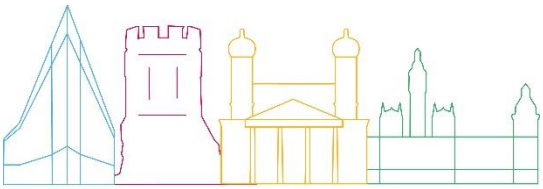
ARCH

ARCH D3.3 City baseline report - Bratislava

29 April 2020



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1. City Profile

The city of Bratislava has an overall territory of 367.66 km^2 and, by the end of 2018, the population of the city was 432 832. The city is administratively divided into 5 districts, which are the basic administrative units of the state administration. However, for self-government purposes, it is further divided into 17 city boroughs, each of which is governed by an elected local government and an elected Mayor. Bratislava City is governed by the City parliament and the elected Mayor – currently Matúš Vallo.

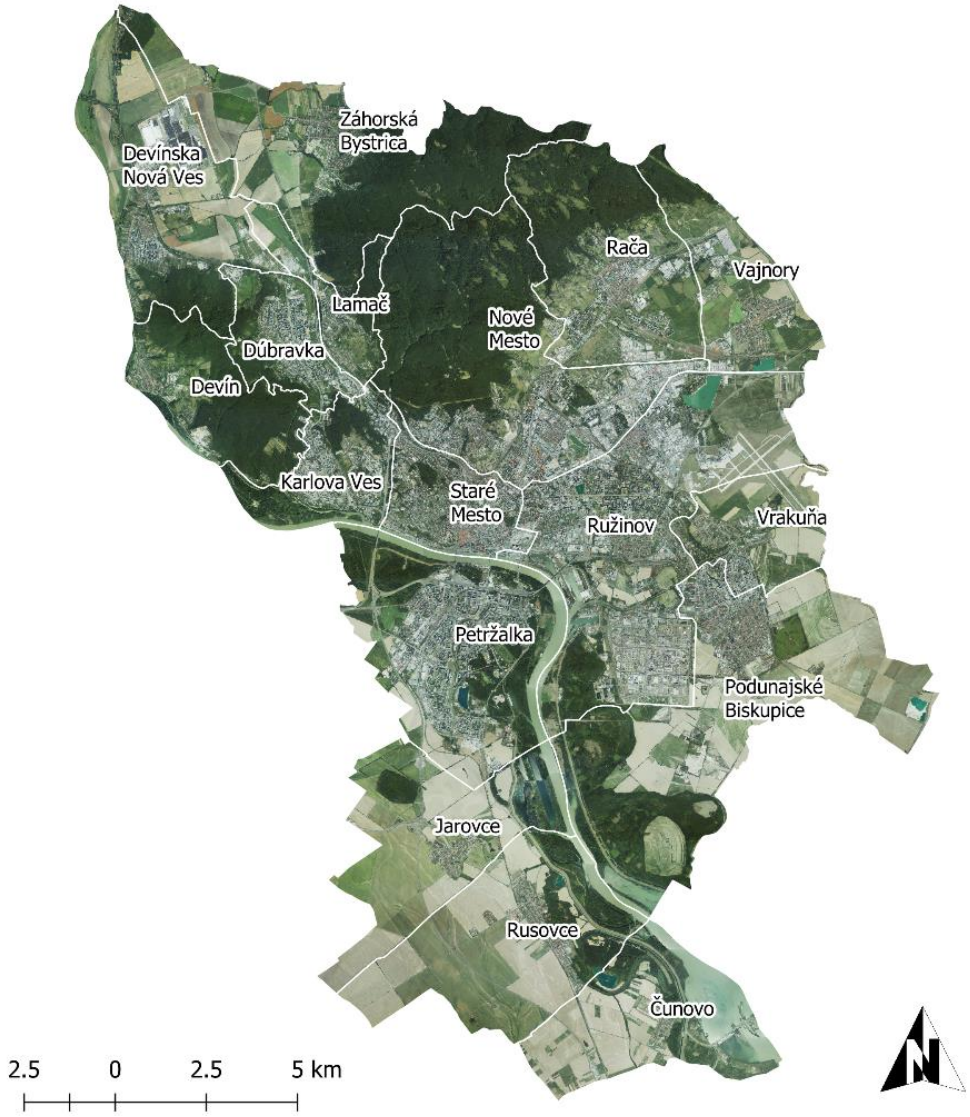


Figure 1.1. Bratislava City – divided by administrative borders into 17 city boroughs (municipalities).

The administrative organisation into districts and boroughs is as follows:

- District: Bratislava I – consists of City Borough Stare Mesto;

- District: Bratislava II – consists of City Boroughs Ruzinov, Vrakuna and Podunajske Biskupice;
- District: Bratislava III – consists of City Boroughs Nove Mesto, Raca and Vajnory;
- District: Bratislava IV – consists of City Boroughs Karlova Ves, Dubravka, Lamac, Devin, Devinska Nova Ves and Zahorska Bystrica;
- District: Bratislava V – consists of City Boroughs Petrzalka, Jarovce, Rusovce and Cunovo.

1.1. Population Growth

Table 1.1 shows the development of Bratislava's population in the period between 2008 and 2018. The population has been steadily increasing since 2008 with exceptions in the years 2010 and 2011 when there was a slight decrease in the number of men, and in 2016 and 2017 when there was a slight increase in the numbers. Bratislava's female population has remained mostly steady throughout this period.

Table 1.1. The population dynamics of Bratislava since 2008 by gender [1].

Year	Population	Men	Women
2018	432 832	203 658	229 174
2017	429 432	201 799	227 633
2016	425 883	199 767	226 116
2015	422 453	197 921	224 532
2014	419 788	196 271	223 517
2013	417 597	195 199	222 398
2012	415 405	194 198	221 207
2011	413 054	193 103	219 951
2010	433 077	203 440	229 637
2009	431 067	202 440	228 627
2008	428 530	201 049	227 481

In terms of population growth, a study conducted on Bratislava's demographic potential anticipates a natural decline shortly after 2020 according to all three scenarios considered. On the other hand, the migration prognosis varies: in the most conservative scenario it is on a decline, in the moderate scenario it remains steady, and in the optimistic case it is on the increase then remains steady. The highest natural population decline is expected just after 2030 in all three scenarios, where the number of deceased people is expected to exceed the number of new-born citizens. At this milestone, the annual values of natural population decline are estimated to be around 1 400 inhabitants/year. According to the moderate scenario of the forecast, by 2034, the annual natural population increase in Bratislava will be lower than present by more than 2 300 inhabitants. In the next period (years 2035-2050), it is expected that the natural decline in Bratislava's population will slightly decrease. Annual values of population decline in the middle of the 21st century will range from -600 (optimistic scenario)

to -1 750 persons (conservative scenario). In the case of less favourable demographic trends and lower immigration, Bratislava's population might decrease after 2025. It is expected that in 2050, the population will be from 420 000 to 490 000; most likely just below the limit of 460 000, which amounts to an increase of less than 8% compared to the current situation [2].

1.2. Age

The most accelerated population ageing in Bratislava is expected by 2035. In less than twenty years, the average age of the population will increase by more than four years, resp. 10%. Subsequently, the ageing will slow down, and shortly after 2040, the ageing of Bratislava's population should stop at values that are more than five years higher compared to the present. More intensive population ageing is not expected in Bratislava [2].

1.3. Population density

Bratislava's population density has not changed rapidly since 2008, which is, in fact, a positive indicator for the future development of the city. The lowest density was reached in the year 2011. Table 1.2 below shows Bratislava's population density per km^2 [1].

Table 1.2. The population density in Bratislava – persons per km^2 [1].

Year	Population density [per km^2]
2018	1172.97
2017	1163.53
2016	1154.51
2015	1146.01
2014	1138.47
2013	1132.91
2012	1127.2
2011	1120.17
2010	1175.16
2009	1168.72
2008	1163.49

1.4. Average age distribution and life expectancy

The ageing index compares the number of seniors (persons aged 65 and above) to the number of children, i.e. children under 15 years. It is one of the basic indicators for a population's ageing dynamics. In general, demographically young populations are characterized by the predominance of children, and the opposite is found in demographically ageing and old populations. According to the Study of Demographic Potential of Bratislava, despite the decline of the ageing population in the last ten years, the ageing index is the highest in the central

parts of Bratislava. Except for the fifth district, it is already possible to identify the prevalence of the number of seniors over children in all districts. There is a certain slowdown in the growth of the ageing index in some urban districts as a result of increased fertility, and thus a more dynamic increase in the weight of the child component in proportion to that of the seniors. This is usually the case of boroughs which offer new development areas. Also, Bratislava is the centre of economic activity in the country with many universities, which makes it appealing for people to migrate and settle there for work or studies.

From an economic point of view, the ratio of the productive and non-productive share of the population is the most relevant. The economic index is defined as the ratio of the number of children (0-14 years) and seniors (65+ years) per one or per one hundred people of working age (20-64 years). The total economic index was in decline in the 1990s and at the beginning of the new millennium. The cause was a sharp drop in the children component. Since then, the overall economic index has remained steady on average with a slight increase over the past five years in some of Bratislava's districts. In the long term, the lowest ratio between the unproductive and the productive component is foreseen to be in Bratislava's fifth district. In contrast, the highest is foreseen to be in the first district (Old Town) where the senior component is higher with a lower proportion of children [2].

As Table 1.3 below shows, the highest percentage of citizens in Bratislava is represented by the category "productive aged resident". The least number of citizens are aged 85 + years [1].

Table 1.3. The population of Bratislava by age categories (2019) [1].

Age	Population	%
(0-5)	32652	7.54
(6-17)	45647	10.55
(18-24)	20241	4.68
(25-34)	64266	14.85
(35-44)	82414	19.04
(45-64)	109270	25.24
(65-84)	70185	16.21
(85+)	8189	1.89

Life expectancy in the city of Bratislava between the years 2007 and 2018 is as seen in Table 1.4 below. The statistics also show a noticeable difference between men and women, with women in Bratislava having a slightly longer life expectancy than men. [3]

Table 1.4. Life expectancy for different sexes in the five administrative districts of Bratislava [4].

