-5).

Table 2: Draft-table for collection of statistical data for flood for a given period, developed within EPICURO Project (For example, 2013-2018)

Key performance indicators	Reference/baseline	Tendency/Result	Responsibility
Frequency of the flooded areas			
No. people living in flooded areas			
No. of elderly people			
Emergency evacuation roads			
Accessibility of roads			
No. hydraulic structures			
Real-time monitoring systems			
Sufficient capacity for rainwater sewage			
Sufficient capacity to accept flood water			
Availability of early warning system			
Etc.			

Regarding the conditions for flood risk management it may be concluded that flood prevention measures have been continuously undertaken in Skopje Region, but still the protective system is not completely constructed, so at some places the system is not enough efficient. It follows the need for further development and supplementation of previously drafted intervention plan in case of big waters, for the purpose of protection or mitigation of the damage made by the floods. Moreover, the possibility for floods occurrence as a result of danger by hydro-geological nature has been undervalued i.e. by heavy rains that in extreme sense may result in land sliding. This phenomenon is closely related to the land erosion as a result of the expansion of

the urban zone and wild woodcutting. The appearances of erosions are already noted in the slopes of mountains Vodno and Skopska Crna Gora.

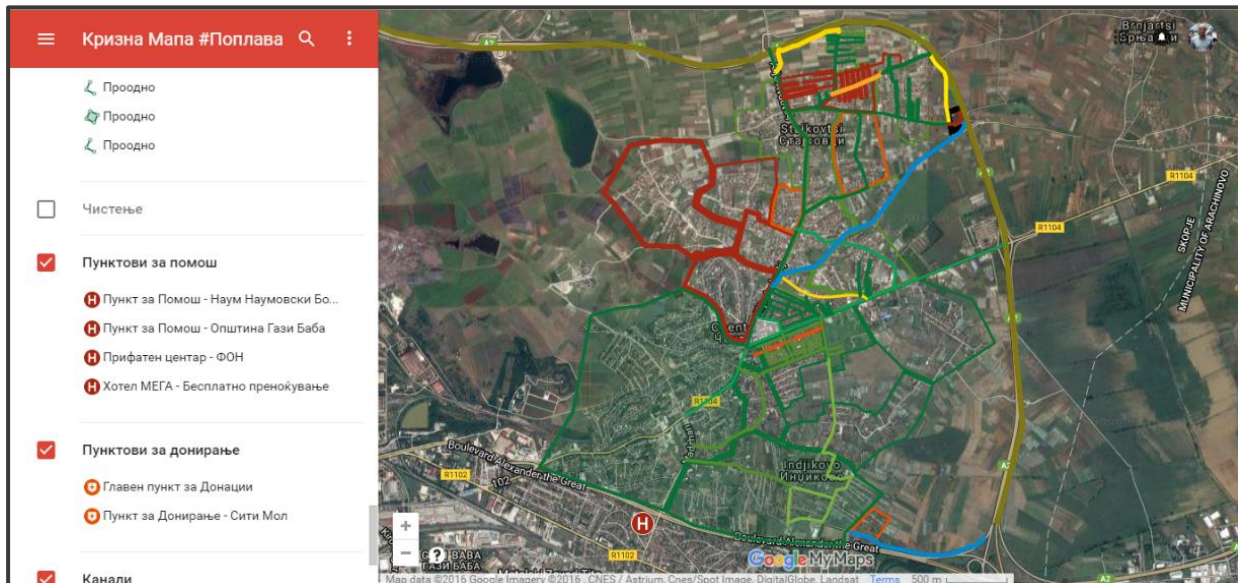
The inefficient infrastructure of the sewage network at micro level and the condition regarding its maintenance and upgrade pursuant to the dynamics for expansion of the city and spatial planning influence the risk of floods that occur as a result of heavy rains.

Picture 1: Conditions of the sewage system (in 2015)



The pictures show reduced capacities of the sewage channels, where apart from the mixed competences of different local and central bodies and institutions, their maintenance is under impact from the deficit of awareness by the citizens (waste, organic waste, rubble and other) and by system urbanization (mainly by the most vulnerable people that usurp this space). The waste water treatment system is in a phase of construction, but there should be made more solutions for sewage. The need appears for further development and changes of previously drafted plan (2010) for intervention in case of big waters, for the purpose of prevention or mitigation of the damage caused by floods.

Picture 2: Map of the hit areas in Skopje, created and developed by volunteers in the phases of response, recovery and rehabilitation from the flood in 2016²



Even though the official central and local governments have undervalued and considered as irrelevant improvisation the mapping of the vulnerable areas in post-crisis phases by the self-organised volunteers, the practitioners and experts have evaluated this creation with high marks because of its design and pragmatics in completion and update of data. It showed as key for coordination, within the delivery of aid and support in implementation on the field.

2.2 URBAN HEAT ISLANDS

The Skopje Region is characterised by modified Mediterranean and medium continental climate. The average air temperature is 12°C, the average annual rains are 510 mm/m², the average morning humidity is 81%, the average cloudiness during the year is 57% and the average wind speed is 12 km/h (Weather base, 2019). The air blasts are most often moving in the directions north-northwest and south-southeast. The climate changes during the year have significant influence on the appearance of strong winds, on the amount of snowfall and on the dry periods (City of Skopje, 2008: 5). The summers are long, dry and hot, and the winters cold with many foggy days.

² The map has been taken from the following link:

https://www.google.com/maps/d/viewer?mid=1t66X1P5XswZNZTosUMKrAzp5qg&hl=en_US

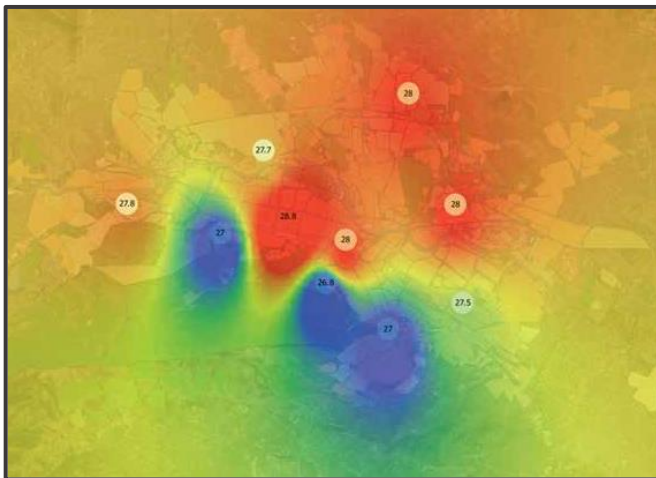


The term ‘heat island’ refers to the built areas that are hotter than the surrounding rural areas. The annual middle air temperature of the city with 1 million or more citizens may be hotter from 1 to 3°C than the surrounding. In night hours, the difference may be up to 12 °C. The heat islands may influence the communities through increase of the energy consumption in summer period, air-conditioning costs, air pollution and green-house gasses, diseases and mortality related to the increased temperatures as well as on the water quality (EPA, 2018). The heat is created by the energy made by the people and by transport means (cars, busses and trains) in bigger cities and at places with many activities and great number of people (National Geographic, 2018). Additionally, the heat islands in the urban areas are characterized by the fact that the same appear when the housing objects are built at close distance, because of so called ‘waste heat’ disposed in the space as product of flaming and movement, because of the thick population, absence of construction standards and bad urban planning policies, paving of the land by tarmac and paver elements that do not allow cooling of the surface through soil, the water passes through the heated surfaces and heats the rivers, streams and underground waters, because of the improper implementation of so called ‘green policies’ where the distribution of the city greenery and alternative green solutions does not correspond to the expansion of the cities and their climate circumstances.