Life expectancy in male citizens	2007-2011	2008-2012	2009-2013	2010-2014	2011-2015	2012-2016	2013-2017	2014-2018
Bratislava I	75.37	75.47	75.51	76.34	76.66	76.85	77.19	77.41
Bratislava II	73.46	73.59	73.79	74.32	74.66	74.87	75.14	75.32
Bratislava III	73.36	73.47	73.74	74.17	74.50	75.10	75.24	75.64
Bratislava IV	75.34	75.39	75.76	75.92	76.28	76.52	76.85	76.96
Bratislava V	73.65	73.92	74.31	74.32	74.69	74.68	74.53	74.50
Life expectancy in female citizens	**2007-2011**	**2008-2012**	**2009-2013**	**2010-2014**	**2011-2015**	**2012-2016**	**2013-2017**	**2014-2018**
Bratislava I	81.37	81.95	82.12	82.30	82.41	82.26	82.29	82.34
Bratislava II	80.15	80.55	80.79	81.12	81.17	81.60	81.82	81.70
Bratislava III	80.46	80.98	81.41	81.39	81.60	81.45	81.32	81.22
Bratislava IV	80.45	80.64	80.97	81.44	81.89	82.23	82.46	82.75
Bratislava V	80.07	80.57	80.93	80.85	81.11	80.90	80.60	80.54

1.5. Poverty index

According to the publication of the Slovak Statistical Office on income and living conditions (EU-SILC), the number of people at risk of poverty living in the Slovak Republic has decreased over the last decade. The region of Bratislava remains the least vulnerable region in terms of poverty, where the at-risk-of-poverty rate was at 4.6 %, which is below the national level of the Slovak Republic (12.4 %). According to EUROSTAT, this indicator does not measure wealth or poverty, but low income in comparison to other residents in that country, which does not necessarily imply a low standard of living. Bratislava region also has the lowest percentage of people at-risk-of-poverty or social exclusion (8.6 %) in all Slovak Republic (average in the Slovak Republic is 16.3 %). This indicator corresponds to the sum of persons who are at risk of poverty or are severely materially deprived or living in households with very low work intensity [5] [6].

1.6. Population growth rate and vulnerable groups

Bratislava has seen steady population growth over the decades. Its position as the capital city and the fact that it is home to many corporations indicate that this growth pattern is likely to continue. The city's location, economic potential and favourable business conditions for entrepreneurs make it an ideal location for start-ups as well as international corporations. The number of legal persons has risen by 4% in the period 2014-2018. However, the number of self-employed persons has been on a steady decline (- 25% since 2014). The housing stock has increased astonishingly by 64.4 % (completed apartments 2014-2018), with new development projects densifying the city, but also spreading over what used to be agricultural areas, unused land or brownfields (e.g. in the city boroughs Petržalka, Devínska Nová Ves, Dúbravka, Ružinov, Nové Mesto, etc.) [3].

With the support of the Horizon2020 project RESIN, Bratislava was able to elaborate the results of the risk-based vulnerability assessment in a comprehensive Atlas of climate change impacts on Bratislava City with a particular emphasis on the impacts and risks to its population and critical infrastructure (road infrastructure and built areas). The assessment was done using the IVAVIA tool and had two stages – a qualitative and quantitative part, with the participation of local stakeholders in the assessment process. The assessment is used as a strategic planning tool, as well as a supporting document for different administrative tasks performed at the City Hall. For this assessment, several vulnerable population groups were identified by local stakeholders in the qualitative assessment workshops: In the case of heatwaves, it is mainly the elderly population over 65 years and the population under 14 years of age, people with cardiac and respiratory diseases, and hospitalised and homeless population groups. Age, health situation and overall capacity and means for responding to the negative impacts of heatwaves are all precursors for defining the vulnerable population groups in Bratislava. Since both case study areas represent famous monuments of national and even European importance, tourists need to be also included amongst the vulnerable populations in future assessments [7]. The level at which the assessment was undertaken was the city boroughs; however, the majority of the indicators were created first on a finer scale – developed based on existing data and information (object level which is finer than the borough level resolution) and then generalised to borough level.

1.7. Economic features

Gross value added (GVA) in current prices for the Slovak Republic was slightly over 76.43 billion EUR in 2017 of which 21.372 billion EUR was generated by the Bratislava region (NUTS 2) as seen in Table 1.5 below. Gross value added at basic prices (in USD billion) is shown in Table 1.6. Both Tables show a steadily increasing trend in Slovak Republic's economic productivity [1].

Table 1.5. Gross value added in current prices (in mil. EUR) [1].

	Slovak Republic	Region of Bratislava (NUTS 2)
2017	76 430.454	21 372.567
2016	73 436.195	20 716.842
2015	71 446.186	20 116.751
2014	68 907.405	19 120.993
2013	67 521.912	18 940.368
2012	66 410.254	18 150.194
2011	63 981.788	17 753.312
2010	61 368.250	17 245.925
2009	58 032.905	16 274.844
2008	62 121.709	16 322.383

Table 1.6. Gross value added at basic prices in USD billion [1]

2018	80.494
2017	75.786
2016	72.948
2015	71.776
2014	68.843
2013	67.264
2012	66.775
2011	64.088
2010	61.659
2009	57.993
2008	61.813

Gross domestic product in the Slovak Republic in 2018 was 3.9%. This constitutes an increase in comparison with the previous two years but is not the best result when considering a ten-year window. The highest rate of real GDP per capita occurred in 2010 as the peak reached 5.5%. On the contrary, the worst result was noticed in 2009 when the rate was negative (See Table 1.7 and Figure 1.2) [1].

Table 1.7. The annual growth rate of real GDP per capita [1].

2018	2017	2016	2015	2014	2013	2012	2011	2010	2009	2008
3.9 %	2.9 %	2.0 %	4.7 %	2.6 %	0.5 %	1.7%	3.5 %	5.5 %	-5.7 %	5.4%

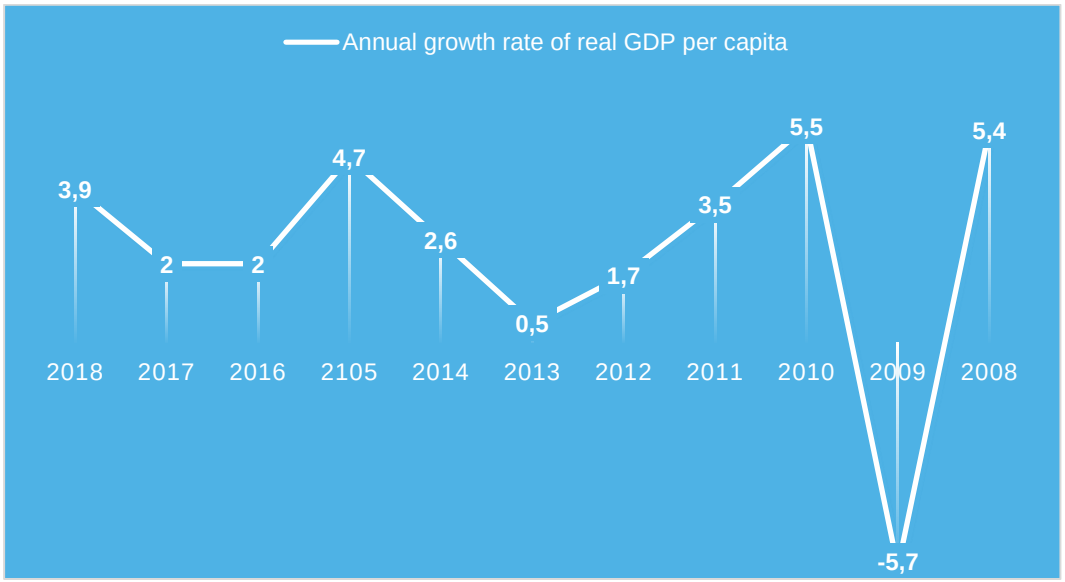


Figure 1.2. The annual growth rate of real GDP per capita in yearly % [1].

Table 1.8 below presents the gross domestic product by production divided into eleven economic sectors. The highest GDP in 2018 was reached in manufacturing, wholesale, automotive services and gastronomy as well as in public services, education, health and social work. The lowest GDP was reached in arts, entertainment and recreation [1].

Table 1.8. GDP by production at current prices in mil. EUR [1].

Sectors	2018**
Agriculture, forestry and fishing	2 119.88
Manufacturing total	20 661.03
of which Industrial production	17 653.49
Construction	6 374.75
Wholesale and retail trade; repair of motor vehicles and motorcycles; transportation and storage; Accommodation and food service activities	15 684.99
Information and communication	3 786.20
Financial and insurance activities	2 508.01
Real estate activities	7 902.13
Professional, scientific and technical activities	8 166.85
Public administration and defence; compulsory social security; education; human health and social work activities	11 626.46
Arts, entertainment and recreation	1 664.61
Gross value added by economic activity total	80 494.91
Taxes on products except for subsidies on products	9 226.05
Gross domestic product	89 720.96

Table 1.9 below demonstrates the strongest areas of the service sector. The dominant area on the Slovak market is mainly real estate activities together with the commercial real estate market where retail and offices dominate. The second one is public administration and social security, followed by wholesale and retail trade which are related to the fact that, e.g. real estate activities play an important role in the Slovak market [1].

Table 1.9. Gross value added by industry at current prices in mil. EUR [1].

Type of industry, service	mil. EUR
Real estate activities	7902.13
Public administration and defence; compulsory social security	5581.18
Wholesale trade except for motor vehicles	4299.79
Retail trade except for motor vehicles	4119.74
Land transport and transport via pipelines	3066.49
Human health activities	2559.24
Electricity, gas, steam and air conditioning supply	1973.12
Financial service activities, except insurance and pension funding	1870.62
Warehousing and support activities for transportation	1682.85
Computer programming, consultancy	1664.34
Legal and accounting activities	1332.21
Activities of head offices; management consultancy	1329.80
Office administrative, office support	1243.47
Architectural and engineering activities	1195.77
Telecommunications	1140.11
Wholesale, retail trade and repair of motor vehicles	918.48
Civil engineering	895.72
Food and beverage service activities	877.87
Advertising and market research	716.43

1.8. Employment

The highest number of employed people is in the District of Bratislava I – Old Town with almost 6000 more than the District of Bratislava II – Ružinov, Vrakuňa, Podunajské Biskupice for example. The lowest number of registered employed people is in the District of Bratislava V – Petržalka, Jarovce, Rusovce, Čunovo. In the Slovak Republic, the sectors with the most employed people are manufacturing, wholesale and retail trade, repair of motor vehicles, and motorcycles. Manufacturing is essential mainly for the Districts II-IV. The wholesale and the

automotive services are important for all of Bratislava's Districts. See Table 1.10 below for employed people per economic activity [1].

Table 1.10. Employed people by economic activity collected through workplace method [1].

	Slovak Republic	District of Bratislava I	District of Bratislava II	District of Bratislava III	District of Bratislava IV	District of Bratislava V
Total	1 589 270	104 468	98 790	54 930	44 988	29 576
Agriculture, forestry and fishing	37 334	N/A	206	N/A	-	100
Manufacturing total	437 396	4 296	11 191	5 555	17 915	1 531
Mining and quarrying	6 221	N/A	-	-	N/A	N/A
Manufacturing	389 323	3 102	7 741	5 255	16 901	1 137
Electricity, gas, steam and air conditioning supply	16 462	981	1 269	N/A	N/A	N/A
Water supply; sewerage, waste management and remediation activities	25 390	N/A	2 181	N/A	158	258
Construction	71 288	1 158	6 866	2 544	571	1 654
Wholesale and retail trade; repair of motor vehicles and motorcycles	219 481	15 580	18 607	10 258	5 857	7 508
Transportation and storage	111 663	4 995	5 902	8 486	3 608	2 037
Accommodation and food service activities	31 257	3 434	1 300	1 001	617	657
Information and communication	44 082	3 391	11 480	3 083	2 805	3 929
Financial and insurance activities	30 348	11 676	5 607	2 463	695	1 033
Real estate activities	21 032	D	2 015	D	367	286
Professional, scientific and technical activities	76 931	19 760	8 875	4 278	3 274	2 659
Administrative and support service activities	68 001	6 797	5 825	1 704	1 122	2 620
Public administration and defence; compulsory social security	143 013	14 637	6 197	5 394	1 725	1 593

	Slovak Republic	District of Bratislava I	District of Bratislava II	District of Bratislava III	District of Bratislava IV	District of Bratislava V
Education	142 099	6 965	4 163	3 508	4 989	1 668
Human health and social work activities	113 099	4 240	8 093	3 699	996	1 347
Arts, entertainment and recreation	24 609	3 414	1 391	792	186	470
Other service activities	17 637	2 376	1 073	1 029	260	485

1.9. Unemployment

Over three years (2016-2018), a noticeable decrease in unemployment rates can be marked, registering the lowest rate over the last ten years. The highest unemployment rate was noticed in 2012 and can be connected to the European debt crisis. The highest unemployment rate in the District of Bratislava I-II was in 2014, District of Bratislava III-V in 2013 (see Table 1.11 below) [1].

Table 1.11. The registered unemployment rate in the Slovak Republic and in the districts of Bratislava City in % [1].

Year	Slovak Republic	District of Bratislava I	District of Bratislava II	District of Bratislava III	District of Bratislava IV	District of Bratislava V
2018	5.04	2.66	2.83	2.94	2.62	2.07
2017	5.94	2.91	3.39	3.40	3.12	2.51
2016	8.76	4.11	4.70	4.83	4.69	3.89
2015	10.63	4.81	5.63	5.69	5.14	4.67
2014	12.29	**4.99**	**6.67**	5.87	5.49	5.30
2013	13.50	4.93	6.08	**5.90**	**5.71**	**5.70**
2012	**14.44**	4.15	5.48	5.58	4.66	4.93
2011	13.59	3.53	5.60	4.65	4.36	4.98
2010	12.46	3.18	4.6	3.80	3.58	3.98
2009	12.66	2.71	4.00	3.39	3.39	3.84
2008	8.39	1.46	1.87	1.75	1.75	2.06

As can be seen in Table 1.11, the highest number of unemployed young people in 2017 was in District of Bratislava II. The highest unemployment rate in the age group from 15 to 24 was in 2012, coinciding with the highest unemployment registered for the overall population. One potential reason for this is the immigration of people in search of work due to the European debt crisis [1].

Table 1.12. The unemployment rate in the Slovak Republic in % [1].

	2017	2016	2015	2014	2013	2012	2011	2010	2009	2008
15-64	8.2	9.7	11.5	13.2	14.3	14.0	13.7	14.4	12.1	9.5
15-24	18.9	22.2	26.5	29.7	33.7	34.0	33.4	33.6	27.3	19.0
25-54	7.6	8.7	10.5	12.0	12.8	12.4	12.1	12.8	10.8	8.7

Table 1.13. Unemployed citizens by age in Districts of Bratislava I-V [1].

Age group	Total	District of Bratislava I	District of Bratislava II	District of Bratislava III	District of Bratislava IV	District of Bratislava V
Total	7 919	673	2 196	1 251	1 761	2 038
15 – 19	68	2	**28**	11	11	16
20 – 24	555	50	**162**	88	140	115
25 – 29	1 031	77	**302**	173	247	232
30 – 34	1 109	88	257	174	228	362
35 – 39	1 208	93	322	176	247	370
40 – 44	1 015	112	298	159	229	217
45 – 49	751	54	236	139	205	117

1.10. Old Town and Devin city boroughs

1.10.1. Overview

The Old Town City Borough (where the monument preservation reserve and preservation zone is located) is a historical centre of Bratislava City. It is the most visited part of Bratislava by tourists. In addition to historical monuments, there are many museums, galleries, embassies, consulates and governmental and state offices and institutions, newly built high-rise office buildings, restaurants and bars. The historic core of Old Town, which is partly surrounded by medieval fortification walls, is a pedestrian zone.

Figure 1.3. Aerial view of Bratislava in autumn time, on the photo we can observe most of the historical city centre, the Bratislava Castle on the southern tip of Male Karpaty mountain range and St. Martin´s Cathedral. Partly also the Hviezdoslavovo square and the Main square. Photo: P. Chromek, Foundation for Cultural Heritage Preservation.

The Devin city borough is a city borough of a rather rural character. The first settlements date back to 1800 AD. The city borough is located in the western part of the City territory (see Figure 1.1), between the Danube River and the Devínska Kobyla natural reserve, just several kilometres away from the Old Town City borough. It is known for Devin Castle; a national natural and cultural heritage site and for winemaking. Despite its rather small population, Devín is the fastest growing city borough with 32% newly build-up area since 2014 [3].

Figure 1.4 (left). Devin Castle from the air. Photo: P. Chromek, Foundation for Cultural Heritage Preservation. Figure 1.5 (right). Devin – the upper castle on the cliff, where the hazard of rockfall is monitored. Photo: M. Musilová, MUOP.

The Old Town City Borough has an uneven distribution of the different age categories, with the elderly population prevailing. During an ordinary working day, the Old Town receives a large number of people commuting there for work and education from other city boroughs as well as from satellite settlements located outside the city borders. In Devin, however, the age categories are more evenly distributed, and its citizens commute to work to other boroughs. Vulnerable population groups in both city boroughs are mainly the elderly (especially in the Old Town City borough), children and visitors (tourists). Another vulnerable group is the hospitalised people in many healthcare and hospital facilities in the Old Town.

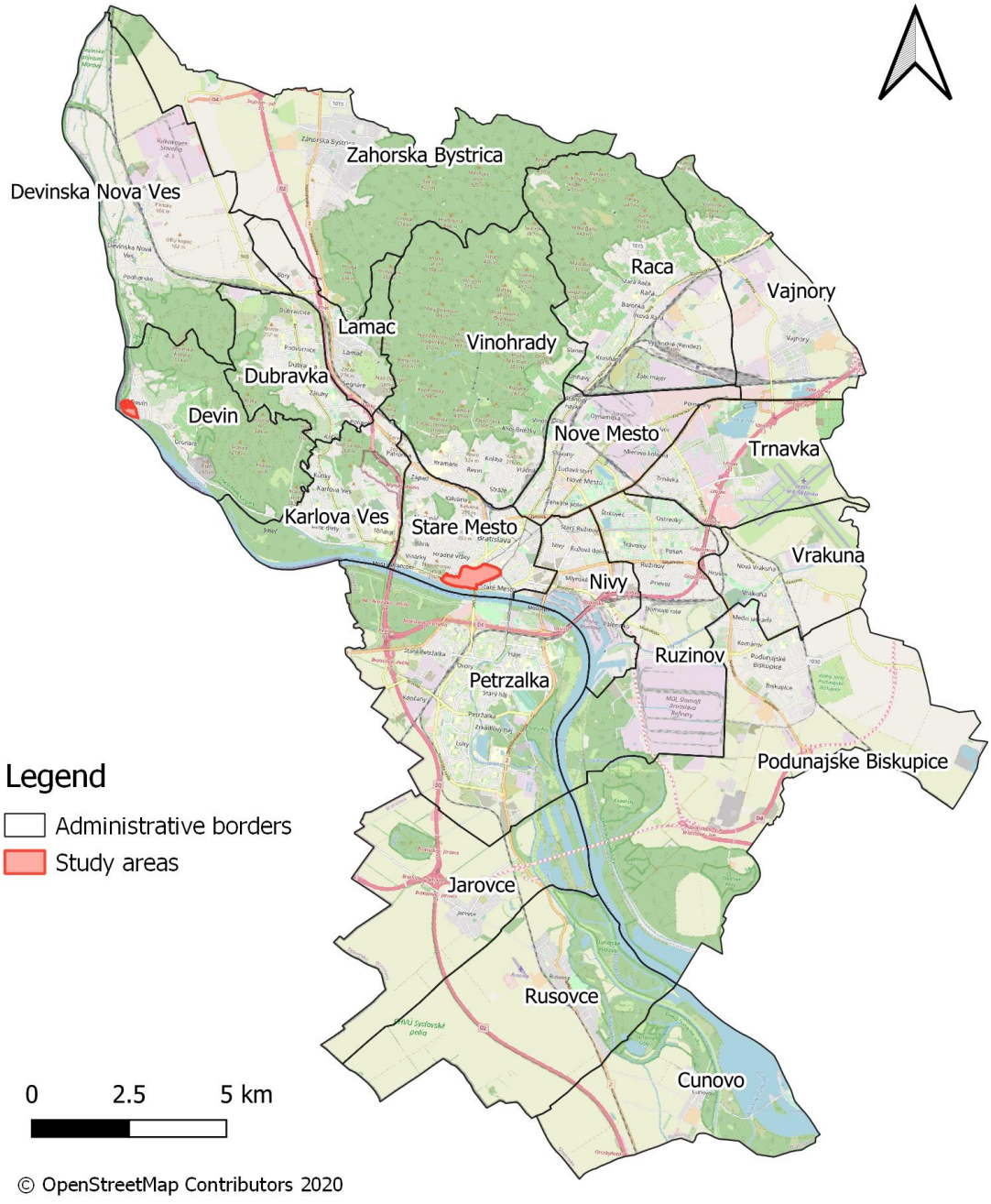


Figure 1.6. The focus sites in Devin City borough and Stare Mesto (meaning Old town in English).