Table 3: Draft-table for collection of statistical data for urban heat islands for given period, developed within the frames of EPICURO Project (for example, 2013-2018)

Key performance indicators	Reference/ baseline	Tendency/ Result	Responsibility
Number of days over 32 °C per year			
People living in inner city thus being exposed to UHI			
Thermal isolation of home (i.e. no. of buildings with low, high, no insulation)			
Living on a high floor of multi storey buildings			
High population density (person/ha)			
Not having working air conditioning			
No. of elderly people			
Single pensioner households			
Accessibility of health services (number of aged care facilities and travelling time from ambulance depot)			
Percentage Population with no Health Insurance Coverage			
Distance to Nearest Health Services			
Etc.			

The Climate Change Strategy 'Resilient Skopje' gives pioneering and detailed view of the urban heat islands in the city (City of Skopje & UNDP, 2017: 32). By use of two types of data, meteorological measurements at 13 micro locations in the Skopje Valley (2013-2015) and by recording by thermal camera set on hang-glider during fly from Vodno to the City Park (2016). The recording was made on the critical parts where heat islands appear as a result of different reasons (thick urban area, concrete, tarmac, big consumers and energy generators and similar). The collected data serve for mapping of the heat islands and for the purpose of planning of the measures for urban resilience of the city.



Picture 3: Interpolation of temperature (blue colour the coldest, red the hottest) – recorded on 1.6.2015 at 2 o'clock p.m. (City of Skopje & UNDP, 2017: 32)

Based on the measurements made by the Hydro-meteoroidal Service the temperature differences in the Skopje Valley are in a range from 1.2°C to 5.7°C. Bigger differences are mainly noticed in the afternoon and night hours, and the highest temperatures as

characteristic for the central city areas, industrial zones (Butel and Avtokomanda) and Taftalidze. Moreover, the strategy notices that the recording by thermal camera showed difference between temperatures at the peripheral part of the city to the central area of about 7°C, while the difference compared with Vodno is 12°C... The parts around the River Vardar are for few degrees lower depending on the distance, and the square 'Makedonija', because of its white colour, is significantly colder than the surrounding. For example, the temperature of the tarmac at Maksim Gorki Street is for more than 6 degrees higher that the temperature on the paving stones at the square (City of Skopje & UNDP, 2017: 32). The Strategy states that the buildings having lighter roof positively influence on the reduction of the temperature in their environment, but their number is not big because of the materials which are traditionally in red colour.

2.3 URBAN FIRES

The urban fires appear at first in the cities with potential of fast expansion on the neighbouring areas. These fires make damage and ruin homes, schools, business facilities and vehicles (City of Eugene, 2019). The urban fires for the City of Skopje have always been and will in close future be serious treat for their citizens, infrastructure, facilities and institutions. Regarding the urban fires, apart from the deficit of operational and technical capacities (mainly refer to the skills and training of fire-fighters, the continuity in the policy of the local governments for



employment of fire-fighters, deficit of contemporary and specialized vehicles and sophisticated equipment and other relevant factors), there is serious absence of relevant infrastructure, including the access points, standpipe network and other standards that refer to construction norms, or to the spatial planning in its entirety, increased level of exploitation and improvisation with the electricity network and other. Anomalies appearing in the system for protection and prevention and crisis management system, where the Protection and Rescue Directorate that is the Crisis Management Centre are key subjects, reflect on the decentralized entities and on the city as parties considered at local level.

Fire prevention refers to undertaking proactive steps for fire prevention before they start and/or reduction of their dangerous impact. The prevention in Republic of Macedonia is in competence of the Protection and Rescue Directorate, and at level of the City of Skopje of the Protection and Rescue Department. The responsibility for the **Operational and tactical measures** and fire-fighting are in competence of the Territorial Fire Brigade (TFB) of the City of Skopje.

Analysing the conditions in the Territorial Fire Brigade of the City of Skopje and the unequivocal data given in the official documents many problems this unit is facing with are easily evident:

1. Human factor / staff capacities

- i. Age limit, that is the possibility to reduce the unit till the end of 2019 for 30% due to retirement will cause functioning, in impeded conditions thus influencing the quality of intervention in particular in bigger interventions;
- ii. If the weak completeness is added to it in accordance with the existing Systematisation of job posts of the City of Skopje in the part of Territorial Fire Brigade of the City of Skopje, which envisages 384 employees in the unit, it appears that the completeness is only 54%, it is clear that the staff capacity becomes acute problem.
- iii. The health condition and the standards of the Law on Safety and Health at Work limit the accomplishment of the obligations for 10% of the total number of employees that are not in a position to intervene in fire-fighting or to be involved in other type of interventions.

2. Professional staff

- i. The alarming problem is the deficit of drivers of special vehicles whereas of 73 systemised job post only 44 are covered which does not meet at all the needs during eventual bigger intervention or two and more interventions at the same time.



3. Specialised FF equipment

- i. The fire-fighting vehicles are fundamental means in the operational process of the unit that has at disposal 51 fire-fighting vehicles used in average between 15, most often 26 and 36 years, up to equipment used for more than 47 years.
- ii. The deficit of motor mechanics and the high costs for maintenance of the vehicles (most of which are not being produced any more) should be additionally taken into account in the process of drafting of the future strategy.
- iii. The maintenance of the mechanic ladders being with older date of production appears as big problem, whereas the ladders are of enormous importance for successful interventions when speaking about fires at higher objects.

4. Spatial organisation

- i. The urban development of the city and the spatial expansion is not adequately followed by the Organisational development of the Fire-fighting and Rescue Unit.
- ii. Proper coverage of the city with fire-fighting stations would be achieved by opening of (at least) two fire-fighting sub-centres for the purpose of covering the municipalities of Kisela Voda, Aerodrom and Sopsishte, as well as Skopje Sever, municipality of Butel and it would improve the time of intervention in that part of the city at the same time taking into account the size and importance of still the biggest industrial zone in the Republic of Macedonia - Vizbegovo.

5. Response time

- i. The time required for the Territorial Fire Brigade of the City of Skopje to receive information, to assess and respond to potential fire danger is called Response time, which in the modern fire management is one of the basic criteria for determination of the quality and efficiency of the fire-fighting units in bigger cities and metropolis.

The same is accomplished by improvement of the quality of the equipment and by the conditions and intensity of the training

6. Trainings and equipment

- a. Territorial Fire Brigade of the City of Skopje in 2017 has realized several exercises in the primary and secondary schools in the territory of the City of Skopje in cooperation with the Protection and Rescue Directorate and the Red Cross, as well as 10 fire-fighting exercises at legal entities and medical institutions, in this way



controlling the preparedness of the unit and making acquaintance with the specifics of the facilities where this type of activities are performed.

- b. In this direction it is necessary to prescribe criteria for the purpose of monitoring of the progress and positioning of the unit in the quality and efficiency scale.

The completeness of Territorial Fire Brigade of the City of Skopje by staff is below 60% which is far away below the European standards, in conditions when in accordance with the legal norms (Law on Fire-fighting and its bylaws) one fire-fighter should cover 1500 citizens, the city is evidently overpopulated and the city governments do not have at disposal relevant statistical data (from the last census performed in 2002) that directly influence on the assessment and projection of the plans and measures for prevention and urban fire management. Moreover, the main holders of the activities for prevention and fire management are overloaded with new safety challenges and challenges that in their background have the safety culture, professionalization, conceptual differences between disaster risk management and disaster management and the wider understanding of the English neologism „first responders“.

Table 4: Draft-table for collection of statistical data for urban fires for given period, developed within EPICURO Project (for example, 2013-2018)

Key performance indicators	Reference/baseline	Tendency/Result	Responsibility
The frequency of urban fires			
No. people living in risk areas			
No. of elderly people			
Emergency path availability (Ensure path legibility)			
Strategic signage placement availability			
Etc.			

Based on the information for the work of Territorial Fire Brigade of the City of Skopje in 2017 (TFB, 2018), there are strong indicators for reduced operational and technical capacity of the forces for preparedness and response.



Table 5: Total number of fires in the territory of Republic of Macedonia for the period 2005-2010 (Statistics of the Ministry of Interior, 2018)

	2005	2006	2007	2008	2009	2010
Urban fires	369	332	406	405	408	418
Vehicles	90	104	99	113	95	73
Open space	337	414	702	420	408	639
Other					12	
Total	796	850	1207	938	923	1130

Table 6: Fires and technical interventions of Territorial Fire Brigade of the City of Skopje in the period 2015-2017 in the area of the City of Skopje

	2015 year	2016 year	2017 year
Fires in urban areas	602	617	901
Fires at open space	605	391	559
Fires in transport means	94	109	162
TOTAL	1301	1117	1622
technical interventions	84	121	119

During the comparison made on interventions the fire-fighting unit had in 2015 and 2016, it is noticeable that the number of interventions in 2017 does not follow this average that moves over 1000 interventions of fire-fighting per year, and in 2017 we have significant increase of the number of interventions in particular in urban area. The stake in the fires in urban area in the given period is about and over 50% from the total number of registered fires.

If crosscut of fires in urban areas and fires in vehicle is made it may be concluded that in the last 15 years there is a trend of growth from 3-5% of the fires in urban areas, and in 2017 there is fast growth of almost 30%.

In accordance with the evidence kept for each intervention particularly, the following reasons for fire events in 2017 appear:

1. Construction deficits

6



2.	Damages due to deterioration	8
3.	Firebox- fireplace	97
4.	Fag-end from cigarette	35
5.	Open fire	253
6.	Electric appliances and devices	72
7.	Electrical conductors	108
8.	Static electricity	2
9.	Conductors heated due overload	23
10.	Crash	1
11.	Other reasons	85
12.	Not specified	932

The fires resulting from open fire (253) are significantly alarming signal that there is absence of consistent penalty policy within the inspectional control. Moreover, the number does not correspond totally with what is defined as urban fire, having regard to the fact that the Territorial Fire Brigade of the City of Skopje has wider territorial competence than the City of Skopje and intervenes as well in other municipalities that are less half-urban.

The fires resulting from electrical conductors refer that the old and dilapidated installation and the problems of the system for electricity reflect as well in this field. The heating bodies often appear as reason for fire, as well as faulty ventilation systems, uncleaned chimneys and other.

In the same 2017, 621 or 38.3% are result of fire caused by carelessness, 63 or 3.9% are by purpose, and while very indicative is the number of fires with unidentified reasons – 932 or 57.7%. The last shows that there are deficits in the relation between the Territorial Fire Brigade of the City of Skopje and the Ministry of Interior – Mol (the latter are relevant because of the expert evidence of the origin and the reasons for the fire) and that it is difficult to detect the reason for fire.

Additionally, the following may be selected as weaknesses of the fire-frightening system:

1. Legal decisions – Law on Fire-fight (Official Gazette of Republic of Macedonia No 67.2004 as of 4.10.2004) and related laws do not correspond to the current conditions and needs. The absence of detailed Law on Fire Protection is more than obvious, and the City of Skopje is the by the strongest attack by the weaknesses of the regulation. The Law on Protection and Rescue (2004) insufficiently treats the protection from fire and explosions. The option, to transform the Law on Fire-fight



- into Law on Fire Protection including special part for the professional fire-fighting units and professional fire-fighters would be the best solution.
2. The organizational structure at level of the City of Skopje, where the Protection and Rescue Department is key pillar, has more formal than practical role. The department should be strong executive factor in the fire protection and prevention.
 3. The competences between the Protection and Rescue Directorate, the Ministry of Interior and the Protection and Rescue Department are not specified enough and there is a conflict among them. The competence of the inspectional control is within the Protection and Rescue Directorate, the Ministry of Interior is authorized for issuance licenses for handling and transport of hazardous and explosive materials, and the Protection and Rescue Department of the City has no precisely defined concept. This setup is unfavourable for the strengthening of the city resilience.

One old quote says that “prevention is always more efficient and cheaper than the medicine”.

Non-confidence towards the popular aphorism quoted above, opposite to the growing need for safety and the fact that the collective and personal safety are basic principles of human needs in the concept of urban living, makes the fire-fight safety and protection extremely important in the modern life.

As the importance of human life is not measurable or presentable in numbers and financial statistics, the City of Skopje must have clear view regarding the resilience towards urban fires, even more because the presented statistical data are in the same direction.



3. Resilience vision and goal

The best method for urban resilience and climate change management is by disaster risk management, defined as ‘application of policies and strategies for reduction of the disaster risk for the purpose of prevention of new disaster risk, reduction of the existing disaster risk and residual risk management, contributing to the strengthening of the resilience and reduction of the losses from disasters’ (UN General Assembly, 2016: 15). The approach to the disaster risk management is relatively new concept and practice, but its implementation is conditioned by the understanding of the disaster risk reduction and dynamics for redirection of the focus from disaster management to disaster risk reduction, climate change adaptation and the local development (World Bank and ISDR, 2008: 2; Velasquez, 18 November 2015). Within the ongoing circumstances, several countries have integrated concepts and principles for disaster risk management. The other, mainly developing countries are less involved in this approach. These countries are more inclined to disaster management (thus meaning preparedness) than management of the risks and circumstances that produce the disaster (that, among other, require risk assessment, vulnerability reduction and capacity increase).

The implementation of the concept for disaster risk management at local level due to the goals of the urban resilience requires serious and consistent approach by the city authorities and non-state parties considered. The approach of the City of Skopje towards urban resilience takes into account the fact that for a long period the urban resilience was not considered as serious topic and as consequence it was not completely integrated in the city policies in the field of urban planning, protection and rescue, environment, utility affairs and other activities.