1.10.2. Overview of the existing local frameworks for cultural heritage management, disaster risk reduction and climate adaptation

Both city boroughs – the Old Town and Devín, are of exceptionally high cultural importance, and monuments of national significance and many archaeological findings can be found here in large numbers. All heritage assets and their respective conditions are listed in the **Central List of Monuments Stock of the Slovak Republic**, maintained by the Monuments Board

(MB) of the Slovak Republic, which contains registers of immovable and movable cultural monuments, monument preservation zones and reserves. It is the primary groundwork for the performance of the state heritage administration. It applies to those assets that are considered national conservation monuments (NCM) and are subject to the highest legislative protection as governed by the **Act of the National Council of the SR No 49/2002 on the Protection of Monuments Stock** (as amended by the Act of the NC SR No 479/2005 Coll). The condition of heritage assets is also partially monitored by the **Principles of Protection of Conservation Sites (Zones, Reservations)** developed by the Monument Board of the Slovak Republic. The latter was established in 2002 and ensures the protection of the monuments stock of the Slovak Republic, following scientific findings and international conventions on the protection of cultural heritage. The Monument Board of the Slovak Republic has assumed decision-making power in legal terms, provided by the Monuments Act and the Statute.

The Municipal Monument Preservation Institute in Bratislava (MUOP) – a municipal research and preservation organisation, also runs a catalogue of city sights, which have lesser legislative protection.

Besides, information that has already been mapped out regarding disaster risk reduction, climate adaptation and cultural heritage management in the City of Bratislava is provided below. It will be expanded in Chapters 3, 4 and 5:

- Emergency response procedures and responsibilities in the city;
- Existing adaptation measures, strategies and key legislation in the city;
- Existing cultural heritage protection measures, strategies and key legislation in the city;
- Existing databases on climate risk information for the city;
- Decision-making structures in the city regarding adaptation;
- Decision-making structures in the city regarding cultural heritage protection;
- Inventory of heritage assets and their condition.

2. Target historic areas identified for ARCH

The target historical objects are in the historical city centre as well as at the City's outside border (see Figure 2.1 below).

Figure 2.1. Location of historical monuments selected for ARCH project. Source: UNIBA.

2.1. Historical monument preservation reserve (Old Town City Borough)

Bratislava's historical centre is situated within the ancient city walls in the Old Town city borough. Based on the terrain and the character of development, the Old Town can be divided into four areas: the western part, the northern part, the eastern part and the historical centre with the Bratislava riverfront (on the left bank of the Danube River). From monument preservation and historical perspectives, the area can be divided into a central historical monument zone and monument reservation (the medieval core of Bratislava). The monument preservation zone is further divided into smaller areas called sectors, based on the character of built-up area, architecture, terrain and landscape.

Figure 2.2. The Bratislava Castle with the St. Martin´s Cathedral in the background. Source: www.visitbratislava.com.

The western part of the Old Town is different from the other parts; it is situated on the Small Carpathian Mountain foothills, and mainly provides residential housing (villa houses). The western border of the Old town is the Mlynska valley – which was once a valley of watermills and its history translates into its current name (*mlyn* means *mill*). The Bratislava Castle is situated on the southernmost tip of the Small Carpathian Mountains and above the western side of the medieval fortification walls (with the northern and western sections of the walls still standing). The historical centre reaches to the left of the Danube (Dunaj) river bank. The northern and eastern borders of the historical centre are outlined by the Square of Slovak national uprising and Štúrová Street. The eastern and northern parts of Old town city borough are mostly residential with amenities and services as well as modern high-rise buildings (Mlynské Nivy, Eurovea, Landererova, Pribinova street), an international bus station and the river port (cargo and passenger). The northern border of the Old Town is outlined by the railway which connects Bratislava with the Czech Republic and Austria.

The surface area of the Old Town Borough is approximately 10 km^2 and has a population of 41 095 (population density is thus more than 4 000 inhabitants per km^2, 2018). During the day, around 70 000 commuters travel to the Old Town Borough. This makes it Bratislava's most crowded borough.

Bratislava's Old Town is known for St. Martins Cathedral and its many churches, the Bratislava riverfront and cultural landmarks (monuments). It is also the residence of most of the foreign states embassies and important Slovak institutions, including the National Council of the

Slovak Republic and Parliament building; the Summer Archbishop's Palace, the seat of the Government of Slovak Republic; and Grassalkovich Palace - the seat of the President of Slovak Republic and other important governmental institutions (such as the Ministry of Interior, the Ministry of Culture, Ministry of Foreign Affairs and the Ministry of Justice).

Figure 2.3. The Michael´s gate – the last standing of four gates of the city fortifications walls. The historical core of the city is a designated pedestrian zone called "Korzo". Photo: www.visitbratislava.com.

Other notable buildings, squares and streets include Trinity Church, Bratislava's Town Hall, Michael's Gate, the Primate's Palace, Comenius University, the Slovak National Theatre, National Uprising Square (Námestie SNP), the Main Square (Hlavné námestie), Hviezdoslav Square (Hviezdoslavovo námestie), Kamenné námestie ('Stone Square'), Obchodná Ulica ('Shop Street'), the building of the Pharmacy Salvator, Zochova Street from the 19th century and many other old churches and palaces. There are still some remnants of the medieval fortification walls (the northern and western section), currently closed to the public due to reconstruction.

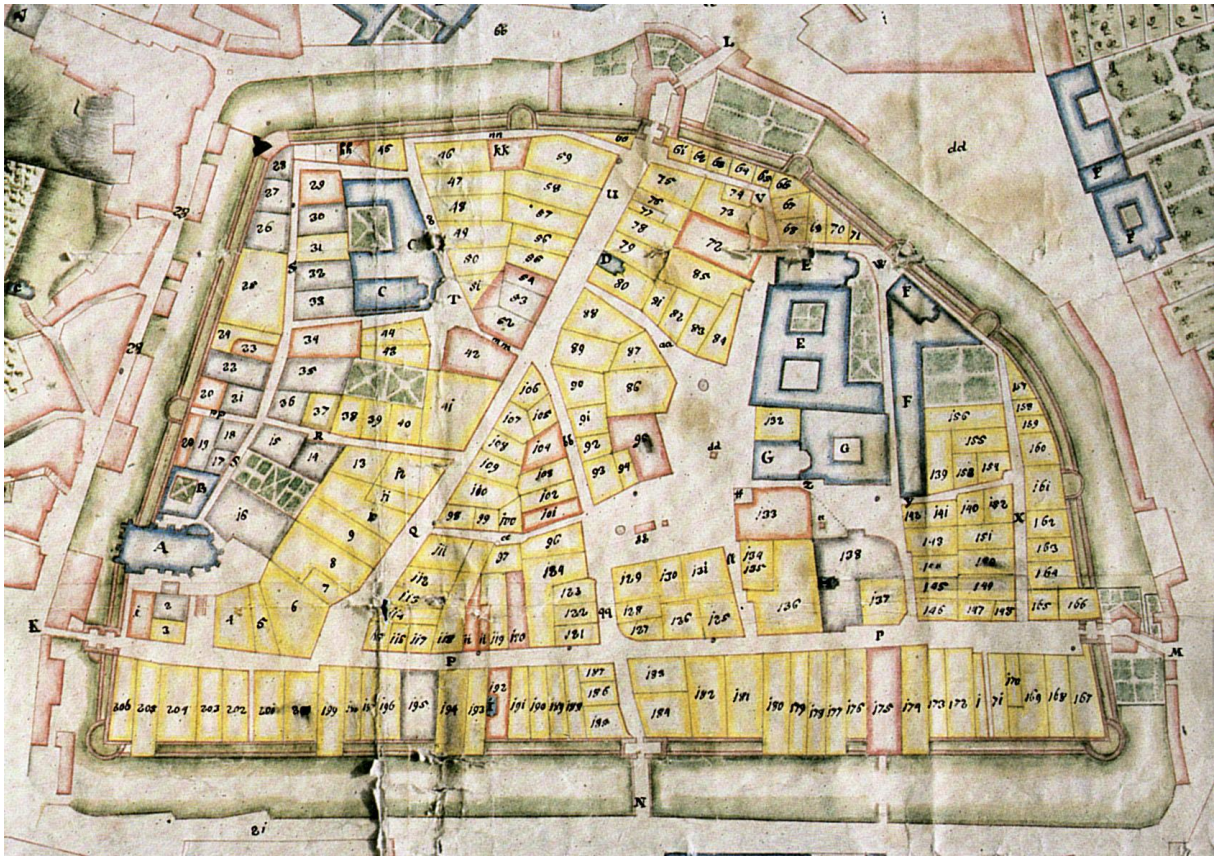


Figure 2.4. Bratislava plan of 1765, which was prepared by Michael Marquart, and therefore, we call it Marquart's plan. This plan is very valuable also as it shows the overall town fortification; shortly after its preparation, after 1775, significant changes occurred – by Maria Theresa's order the fortifications and gates (except the Michael's Gate) were torn down, many bastions were demolished, and embankments were refilled, on which new buildings were developed. Source: Archive of Bratislava City, inventory no. 1021.