Therefore, the main goal of the city is to develop efficient strategic plan in correlation with the neighbouring municipalities through joint monitoring of the identification of the dangers and implementation of the measures, attracting financial funds, organization of trainings etc. Development of consistent plan means defining of:

1. relevant subjects capable for implementation of the measures and activities and eventually making functional connection between the internal experts and the Mayor’s office in suggesting and implementation of the measures from the plan;
2. adoption of action plan and time frame for implementation;
3. sources of funding;
4. determination of relative goals and indicators for progress;
5. Where appropriate, envisaging of the activities for adaptation in the local development plans.



The main goals of the City of Skopje, regarding the general concept of EPICURO Project, refer to:

1. Improvement of the conditions regarding the management of knowledge and cooperation between the key categories of subjects at local level.
2. Increase of intersectoral cooperation and cooperation of the City of Skopje within the activities for climate change adaptation. Special attention is paid to the local perspective of sharing data, knowledge and skills related to the work on topics of mutual interest (urban resilience, urban heat islands, climate change actions, civil protection etc.) between the internal experts (persons working in different sectors of the city administration) and at international level.
3. Implementation of the measures covered by the climate change strategy 'Resilient Skopje' devoted to different key areas, such as: energy efficiency, transport, air pollution, public health, utility services and public greenery.
4. Increasing of the awareness of all relevant state and non-state parties considered for the local risks and vulnerability through informing, development skills and knowledge through meetings, practices, training and formal relations.
5. Raising awareness and building consistent approach toward the global and European risk for disaster risk management and reduction.
6. Establishment close cooperation with external subjects (academic community, citizens, professional associations and civil society) for the purpose of raising the awareness and making all the relevant categories more inclusive in the planning of the development and interoperability.
7. Investment in human capital from the aspect of the city administrations, as well as in innovations and technologies in accordance with the ongoing and forthcoming local strategies for disaster risk reduction.
8. Initiating changes in the form and informal approaches towards the three selected key fields (urban fires, floods and urban heat islands).
9. Promotion of adaptation of the municipal services, enterprises and institutions, the citizens and the infrastructure of the City of Skopje towards the resilience and climate change risks.
10. Suggesting sustainable model of the Strategic team (in a way promoting the quality and expertise), as well as model of cooperation between the team and the Innovation Lab of the City of Skopje.



4. Responsibilities of the local subjects and the urban resilience strategic team

The plan should be complementary document for creation of comprehensible urban resilience action plan and strategy and climate change adaptation. Having regard to the fact that the Council of the City of Skopje has not officially adopted the Climate Change Strategy of UNDP in Skopje (Resilient Skopje), the same is not less important. At the same time the strategy is good basis for development of the plan, and the plan is limited to the three selected dangers.

The time period for development and implementation of the plan is 2018-2022. The Strategic team should participate in the activities and the same mean:

1. Implementation of the campaign for inclusion and reposting good and proper examples contained in the project catalogue 'the best practices' (aimed at citizens and key subjects involved in the implementation of the concept for urban resilience).
2. Development of new initiatives and activities, in particular regarding the volunteering and developing skills for better interaction among all the parties considered (state and non-state subjects).
3. Counselling of the creators for policies for civil protection, urban resilience and climate change, suggestion of new ideas and measures and monitoring and evaluation of the relevant actions and solutions, in accordance with the assessment by the team members.

5. Urban resilience activities and solutions

When the matters are about defining of the goal of the suggested measures for building resilience, two main approaches must be taken into consideration in the creation of the measures regarding the time required for goal accomplishment:

- a) **Short-term**, related to the continuity of service provision (how to optimize the continuous functioning of the endangered infrastructure or subject) and to return to the minimum level that will enable continuous functioning of the system or the community.
- b) **Long-term**, related to the adaptation possibilities resulting in continuous and proper implementation of the adaptation and resilience measures and is aimed to enable the community or the system to manage the climate change within longer time period.

The selected measures for increasing of the urban resilience, notwithstanding which initiative/frame/concept/ will be selected by the city policy creators, should take into account both key factors that influence the city resilience. Those are: interdependence between the infrastructure and the climate change (EUC, 2018: 26-28).

The Strategy (City of Skopje & UNDP, 2017: 63) envisages recommendations for risk management and resilience increase. They are aimed at bigger inclusiveness of the disaster risk management and climate change risks in the sectorial strategies, programs and plans at local level; strengthening of the operational and technical capacities; in time and proper update of the strategic documents regarding all the phases for risk management and disaster and climate change management; mapping and analyses of direct and long-term consequences and losses from natural disasters towards people, communities, infrastructure, critical objects and development; development of scenarios and modules for training and response; information exchange based on intersectoral, interagency and international cooperation, building resilience culture, training, actualization of the gender aspects and development of innovative models by implementation of activities for raising public awareness of so called 'fire responders' and among citizens.

Climate Change Strategy 'Resilient Skopje' identifies general measures for building urban resilience (City of Skopje & UNDP, 2017: 65-66) that would become part of the action plan. The same refer to:

1. Update and upgrade of the key strategic documents.
2. Bigger inclusion of the issue for climate change in the urban planning.



3. Continuous cooperation through implementation of Mezzo-meteorological measuring and monitoring in cooperation with the National hydro-meteorological services.
4. Proper implementation of the Directive on Issuance of Integrated Ecological Licenses (IPPC) and approvals of studies for environmental protection.
5. Drafting climate atlas for the City of Skopje.
6. Strengthening the green fund of the city, as well as field activities by engagement of all the available state and non-state resources.
7. Designing and implementation of activities for raising awareness for the environment and climate change, animation of the citizens for the purpose of becoming active participants in taking concrete measures etc.
8. Increasing of the capacity of the City of Skopje and the municipal administrations for strengthening the urban resilience towards climate change by introduction of methodologies for innovative learning (as institutional mitigation measure).

Mitigation measures and adaptation of the UNDP Strategy are relevant (City of Skopje & UNDP, 2017: 67-74). The direct mitigation measures mean:

1. Application of measures for use of alternative sources of water for irrigation of green surfaces and for cleaning the streets and public surfaces.
2. Reduction of the risks from floods and erosion by forestation of woodless and woody areas, where there are no plans for any use (and it is contained in the urban planned documentation).
3. Drafting study for innovative curves of intensity, duration and repeating of the intensive rains in Skopje Region in case of climate change.
4. Implementation of the study for innovative intensive rains, time and frequent crisis in Skopje region in the field of climate change.
5. Reassessment of the capacity of the sewage network from the sewage system in Skopsko pole
6. Monitoring of the quantity and quality of waste waters in the main collectors of faecal waste waters and collector of atmospheric waters at measuring place before entrance into recipient.
7. Aimed activities for raising the awareness for the influence of climate change to the droughts and floods, as well as possibilities for protection and negative impact reduction.