There are several sites of Celtic specialised industry facilities in the territory of the historical monument preservation reserve in the Old Town dating back to the first century BC and the acropolis of a Celtic oppidum at the Bratislava castle hill. These include pottery kilns (Hlavné square, Uršulínska Street, Radničná Street 1), ironwork workshops (Ventúrska Street. 12/Zelená Street 10, Michalská Street 9), minting workshop (Panská Street 19) and an iron melting furnace on Rudnayovo square 4. These monuments, as well as other (unknown) underground monuments, are vulnerable to changes relating to surface permeability, intense precipitation and rising groundwater levels, which are driven by climate change and urban development in the surrounding areas**.**

Figure 2.5. A map showing the location of study sites in the historical monument reserve in Bratislava.

2.1.1. Celtic pottery kiln, Ápponyi House

In the western part of the Ápponyi House courtyard, a Celtic pottery kiln was found in 2007. The Ápponyi house belongs to the City Museum of Bratislava at Radničná Street 1. The twin chambered kiln of vertical type is on in situ display and is the best-preserved kiln. Its circular rack with evenly positioned air-holes had a diameter of 156 cm. One section of the rack had collapsed into the fire-pit, the other section remained intact.

Figure 2.6. The kiln in Ápponyi House (original) and its reconstruction. Authors: J. Minaroviech, J. Šimún, STUDIO 727. Source: MUOP.

Prints of the original twig structure which was burned in the course of firing are clearly visible on the reverse side of the rack. Hot air was drawn into the kiln from the pre-kiln pit via two heat ducts. The circular clay dome with a top opening which covered the upper chamber did not survive. Ceramic pottery shards were found in the fire chamber. Experiments have shown that depending on the dimensions of the kiln and its load, firing of a batch of pottery could take from 48 up to 72 hours. The kiln and the place around it were protected against the weather by simple roofing.

Figure 2.7. A 3D reconstruction of the original structure of the twin chambered kiln. Authors: J. Minaroviech, J. Šimún, Studio 727. Source: MUOP.

2.1.2. Celtic mint, Pálffy palace, City Galery Bratislava, Panská Street. 19, Bratislava

So far, the most extensive collection of technical ceramics comes from the Celtic workshop in Panská Street 19. The permanent exhibition of the Celtic minting is situated in the basement of the Pálffy palace. Besides the artefacts documenting the minting workshop (technical ceramics), there is also a pit with human bone remains on exhibition. The findings from the late 1980s consisted of dosage cups and fragments of clay plates used for dosing of coinage metals (silver, gold, lead and bronze); 75 casting cups and 22 fragments of dosages plates used for the production of coins on the site. The level of local metalworking is also attested to by an iron anvil, pieces of a clay mould, and smelting slag lumps. These findings are credible indications that a workshop of minting local coins was situated in this part of the Celtic *oppidum* of the *La Tene* period (140 – 1 BC). Possibly, there was more than one mint operating in the territory of Bratislava in the late *La Tene* period. The Celtic oppidum – a settlement of proto-urban character, was built around today's castle hill area.

Figure 2.8. The Celtic mint exposition inside the Pálffy palace. Photo: M. Musilová, MUOP.

2.1.3. Celto-Roman structures at the Bratislava Castle

Very recent archaeological research of the Bratislava castle, conducted by MUOP (Municipal Monument Preservation Institute in Bratislava) in the years 2008 – 2014, brought forth the discovery of precious Celto-roman architectures, built by Roman builders for the Celtic elite in the second third of the 1st century BC. The castle hill served as an acropolis of the Celtic city, the so-called *oppidum*. The stone architectures reveal the luxury of the Middle Danube region of that time. A structure with late Roman republican pavement of the *opus caementitium* type with floral patterns and meander was found under the palace courtyard. The *opus caementitium* pavement created part of a representative audience hall. Today, these finds are presented in situ. Similar types of such floors were found only in the Mediterranean area from the same period. Foundations of seven other buildings dating to the same period were found on the so-called Northern terrace of the castle. Three of them are also preserved *in situ.* The best preserved and presented is structure No. II - the Merchant´s House with luxurious imported goods and domestic Celtic wares. All Celto-Roman buildings are part of the so-called Celtic Path.

Figure 2.9. Details of the *opus caementitium* pavement and remains of Celto-Roman buildings found during the archaeological research lead by MUOP at the Bratislava the castle hill in 2008-9. Photo: B. Lesák, M. Musilová, MUOP.

2.1.4. Saint James's Chapel

Besides the above-ground historic buildings and monuments, there are many underground monuments preserved in situ within the monument preservation reserve in Bratislava. The Saint James's Chapel (Kaplnka sv. Jakuba) is the oldest sacral medieval structure and the only ossuary (charnel or bone house) in Bratislava. It is located underground next to the Old market hall (Stará tržnica) at the Slovak National Uprising square (Námestie SNP). Archaeological excavations in the late 1990s documented four structures from various times: a pre-Romanesque rotunda, a Romanesque charnel house and two construction stages of a Gothic charnel house. The rotunda was the oldest structure with the outer diameter of about 8.3 m, built around 1100. After its demolition around 1200, it was replaced by a Romanesque charnel house (a chapel with a circular floor plan, a semi-circular apsis, and an underground charnel house (bones house). The first record of the St. James´s Chapel dates to 1422; at that time, a Gothic chapel with rectangular aisle and polygonal apsis rebuilt around 1400, already stood there. The chapel was demolished during anti-Turkish actions around 1529.

Figure 2.10. A hypothetical reconstruction model of the different development stages of Saint James chapel and St. Laurence church. Authors: J. Minaroviech, B. Lesák, J. Hoššo. Source: MUOP.

Figure 2.11. Ossuary in the Saint James chapel. Photo: E. Pauditšová, UNIBA.

2.1.5. The fore-gate of the Fishermen`s Gate at Hviezdoslavovo square

The foregate of the Fishermen`s Gate is a uniquely preserved example of 15th-century Gothic fortification architecture in the Slovak Republic. The rectangular structure had two corner turrets and a drawbridge in the middle. It was built within the city's six-metre-deep moat. After infilling in the main carriage entrance, due to the threat of Ottoman invasion in 1529, only a small, lateral door for pedestrians survived. Also, a wooden bridge, the piles of which have been preserved, remained in use. In 1756 the Fishermen`s Gate and its foregate were restored and renamed after Empress Maria Theresa. The Empress later had it demolished in 1776. Today, visitors can observe the remaining walls of the gate through a glass plate at Hviezdoslavovo square. The walls on display were discovered by the archaeological research directed by PhDr. Margaréta Musilová from the Municipal Institute for Monument Protection in Bratislava (MUOP).

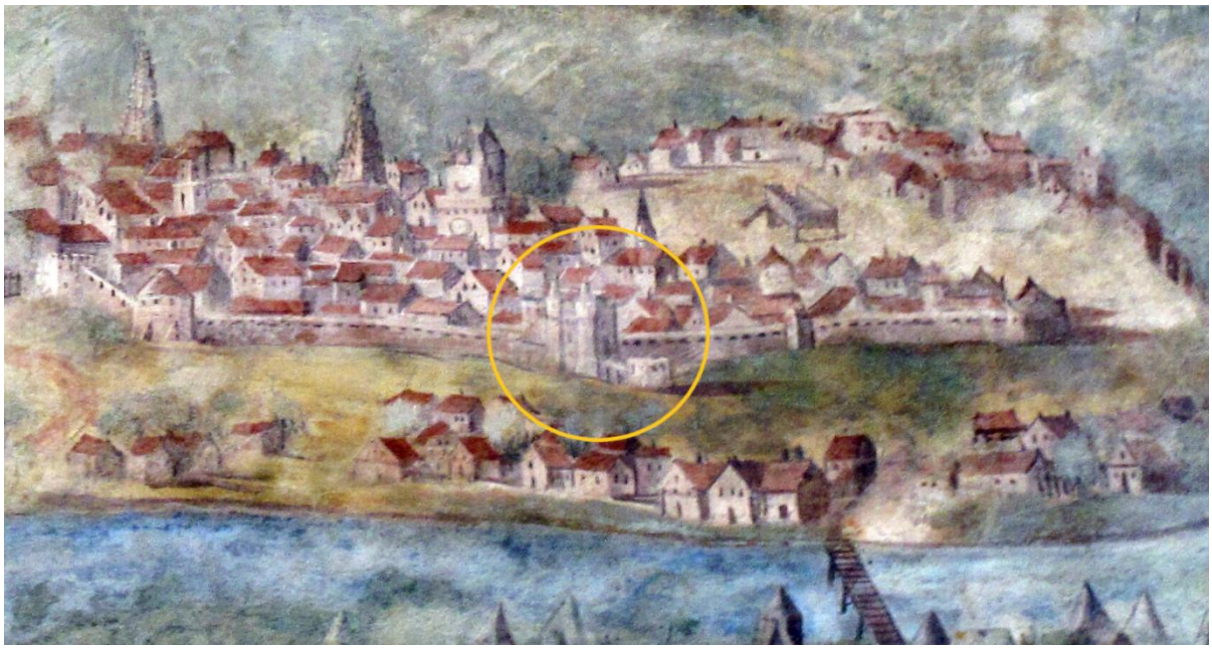


Figure 2.12. A fresco painting of Bratislava found on the Michelozzo courtyard in the Palazzo Vecchio in Florence. The yellow circle highlights the Fisherman´s Gate. Photo by: M. Musilová (MUOP).

Figure 2.13. The Fishermen`s Gate during and after excavation. Photo: M. Musilová, P. Horanský, MUOP.

2.2. Devín Castle (Devín city borough)

The Devín city borough is one of the smaller city boroughs in Bratislava. The population is 1 636 (2018), and the entire cadastral territory is roughly 14 km^2. The Devín city borough is situated in the western part of the cadastral territory of Bratislava City at the confluence of the rivers Morava and Danube. It is well known for the Devín Castle national monument, the ruins of which are one of the most visited monuments in Bratislava. Despite its small size, the Devín Castle Hill is surprisingly rich in rock variety and geological history starting from Early Paleozoic to Late Tertiary period. Twelve open fissures with narrow karst and pseudo-karst caves (16 – 13 million years old) are beneath the castle in the rock cliff, where a permanent exhibition was reopened in 2017. The castle is a historical monument of national as well as of European importance.