In this part the adaptation measures envisaged in the climate change strategy, in the part of risk management and urban resilience improvement (City of Skopje & UNDP, 2017: 72), envisage:

1. Update of the Assessment of vulnerability of the area of the City of Skopje and of municipalities from all types of risks and dangers, as well as the Assessment and the Plan for Protection and Rescue.
2. Adoption of Integrated Action Urban Resilience Plan.
3. Introduction of the practices for disaster risk reduction and climate risks in GUP and other sectorial strategies, programs and plans.
4. Drafting, adoption and update of plans and scenario for prevention response to natural disaster and climate change risks at level of the City of Skopje and municipalities.
5. Implementation of the targeted activities for strengthening the public awareness of the general population and persons with disabilities.

Apart from the stated general measures and recommendations, it is necessary to:

1. Purchase system for early warning of the citizens in case of immediate danger that would function through electronic notifications (SMS, radio, social networks).
2. Introduction of proper standard operational procedures for expressed respect of the principle of subordination in direction of elimination of the recently detected problems and coordination among more stakeholders of the system for protection and rescue (LSU, MoI, PRD, CMC, Red Cross, ARM and other).

5.1 FLOODS

The preventive and operational activities and measures for implementation of the protection and rescues from floods in the City of Skopje are part of official document of the City (City of Skopje, 2010: 9-13), where due to efficient monitoring of the dangers and big flood management, Skopje area is divided in five sectors.

The recommendations for flood risk management contained in the strategy means (City of Skopje & UNDP, 2017: 62):

1. Continuous upgrade of the network of hydro-meteorological stations



2. Defining new criteria and standards as part of the spatial and urban plan documentation, for dimensioning of the sewage systems in the urban areas with high level of urbanization and economic importance
3. Minimal measures are suggested for the urban zone in the City of Skopje that include continuous cleaning and maintenance of the entire existing infrastructure for flood protection, that is its return in the original condition and long-term maintenance
4. Treatment of the downpours effectuating Skopje from Vodno side and from the south side of Skopska Crna Gora, characterized as the most critical and priority, and directly aimed at significant public infrastructure and settlements, combined with different measures providing high level of protection (protection from floods with rare probability for appearance), accompanied by a series of non-structural measures related to the urban planning and land management.
5. Regular management of the dams and reservoirs opposite Vodno from the City of Skopje for the purpose of avoiding damage that may appear during their destruction.
6. Gender analysis on the exposure and vulnerability of the citizens of the City of Skopje and at the municipalities in the territory of the City of Skopje towards different types of floods.

Adaptation measured (City of Skopje & UNDP, 2017: 70), envisaged in the climate change strategy in the part of flood management risk mean:

1. Meteorological and hydrological monitoring.
2. Establishment system for warning of the community (early warning).
3. Integration of the flood risk management in the urban plans for the areas vulnerable to floods.
4. Flood management in the urban zone of the City of Skopje.
5. Water resource management along Vardar and Lepenec.
6. Regulation of riverbed and cleaning of the rivers and channels because of the danger from flood watercourse of Skopska Crna Gora.
7. Building retentions.

The retentions (pool and channels) are characteristic for the flatland areas where the devastated and not used parts of the land may be transformed in reservoirs for the purpose of collecting part of the waters in case of danger. The same, in conditions when there is no danger from flood may be used as well for other purposes.



Apart from the given measures, it is necessary to include certain innovations as integral part of the plan for the city. Those are:

1. Mapping of critical points at the entire territory of the City of Skopje including the rural part as well, that is expert team should make assessment of the critical points where there were floods till now and where there is a potential for flood to appear. Those measures are clearly structural.
2. Regular (weekly) maintenance of the current atmospheric and sewage network on zone basis and in cooperation with Skopje's municipalities. It means cleaning of the sewage network from waste, sludge, wash and roots as factors that seriously reduce its streaming power and capacity. Extraordinarily, in case of announcement of heavy rains or other danger from flood, it is necessary to perform daily checks in the sewage system for atmospheric waters. Atmospheric canalization should be built in places that miss it now and the capacity should be increased at places with small capacity as soon as possible as priority for flood protection.
3. Increased (inspectional) control and cleaning of the channels for reflux of big waters through the entire territory and bigger repressive measures by the competent authorities for cleaning of the same as well as control and repressive measures for the citizens who throw garbage in the channels and at any way endanger its functioning.
4. Rebuilding of cross-cut water collectors (registers)³ necessary at the streets with fast water fall in bigger amounts for the purpose of preventing the water from collecting in bigger amounts in the lowest spot height for a short time period and to prevent flood on the same.
5. Increasing of the capacities of the institutions that are directly responsible for flood protection. For example, PE Vodovod i Kanalizacija as leading subject for flood protection in accordance with the strategic documents, should be equipped by modern systems for flood prevention such as: fast silos for filling bags, sand and other material and technical assets that will be put at disposal at any moment. It as well means purchase of aerial and fast installing mobile dams, professional motor and electric pumps for water and mud sewage, equipment for marking and notification of the vehicles and passengers (mobile traffic signs for prohibition of movement, lightening signalization, displays and similar).

³ The first ten is the first build in 2013 at ten critical locations in the traffic network in the recent period. After series experiences with flood, registers were installed in form of cross-cut grid at the streets and boulevards aimed to collect the atmospheric waters before they are accumulated in the lower parts of the traffic lines and underpasses.



6. Training on forming specialized spatial forces trained and equipped in accordance with the European standards.
7. Building embankment or quay at the Vardar River in the part of the piping Rashche for the purpose of protection of the sources from which the entire city consumes water and rebuilding of the not built part along the embankment in 10 km length – from Novo Lisiche to Dolno Lisiche. This is particularly important because in the last several years, there were situations where embankment from bags was made and there was intervention by mechanization for the purpose of prevention of the flooding of the piping.

5.2 URBAN HEAT ISLANDS

The Resilient Skopje - Climate Change Strategy defines part of the recommendations and measure as required for dealing with the urban heat islands. The recommendations for dealing with urban heat islands as part of the strategy mean (City of Skopje & UNDP, 2017: 62):

1. Establishment modern automated meteorological-climate monitoring system for the needs of the City of Skopje and Skopje Valley. In this way, information will be provided about the climate system's "vulnerability" and the possibility of providing early warnings about extraordinary, dangerous and catastrophic meteorological conditions.
2. Developing an Urban Heat Index and its gender monitoring.
3. More detailed measuring of certain specific areas that are registered as urban heat islands.
4. Gathering thermal Imagery from a plane in order to cover a larger area of the city.
5. Preparing a detailed analysis of the heat islands in Skopje and designing, prototyping and testing measures for mitigating the consequences from urban heat islands by (for example, introducing a practice of constructing white roof tops).
6. Developing a web-platform and interactive database for all data related to the urban heat islands in Skopje.
7. Gender analysis of the information, plans and recommendations for mitigation.
8. Collecting gender-disaggregated data for informing mitigation analyses.