Figure 2.14. The Devin castle and its surroundings, before the recent reconstruction of the upper castle. Photo: P. Chromek, Foundation for Cultural Heritage Preservation.

Although located only several kilometres away from the city centre, the borough has a rural character with natural protected areas in its cadastral territory such as the Devínska kobyla national natural reserve (5th highest level of nature protection) and the alluvium of Morava river (4th level of nature protection). Above the confluence of the rivers Danube and Morava, a medieval castle's ruins are lying on the limestone promontorium (212 m a.s.l.) which belongs to the most important historical and archaeological sites of Central Europe. The cliff along with the castle offers charming natural scenery with a beautiful view. This National Cultural Monument is under the administration of the City Museum of Bratislava.

Figure 2.15. The Sandberg – at Devínska kobyla once used to be a sandpit. Today it is one of the most important paleontological sites in the country, protected with 5th (highest) level of nature protection. It is rich in fossil remains of marine coastal fauna and flora that lived the see that used to cover the area some 14 – 16 million years ago. Photo: www.visitbratislava.com.

Thanks to its strategic position, the Devín hill was settled by humans since the young Stone Age – Neolithic. The importance of the site rose with the significance of the crossroads of transcontinental Amber and Danube routes. The Celts built here a hillfort before the arrival of Germans. The Romans besieged the site at the turn of the ages. The significance of the site doubled after the Romans took permanent control of the Middle Danube and made the nearby town of Carnuntum (today in Austria) the capital of the Pannonia Superior Province in the 2nd century under Traianus.

The Germanic nobility adopted the Roman fashion of building stone residences, remains of which have been found on the Devín Castle hill too. The first written document about Devín is from the year 863 – in which the castle was referred to as Dowina. In the time of the Great Moravian Empire, Devín (Dowina) was an important fortification. A one-aisle church with a nearby cemetery was found on the castle hill, serving the local elite of the Slavs. After the fall of the Great Moravian Empire, the owners of the castle changed frequently and each gradually developed and extended it. The last noble family, which bought the castle, was the Pálffy family from 1635. The castle was hugely damaged in 1809, when the French army of Napoleon blew the castle up, and has not been restored to its original state since then In 1932 the Pálffy family sold the Devín castle to the Czechoslovak Republic for a symbolic 1000 crowns. Devín Castle became a symbol of the national awakening, and some of its fame was restored. Various sensitive reconstruction projects throughout the 20th century and very recent restorations of

the upper castle have helped to maintain the castle in better condition and make it accessible to the public.

In May 2017, the museum opened the upper part of Devín Castle with a new exposition in the caves in the cliff underneath the upper castle called “Devín Castle in the 13th - 20th Centuries”. Through more than 300 archaeological finds from Devín Castle, it presents the history and development of the castle, its owners and the most important events that took place in Devín.

The exposition is also complemented by the geological history of the castle and a unique presentation of the remains of the sea from the Tertiary period (16 million years ago), which are preserved here in the form of sea sand and also observable sea-level effects in the Devín rock cliff. Currently, there is ongoing archaeological and geological research in the area as well as plans for the reconstruction of ruins (the walls) and buildings on site.

Figure 2.15 and 2.16. New permanent exhibition “Devín Castle between the 13th and 20th centuries” in the cave of the upper castle (left), newly discovered structurally disturbed medieval fortification after removing of self-seeding trees (right). Photos: Bratislava City Museum, 2017.

2.3. Stakeholders

The following stakeholders are significant (in terms of direct monument protection competence) for the management and maintenance of both historical areas – the monument preservation reserve in the Old Town and the Devin Castle and its surroundings:

- Bratislava City Museum
- Bratislava City Gallery
- Old Town City Borough (municipality)
- Devín City Borough (municipality)
- Regional Monument Board of SR
- Slovak National Museum – Historical museum

The following stakeholders are considered relevant in terms of their competencies in different areas (not necessarily monument protection), which contribute to proper preservation of cultural monuments and historic areas:

- Bratislava-Old town city borough (municipality)
- Bratislava-Devín city borough (municipality)
- Metropolitan Institute of Bratislava (MIB)
- State Nature Conservancy
- Slovak Hydrometeorological Institute
- Bratislava Water Company
- Slovak Water Management Enterprise
- General Investor of Bratislava (GIB)
- Bratislava-self-governing region
- Bratislava Tourist Board

2.4. Challenges and hazards affecting the historical areas

The Old Town becomes increasingly crowded during the day as people commute to work or universities and visitors arrive either by buses or by ship cruises. Due to the high concentration of impermeable surfaces, high population density as well as the concentration of cultural heritage sites, the Old Town is especially vulnerable to climate change impacts such as pluvial flooding and heatwaves.

Figure 2.17. Model of the risk of pluvial flooding in the historical monument preservation reserve – the most vulnerable are the Laurinská, Panská street, Klariská as well as and Kapucínska street [7].

The high share of impermeable surfaces become quickly warmed up, and it gets very uncomfortable for pedestrians during the summer heatwaves. Paved roads and sidewalks, high building density, as well as topographical relief, increase the risks of pluvial flooding in the historical city centre. The Old Town is located at the foothills of Male Karpaty mountains, which are densely built-up with villa houses (see Figure 1.3.). During heavy rainfall, the rainwater comes rushing down into the lower parts of the historical centre. Underground historic buildings and monuments are at risk from pluvial flooding as a result of intensive rainfall periods, especially during summer months and augmented by aspects such as building density, surface permeability and terrain.

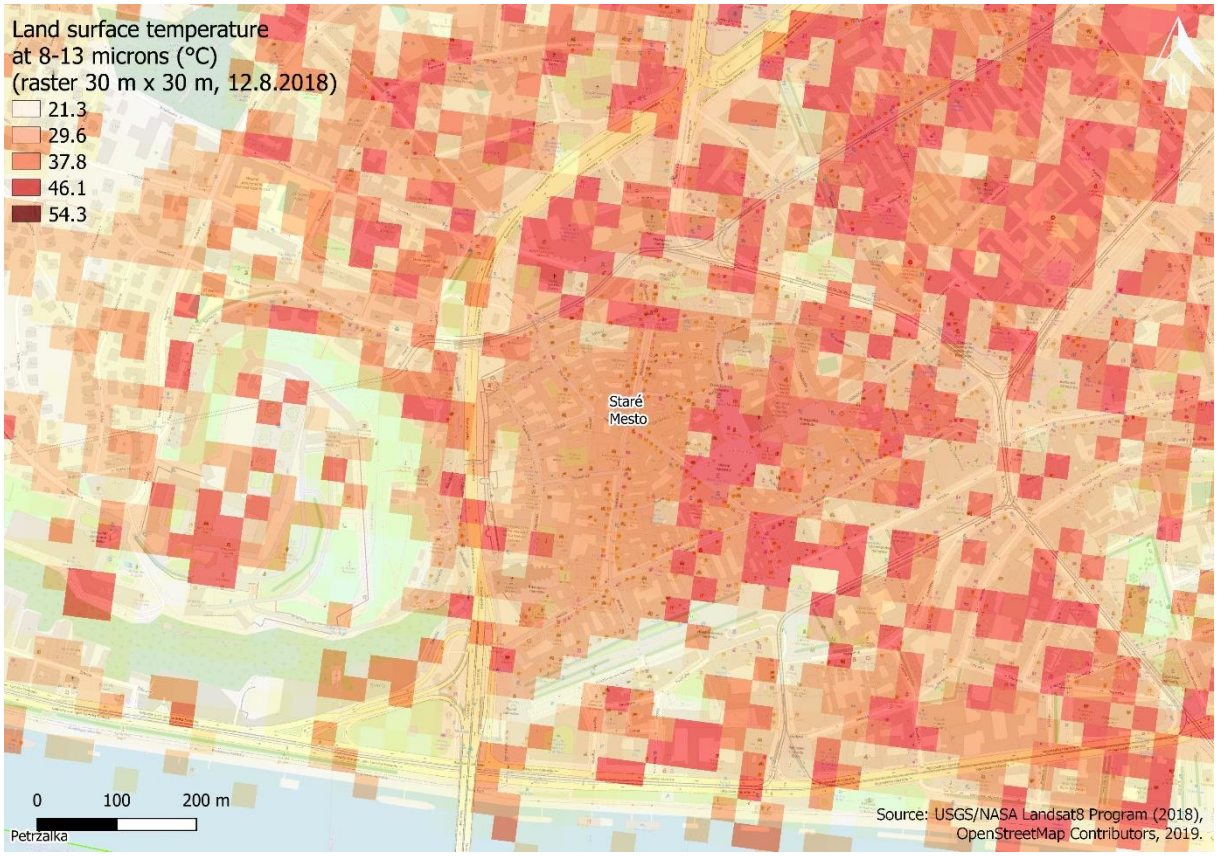


Figure 2.18. Land surface temperature model based on the evaluation of a multispectral satellite image of Landsat 8 [7]. The image shows the historical centre and the castle hill on the left.

Bratislava city is also planning the revitalisation of several squares, parks and courtyards as well as the reconstruction of medieval fortification walls so that they could be again accessible for the public. The public spaces which will be made greener and better suited to their functions also concerning the needs for adaptation to climate change are: the area of bus stops at Zochova street, Hodžovo sq., Freedom sq. (Námestie Slobody), Comenius sq., City hall sq., National Uprising sq., Suché mýto sq., Stone sq. (Kamenné nám.), Skatepark Nový Most and Park Dunajská street.

2.5. Gaps and needs for cultural heritage resilience

2.5.1. Old Town

The Old town itself has been evaluated as a borough with very high or high risk (compared to other boroughs) in all the areas of vulnerability assessment in the Atlas as follows: risk of extreme heat to the urban population, risk of pluvial flooding to the urban population, to buildings and to road infrastructure. The local stakeholders identified underground in situ archaeological objects and monuments as extremely vulnerable to intensive rainfall events, which are channelled through the narrow and paved streets into the historical city centre and some of the streets and buildings become flooded (especially their basements or lower levels). During summer, the accumulated heat from a series of tropical and supertropical days in

Bratislava makes walking in the city centre almost unbearable at noon and in the afternoons. The squares and paved public spaces with minimum shade, vegetation or breeze are the hottest surfaces.