In general, the access for dealing with the urban heat islands covers strategies for cooling of the areas, air and other parts of the space, but as well as measures for adaptation of the



heating effects. Summary, the measures derived from different solutions for dealing with the urban heat islands⁴ refer to:

1. **Trees and vegetation** – Increased coverage of the tree and the vegetation reduces the surface temperatures and the air by provision of shade and cooling through evapotranspiration. Trees and vegetation as well may reduce the leakage of atmospheric waters and to serve for protection from erosion.
2. **Green roofs** - The growing vegetative layer (plants, bushes, grasses and/or trees) on the roof reduces the roof surface temperatures and the surrounding air and improves the atmospheric water management. They are as well called ‘roof gardens’ or ‘eco roofs’, green roofs achieve this benefits by provision of shade and removal of air heat through evapotranspiration.
3. **Cold roofs** – Instalment of cold roof drafted by materials or layers that significantly reflect the sunlight and the heat from the building reduces the roof temperatures, increases the comfort of the residents and reduces the energy consumption.
4. **Cold surfaces** – Using of paver materials for pavements, car lots and streets make the same colder than the conventional pavements (by reflection of more sunlight and improvement of the water evaporation), and it not only cools the pavement surface and the surrounding air but is as well may reduce the leakage of atmospheric waters and improve the night visibility.
5. **Smart growth** - This practices cover a line of strategies for development and protection helping the natural environment protection and at the same time make our communities more attractive, economically stronger and livelier.

5.2.1 Results from the Performed Pilot Test of the Measure for Urban Heat Island Management

The concept of urban heat islands collaborates with the goals of EPICURO Project in a way that it gives detailed picture at micro level of the parts of the city influenced by the climate change effects, urbanization and the manner of implementation of the city strategies for mitigation and adaptation. The location for pilot-test is one of the most identified critical locations regarding the appearance of urban heat islands, determined on the basis on the records contained in the UNDP and City strategy.

The selection of the topic and the manner of implementation of the pilot-test do almost not consist of technological solutions, but the measurement of the conditions before and after

⁴ See more in Chapter 7.4.



application of white colour on the walking paths is supported by relatively well selected combinations of devices – drone and thermal camera. Skopje, in conditions of not yet developed awareness by the policy creators for the importance of the urban resilience, the results from the pilot test of the selected measure should be in direction to serve as support for the efforts for consistent and continuous implementation of the urban resilience strategies.

The green roof and forestation felt off from the suggested measures because they do not provide achievement of the short-term effect. Their application requires additional administrative procedures. The solutions for use of white tarmac as well are still not commercialized by the city companies and the private sector. Therefore, the team of the City of Skopje has decided to paint in white part of the walking path at selected location and to collect data before and after the pilot-test. Therefore, the team has determined the following activities within the implementation of the measure:

1. Introduction of the pilot-test (defining of the goals, participants and activities).
2. Points of interest (etiology and influence of the urban heat islands towards the citizens and the urban environment).
3. Analyses (probability, consequences, risk level).
4. Treatment (establishment of options, defining of the best practices and implementation).
5. Evaluation, future activities and sustainability (Risk assessment and priority determination).

Methods: painting the tarmac in white and drisla; and measurement by thermal camera: 8 days (before and after the treatment), three times during the day.

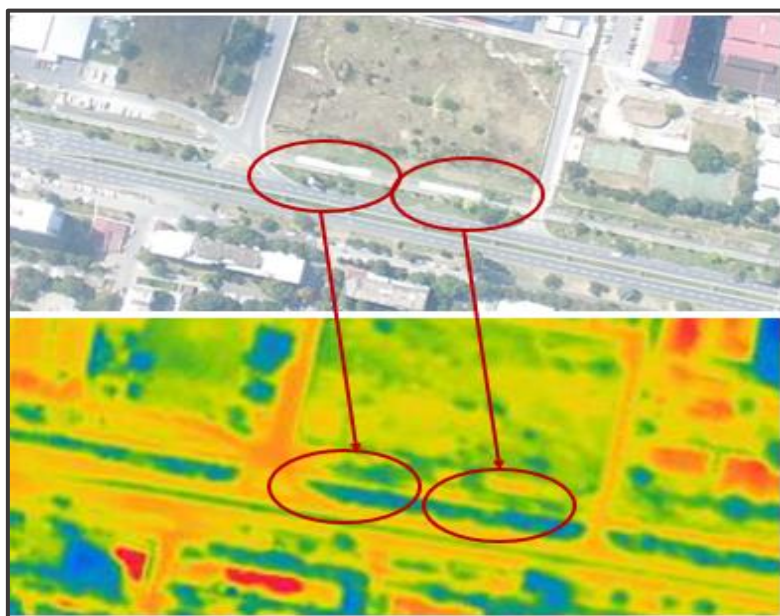
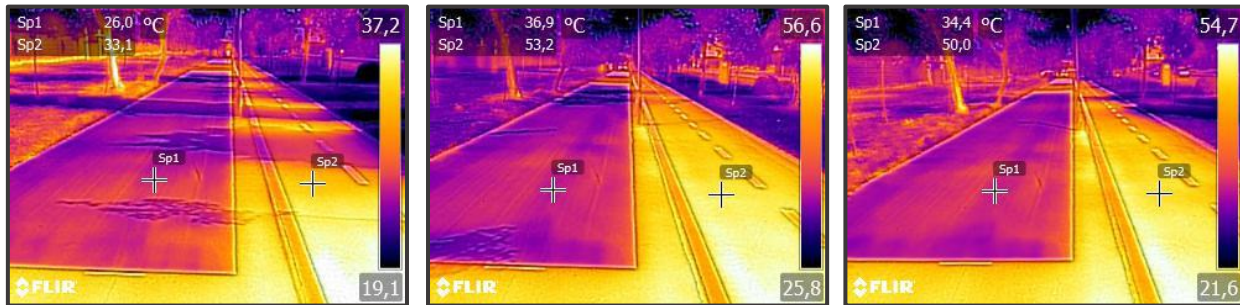
Characteristics: a) The technological solutions include use of thermal camera for measurement and presentation of the empirical units; and b) Comparative method – by use of similar concepts in bigger cities (Los Angeles).



Picture 4: Photo from implementation of the pilot-test of two parts in total area of 225m²