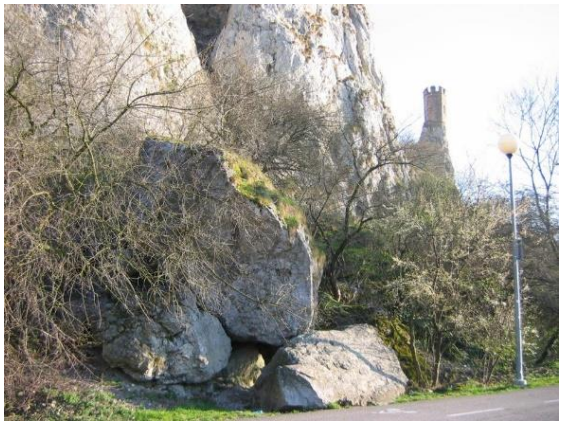
For the City to plan its implementation of adaptation measures and to its resilience to climate change impacts, there is a need to develop adaptation pathways for the historical monument reserve with possible additional applications in the Bratislava castle area or other areas adjacent to the historical monument reserve, where there are also buildings and monuments of great historical value. The measures need to be adapted to the current needs of multifunctional public space and to respect proper monument preservation practices and relevant regulations. Bratislava City has developed, with the support of H2020 RESIN project, a model of areas at most risk from pluvial flooding; however, this model is based only on above-ground hydrological models. What needs to be considered in more detail is the permeability of materials used on the surface, together with the dynamics of underground water, relief, buildings, and the capacity of the sewage system to name a few [7].

In terms of making the city more resilient to heat, Bratislava City has been relying mostly on the data from Landsat 8 on the land surface permeability and other information evaluated in the Atlas [7]. However, the Slovak Hydro-Meteorological Institute has been testing an urban heat model on the territory of Bratislava, and the results are already available for the public [8].

Figure 2.19. The Main square in Bratislava. In the second half of the 20th century, the park-like square was paved to match its origin from medieval times. In 2017 the City decided to plant mature trees on this square, and the adjacent Franciscan (Františkánske) square, to help ease the impact of summer heat on the pedestrian zone as can be seen in the picture. Photo: www.visitbratislava.com.

2.5.2. Devín Castle

The most significant hazard at Devín castle is most likely rockfall due to the erosion of cliffs and castle walls, thereby threatening the expositions in the caves and the safety of its visitors. In fact, the whole upper castle is going to be lost due to rockfall in the future; when this will occur is unknown. Climate change – especially droughts, extreme temperatures during summer and heatwaves – contributes to increased morbidity of vegetation and especially trees (as the vegetation becomes more prone to diseases), increased cost for maintenance and irrigation of natural assets as well as the built environment (castle walls, other service buildings present at castle site, etc.). This, however, is an overall condition relevant for urban vegetation in Bratislava, not just in Devín.



Figures 2.20 and 2.21. The danger of rockfall on the north-western side of the cliff (left), crack-gauge for monitoring rock displacement adapted specially for this Devin site using silica rods inert to temperature fluctuation (right). Photo: Bratislava City Museum, 2017.

The remaining castle walls are threatened by erosion due to the use of inappropriate materials for their reconstruction in the second half of the 20th century. The physical properties of the joining material used are different than those of the rocks which holds it together. This results in creating cracks and fissures in the castle walls when the temperature quickly changes, as well as during the winter months, where moisture and water enter the cracks and freezes which speeds up the process.

Within the subsystem 06 Stability of rock massifs under historical objects (which is a subsystem of the “Partial monitoring system of the Ministry of the Environment of the Slovak Republic” – see chapter 8), a complex continuous monitoring system was installed on Devín Castle (Bratislava) in November 2005, for monitoring static disturbances. The monitored sites are situated on a natural overhang in the central courtyard, by the staircase in the relic of the circular building with significant static failures and in the fortifications of the central castle. Based on the results of monitoring measurements, reconstruction work began at Devín Castle. Monitoring is currently suspended for technical reasons.

Restoration of the castle walls and the inner underground exhibitions, as well as the purchase of monitoring devices, was supported by previous projects funded by EEA Grants and Norway Grants. This included the monitoring of displacement of the most tectonically-disturbed parts of the rock cliff. The Bratislava City Museum oversees the implementation of active measures

as well, which include removing naturally seeded vegetation at the rock face (cliff), stabilisation of the loose parts, rainwater diversion in case of rock falls of smaller volume. Larger volume rock falls require stabilisation works – filling of the cracks, rock nailing and anchoring.

The Bratislava City museum together with the Bratislava City applied for external funds for the restoration of the remainder of most threatened walls. Another problem at the Devín castle seems to be rainwater and moisture that find their way into the caves and chambers, which are open to the public and used for expositions and the presentation of archaeological objects. Spreading of algae and fungi happens as a result of access humidity, which negatively impacts the condition of the exposed objects (see Figure 2.22). An air-drying system for reducing the humidity in the interiors has been installed; however, this measure is not as effective as needed.

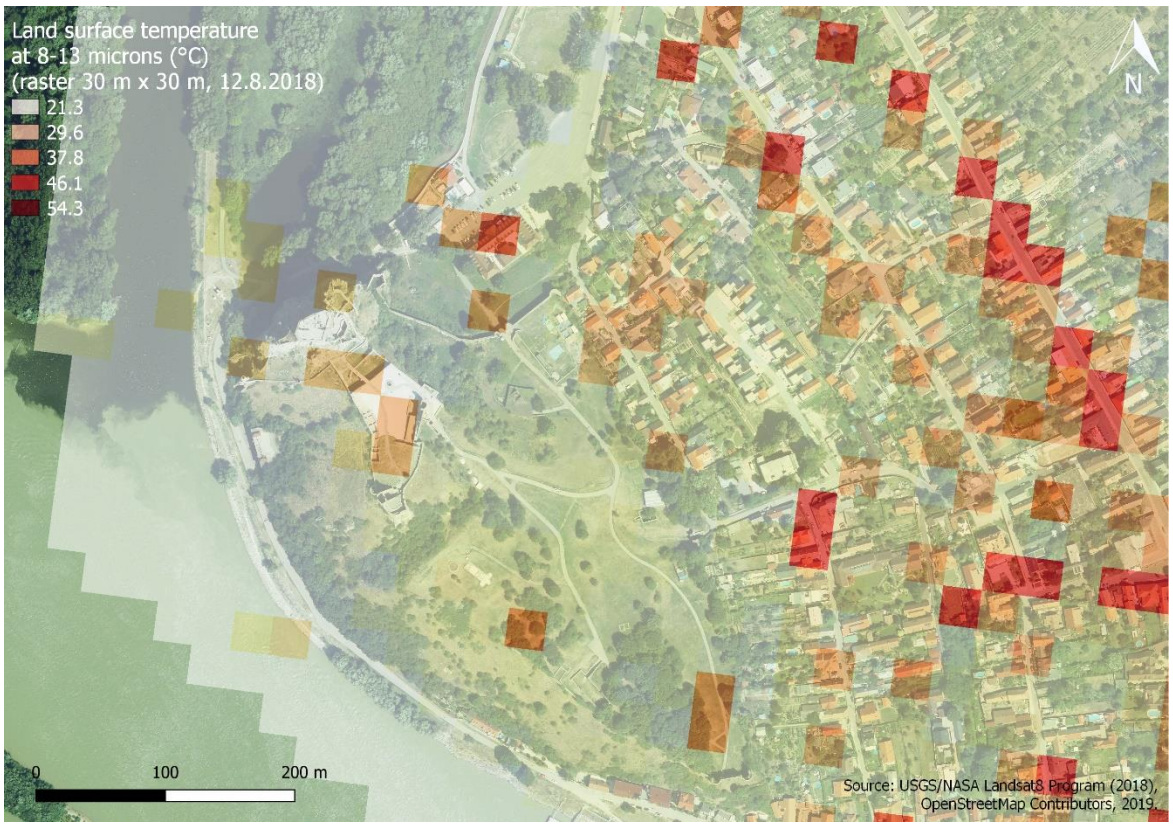


Figure 2.22. The land surface temperature model based on the evaluation of a multispectral satellite image of Landsat 8 [7]. The image shows the Devín Castle on the hill on the left.

Figure 2.23. Traces of moisture inside the caves in the upper castle (left), impact of the additional moisture can be seen on the remaining tertiary sands inside the cave (right), as green algae. Photo: E. Streberová.

Figures 2.24 and 2.25. Damage to the middle castle by rainwater (left), erosion in the castle walls in the upper castle (right). Photos: E. Streberová.

Another part of the Devín castle, the so-called middle castle, is covered partly in grass and party in a smaller fraction of gravel. Both these materials allow visitors to move freely and to explore. Planting of higher vegetation is not possible due to strong winds on the exposed castle hill and the possible damage that the roots could cause to the underlying chambers and caves. This makes it easy for the weather extremes to continue eroding the slightly sloped sections of the middle castle or to continue widening existing cracks or contribute to creating new ones in the castle walls.

3. Governance framework for cultural heritage management

This section looks at the governance framework for cultural heritage relevant to Bratislava's identified sites. It elaborates existing policies, strategies, visions and action plans for the management, protection and use of cultural heritage in Bratislava at the different governance levels.

3.1. International

The following international policies and declarations are relevant for the conservation of monuments in the Slovak Republic: the Convention for the Protection of Architectural Heritage of Europe, European Convention for the Protection of Archaeological Heritage or European Landscape Convention, Convention on the Underwater of Cultural Heritage Protection, and UNESCO Conventions concerning the Protection of the World Cultural and Natural Heritage and the Safeguarding of the Intangible Cultural Heritage. The Slovak Republic is a signatory to all of these internationally important declarations.

3.2. National

Declaration of the National Council of the Slovak Republic on the protection of cultural heritage (National Council of the Slovak Republic, 2001). This declaration of the National Council of the Slovak Republic recognises that irreplaceable cultural values created by previous generations are constantly threatened not only by the natural causes of deterioration and decay, but also by changes in lifestyle, the transformation of social and economic conditions, the decline and disappearance of traditional crafts and techniques, and the application of technologies which are often incompatible with the nature of these cultural assets. The declaration supports the implementation of principles enshrined in international treaties, conventions and recommendations of international organizations for the protection of cultural heritage in particular UNESCO and the Council of Europe. It documents and applies these for the development of the rights and obligations of everyone to protect cultural heritage under Article 44 of the Constitution of the Slovak Republic.