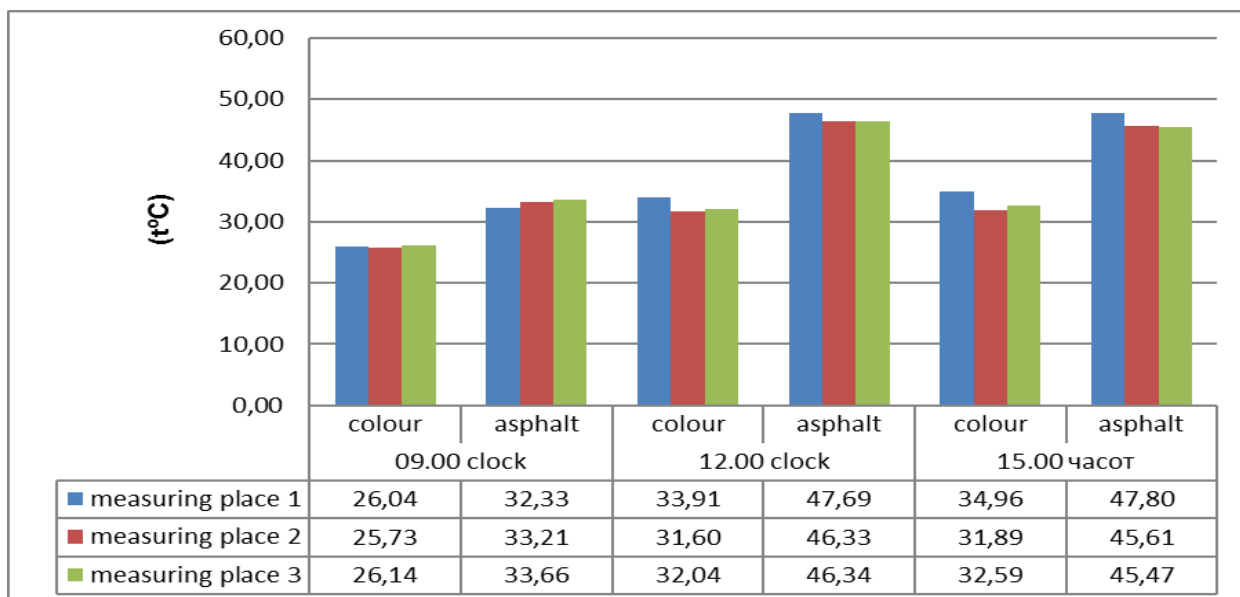
The measurement by thermal camera (manually and connected on the plane) were performed on different points (on land and in air) at the selected location, and they were implemented successively in eight different days in August 2018.

Picture 5: Results from the measurement of the pilot-test as of 24.08.2018, at 9, 12 and 3 o'clock p.m.



Picture 6: Recording with thermal camera from the plane (August 2018)

Picture 7: Statistics presenting the temperatures of the air, tarmac, treated tarmac and the temperature differences in the measurement period





The differences of almost 20°C in the medial temperatures among the three measurements categories (air, tarmac and treated tarmac) are serious guidepost for the future activities of the City of Skopje in building the activities for urban resilience and climate change adaptation.

The pilot-test should have direct influence on the strategies and tools that are to be built in the future strategic plans for climate change management, particularly in urban heat island management and adoption of administrative measures for interventions in the local and national legislation for designing of urban traffic solutions. The application of the pilot-test is subject to analysis, assessment and forecast of the influence of the urbanisations, green policies and effects from climate changes in the territory of the City of Skopje at micro level.

Conclusions:

- **Colouring with white paint of the walking paths (as replacement simulation for putting white tarmac) significantly reduces the surface temperature.**
- **The temperature of the tarmac and the air is closely connected.**
- **The differences in temperatures of the tarmac are increased by increasing of the air temperature.**
- **The differences in the temperature of the tarmac are higher in the afternoon hours.**

Recommendations:

1. The use of so-called white tarmac at walking and biking paths is good short-term measure for dealing with the urban heat islands (until sequent and full implementation of so-called 'green policies').
2. Implementation of measures for reforestation of the areas endangered by the urban heat islands is required. It particularly refers to walking and biking paths.
3. Tests in different colours of marking of the biking paths and giving recommendations to the existing regulations are required.



5.3 URBAN FIRES

The recommendations for the measures for dealing with urban fires in the biggest part refer to the Territorial Fire Brigade of the City of Skopje, standards for spatial planning, the manner of use and maintenance of the electricity network and of the inspection supervision.

In accordance with the presented conditions and analysis that refer to Territorial Fire Brigade of the City of Skopje, the most emergent measure for dealing with the urban fires is completing of the Territorial Fire Brigade of the City of Skopje by professional fire-fighters as well as by material and technical tools, especially in the part of height safety and ruin safety, and in accordance with the standards of the European Civil Protection Mechanism. **Because of the seriousness of the problem, the human factor as basis of the Fire Fighting Unit and staff require emergent action that might be made the best by proper program.**

The need of bigger and systematic recovery of the driving park as soon as possible is enforced as imperative, thus simplifying maintenance of the vehicles, making savings regarding the maintenance and gas consumption, and the benefit would be vehicles safer for use and better protection of the citizens of the City of Skopje.

Moreover, it is necessary to mark the traffic lines with special lines for emergency vehicles (Emergency Ambulance, Fire-fight Unit, Police), but as well marking of the emergency paths in front of the collective housing facilities and provision space for fire-fighting vehicles and for evacuation of citizens.

It is necessary to continue the construction of external standpipe network, and to check and maintain the internal in regular time intervals.

The City of Skopje would have to supply automatic reporting switchboard for fire that would function on base of public private partnership, including possibilities for connection of the facilities from other Skopje's municipalities, private sector as well as option for prepayment by interested citizens.

It is necessary for the Territorial Fire Brigade of the City of Skopje to give support to other municipalities which are not part of the city (for example, in the municipalities of Ilinden, Petrovec and Sopiste), but that are under the jurisdiction of the TFB. The support and assistance would consist of so-called soft or non-structural measures (training, expertise, etc.) if these municipalities decide to build fire protection centers. The same is necessary because of the fact that the distance is too big to have prompt reaction in case of fire or technical intervention.

To build proactive and partnership relation with the Fire-fight Association of the City of Skopje, as a body that will initiate and develop voluntarily concept, will perform training and will test measures for fire protection for the purpose of introduction and practicing of the procedures for prevention and protection from natural and technical disasters.

To implement the provisions from the Law on Inspectional Control and the legal obligations in the part of protection of the environment of Skopje that is the mountain Skopska Crna Gora as



well as Park wood Vodno and Gazi Baba. It means construction of fire-fighting roads and fire-fight crosscuts as well as professional training and equipment of the employees of PE Makedonski Shumi and PE Parkovi i Zelenilo as competent for the mountain Skopska Crna Gora and park woods Vodno and Gazi Baba.



6. Links to sources of additional information and data for building measures for urban resilience

6.1 GENERAL SOLUTIONS

<https://www.cdp.net/en/research/global-reports/cities-infographic-2017/cities-in-action>

http://c40-production-images.s3.amazonaws.com/other_uploads/images/445_C40_CRAFT_v11.original.pdf?1453129528

<http://www.c40.org/>

<http://www.preventionweb.net/arise/good-practices>

<http://www.oecd.org/cfe/regional-policy/resilient-cities.htm>

<http://www.100resilientcities.org/resources/>

<http://www.unisdr.org/we/campaign/cities>

http://www.covenantofmayors.eu/index_en.html

http://siteresources.worldbank.org/INTEAPREGTOPURBDEV/Resources/Primer_e_book.pdf

<http://www.rggi.org>

www.ncdc.noaa.gov

<https://www.resalliance.org/publications>

<http://www.100resilientcities.org/21-ways-to-make-european-cities-more-resilient/>

http://www.unisdr.org/files/26462_handbookfinalonlineversion.pdf

http://resilient-cities.iclei.org/fileadmin/sites/resilient-cities/files/Resilient_Cities_2016/Documents/Resilient_Cities_2016_Report.pdf

<http://www.unisdr.org/we/coordinate/hfa>

<https://www.brisbane.qld.gov.au/community/community-safety>

<http://resilient-cities.iclei.org/bonn2011/resilience-resource-point/resilience-library/costs-and-finance/>



6.2 PROJECTS

<https://www.pulseproject.info/#pulse>

<https://www.resilienceconnections.org/projects/13>

<https://www.conted.ox.ac.uk/about/3s-recipe>

<https://www.conted.ox.ac.uk/about/3s-recipe>

http://brigaid.eu/new_related-projects/

<https://www.h2020darwin.eu/>

http://opticits.com/2016/06/27/european-research_resilience_uk-friends/

<http://smr-project.eu/home/>

<http://resistand.eu/>

<http://www.interreg2seas.eu/en/WRC>

<http://www.ramses-cities.eu/results/>

<http://www.turas-cities.eu/>

<http://www.iclei-europe.org/topics/climate-change-adaptation/>

<http://www.resccue.eu/resccue-project>

<http://www.resin-cities.eu/home/>

<http://jpi-urbaneurope.eu/project/resilient-cities/>

http://ec.europa.eu/regional_policy/en/projects/ALL

<http://ec.europa.eu/environment/life/project/Projects/>

<http://climate-adapt.eea.europa.eu/knowledge/tools/sat>

https://ec.europa.eu/info/eu-regional-and-urban-development/cities/priority-themes/climate-adaptation-cities_en#project-databases-and-examples

<http://urbact.eu/resilient-europe>

6.3 EARLY WARNING SYSTEMS

http://www.wmo.int/pages/prog/drr/projects/Thematic/MHEWS/MHEWS_en.html#goodpractices

<https://www.hindawi.com/journals/amete/si/434023/cfp/>



http://www.preventionweb.net/files/24259_implementationearlywarningsystems1108.pdf

<https://opengeospatialdata.springeropen.com/articles/10.1186/s40965-016-0010-3>

<https://climatecolab.org/contests/2017/A2R-Anticipating-Climate-Hazards/phase/1318612/proposal/1333769>

<https://climatecolab.org/contests/2017/A2R-Anticipating-Climate-Hazards/phase/1318612/proposal/1333769>

http://www.unisdr.org/files/608_10340.pdf

<http://www.adaptation-undp.org/early-warning-systems-ews-different-types-hazards>

http://www.meted.ucar.edu/communities/hazwarnsys/ffewsrsg/FF_EWS.Chap.8.pdf

http://www.hydrology.gov.np/new/hydrology/_files/9a8425b638e7ad05eb8276bc22802456.pdf

6.4 URBAN HEAT ISLANDS

<https://www.epa.gov/heat-islands>

https://www.epa.gov/sites/production/files/2016-09/documents/heat_island_4-page_brochure_508_120413.pdf

https://www.japanfs.org/en/news/archives/news_id027856.html

<https://scied.ucar.edu/longcontent/urban-heat-islands>

<http://thegreencity.com/the-causes-and-effects-of-the-urban-heat-island-effect/>

<http://www.actionbioscience.org/environment/voogt.html>

<http://www.cityofsydney.nsw.gov.au/vision/towards-2030/sustainability/carbon-reduction/urban-heat-island>

<http://www.citymetric.com/topic/urban-heat-islands>

<http://www.whiteroofproject.org/urban-heat-islands>

6.5 SUSTAINABLE SEWAGE SYSTEM

https://www.islington.gov.uk/~/_media/sharepoint-lists/public-records/planningandbuildingcontrol/publicity/publicconsultation/20122013/20121220goodpracticeguides2suds

<https://www.nibusinessinfo.co.uk/content/sustainable-sewage-systems-suds-best-practice>



http://www.rtpi.org.uk/media/12398/ea_suds_final_a4_280308.pdf

<http://www.stormtech.com.au/information/best-practices-environmentally-sustainable-sewage>

<https://www.ice.org.uk/news-and-insight/the-civil-engineer/april-2017/sustainable-sewage-systems>

<http://www.knollandsseptictanks.co.uk/downloads/sewage/guidance-to-proprietary.pdf>

https://www.london.gov.uk/sites/default/files/lldap_final.pdf

<http://www.gov.scot/Topics/Environment/Wildlife-Habitats/16118/EcoTraining/suds>

<http://www.ecrr.org/Publications/tabid/2624/mod/11083/articleType/ArticleView/articleId/3316/Rural-sustainable-sewage-systems.aspx>

<http://www.engineeringnaturesway.co.uk/category/best-practice/>

http://www.floodrisk.co.uk/sustainable_urban_design_systems_suds.htm

<http://www.hrwallingford.com/news/new-suds-manual-delivers-practical-guidance-for-sustainable-sewage-systems>

6.6 RELEVANT SOURCES FOR MONITORING AND EVALUATION:

Monitoring and evaluation framework (UNISDR): www.unisdr.org/we/inform/publications/49324

Step by step guide to Monitoring and Evaluation:

www.geog.ox.ac.uk/research/technologies/projects/mesc/guide-to-monitoring-and-evaluation-v1-march2014.pdf

Methodological framework of measures for flood mitigation:

www.researchgate.net/publication/281630068_Methodological_framework_of_measures_for_flood_mitigation

Impacts on urban heat islands: www-sciencedirect-com.resursi.rtu.lv/science/article/pii/S0959652617323806

The Resilience to Emergencies and Disasters Index: Applying big data to benchmark and validate

neighbourhood resilience capacity: www-sciencedirect-com.resursi.rtu.lv/science/article/pii/S2210670717313707

Community resilience framework for an earthquake prone area in Baluchistan: www-sciencedirect-com.resursi.rtu.lv/science/article/pii/S2212420912000131

7. Action plan (including organizational chart) for urban heat islands mapping in the city

3 priority locations Surface = 15 000 m ²	Number of determined locations	1	First part
Urban-traffic solution for treatment of surfaces in the zones of the urban heat islands	Determined process	2	
Construction process, painting of horizontal and vertical surfaces in white	Determined activity	3	
1. painting of biking and walking paths 2. painting and foresting other concrete and tarmac surfaces (facades) and roofs	Activity type	4	
City of Skopje – Departments for Ecology, Urbanism and Traffic and Roads	Owner of the Process	5	
Entire or partial stoppage of urban heat islands	Activity target	6	
Planned and coordinated, direct construction-technical field activities	Type of the activity influencing the achievement of the goal	7	
Limited budget as possible RIKS for non-accomplishment of the project plan	Determined risk	8	Risk Mapping
Probability of occurrence of financial deficit is based on the fact that the project in the fiscal year is not put in the budget of the City of Skopje	Explanatory note to the probability for risk appearance	10	
Non-accomplishment of the goals	Possible risk impact	11	
Financial construction	Financial impact	11	
3 phases	Defining phases within timeframe and contents per phases	12	Determination of operational activities
6 months February – June 2019	Total period of realization of the project for prevention of urban heat islands	13	
Department for _____ of the City of Skopje	Explanatory note for the level of implemented/realised activities	14	
Department for _____ of the City of Skopje	Average level of realization Report to the Council of the City	15	
Quarterly reports by the Department for _____ of the City of Skopje	Not realized activities and project weaknesses	16	



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