Strategy for the Conservation of Monuments (2017 – 2022). The Strategy aims to create such conditions and tools for the protection of monuments, which will guarantee their authenticity and integrity under current conditions, and which will contribute to improving the construction and technical condition of the heritage fund. In the area of territorial protection, it mainly promotes cultural heritage protection interests through spatial planning tools. The Strategy emphasises that the effectiveness of applying historical monuments protection strategies into land-use planning documents is dependent on how regulations are formulated and on their clear quantification. The Strategy is an opportunity to initiate the elaboration of a methodology focused on practical feasibility within territorial and construction proceedings.

Guideline of the Ministry of Culture of the Slovak Republic on the protection of national cultural monuments in crisis situations (Ministry of Culture of the Slovak Republic, 2008). This guideline regulates the procedure of legal entities and natural persons responsible

for the special protection of movable national cultural monuments referred to as 'special protection of cultural monuments' in the context of preparation for crisis situations and during crisis situations. The Regional Monument Board plays an important role in the area of special protection of cultural monuments and the fulfilment of tasks ensuing from providing special protection to cultural heritage. It provides legal entities and natural persons (owners or administrators) with professional and methodological assistance. The degree and method of special protection of cultural monuments shall be ensured depending on local sources of danger and the resulting categorization of the territory of the Slovak Republic, which is decisive for differentiating the scope of planning and implementation measures.

Last but not least, the Act on the protection of monuments and historic sites No. 49/2002 Coll. [9], governs the protection of cultural heritage monuments, historical sites, archaeological finds and archaeological sites. It is based on scientific knowledge and international conventions in the field of European and world cultural heritage to which the Slovak Republic is a signatory. According to Paragraph 1, this Act further regulates the organisation and competence of state administration authorities and territorial self-government authorities, as well as the rights and duties of owners and other legal entities and natural persons, and the imposition of fines for unlawful conduct in the field of the protection of monuments and historic sites which form an important part of cultural heritage and the conservation of which is in the public interest.

3.3. Regional

The framework of the future **Strategy for Development of Local and Regional Culture and Culture of National Minorities of the Slovak Republic by 2030 (Ministry of Culture of the SR, 2019).** The Concept serves as a basis for the creation of a comprehensive “Strategy for the Development of Local and Regional Culture and Culture of National Minorities of the Slovak Republic by 2030”, which the Government ordered the Ministry of Culture to submit by 31 December 2020. The main priorities of the strategy include improving the quality of public libraries, creating a legislative framework to ensure the support of cultures of national minorities, creating tools for coordinating and optimizing the performance of professional activities of regional cultural institutions, expanding regional activities of departmental organizations and intensifying the heritage. The strategic aim of the Ministry of Culture is to strengthen cultural centres to become a really attractive place for education, creating a cultural environment and awareness-raising.

Development Strategy for Culture in the Bratislava self-governing region for years 2015-2020. This strategy addresses the development of culture in the spirit of four priorities, which are consistent with those applied across Europe: promoting cultural identity, promoting cultural diversity, promoting creativity and promoting citizens' participation in culture.

3.4. Local

In 2016, Bratislava City initiated the preparation of a conceptual and strategic document named the **Framework for development of culture in Bratislava;** however, it has not yet been finalised. The City borough of Staré Mesto has a **Cultural policy concept of Bratislava-Staré Mesto** for the period of 2016-2020. The document emphasises support for the socio-economic use of the cultural potential of the Old Town as well as for public and cultural activities and

better involvement and cooperation among individual departments of the Office district and city district organizations. An action plan for implementation is part of the document to help implement the individual goals of the Framework.

4. Governance framework for disaster risk reduction

This section looks at the governance framework for disaster risk reduction with relevance to Bratislava's identified sites. It elaborates the relevant policies, strategies, visions and action plans for disaster risk management in Bratislava at the different governance levels.

4.1. National

The basic document for the identification of a potential threat in the territory of the Slovak Republic is **Analysis of the territory in terms of possible extraordinary events of the Slovak Republic**. The document is drawn up at all levels of state administration based on Act No. 42/1994 Coll [10]. on civil protection of the population, as amended, in accordance with Article 6 of Decision no. 1313/2013 / EU of 17 December 2013 on the European Union Civil Protection Mechanism. Under the Act, an emergency is defined as a natural disaster, accident, disaster or terrorist attack. A natural disaster is an extraordinary event in which the accumulated energies or masses are undesirably released as a result of the adverse effects of natural forces, in which hazardous substances may act or cause destructive factors that have a negative impact on life, health or property.

The Act also regulates the structure and content of the territorial analysis document in terms of possible extraordinary events of the Slovak Republic. The introductory part of the analysis focuses on geographical, demographic and economic characteristics of the territory. For the risk assessment the following structure is recommended: identification of the crisis phenomena and threatening factors, threat to the population, size of the hazard zone - area in km^2, anticipated secondary phenomena and possible overlap from territory to municipality / district / county / state. This analysis, however, does not directly assess the level of risk, but only identifies the risk and further identifies the resources and means available for managing the emergency in the analysed area. The list of risks to be assessed is included in the analysis, which modifies the structure and content of assessments on extraordinary events a document prepared at all levels of state administration [11].

In the Slovak Republic, flood risk is assessed in accordance with Directive 2007/60 / EC of the European Parliament and of the Council on the assessment and management of flood risks and **Act no. 7/2010 Coll. on flood protection** [12] [13]. This law was created as a consequence of the European Commission's Communication on Evaluation COM (2004) 472, Brussels, 12.7.2004 [14] and is in accordance with Directive 2007/60/EC [12]. When assessing the existing potential of significant flood risk in the Slovak Republic, the risk was considered potentially significant in those geographical areas where the flood in the past endangered health, the environment, cultural heritage or economic activity. In assessing the likely occurrence of a potentially significant flood risk, information on the current status of flood protection in individual geographical locations was used. The evaluation process was based on the available materials, and expert estimates were carried out to determine whether, within the expected flood range whose maximum flow rate can be reached or exceeded on average once every 100 years – such as buildings, infrastructure and industrial or agricultural estates [15].

Preliminary flood risk assessment in the Slovak Republic – update 2018 was prepared in accordance with the requirements of Directive 2007/60/EC. This document includes information about particular river basins in Slovakia. Preliminary assessment documents are publicly available on the website of the Ministry of the Environment SR [16]. Information about flood risk prediction is based on records of changes in the hydrological regime of Slovak rivers [17] [18]. This data is together with the proposal of adaptation measures part of the **National Climate Program of the Slovak Republic** [19].

Since 2002, Slovakia has the **Concept of sustainable exploitation of rock environment,** which implies to monitor geological environmental factors. The aim is to predict impending disasters. In 2006 the agreement on cooperation for the provision and use of geological information was signed between the Civil Protection Office of the Ministry of the Interior of the Slovak Republic (now the Crisis Management and Civil Protection Section) and the State Geological Institute of Dionýz Štúr (SGIDŠ). At the beginning of 2007, a working group for geological hazards so-called Geohazards Working Group as a part of **EuroGeoSurveys** (EGS) was created. One of the results of EGS activities is a strategic plan for assessment and prevention of geological hazards in European countries (including the Slovak Republic). In the Slovak Republic the plan includes eight subsystems:

01 – Landslides and other slope deformations;

02 – Tectonic and seismic activity of the territory;

03 – Anthropogenic sediments of environmental burden character;

04 – Impact of mining on the environment;

05 – Monitoring of radon volume activity in the geological environment;

06 – Stability of rock massifs under historical objects;

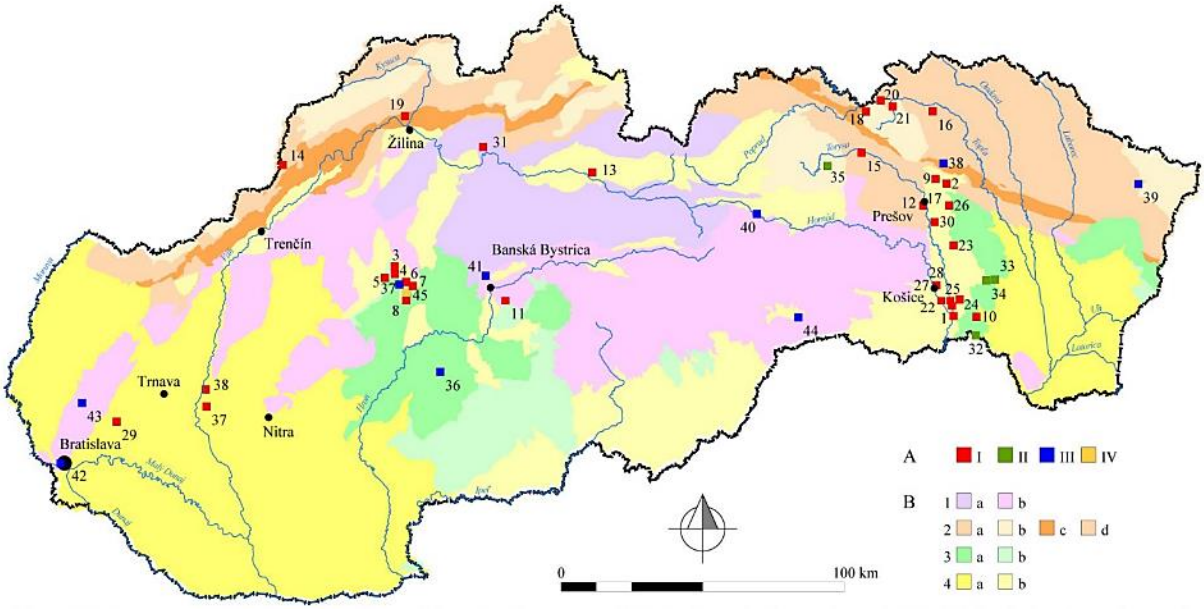
07 – Monitoring of river sediments;

08 – Volume unstable soils.

These partial information subsystems are continuously updated. The **Concept of Geological Research and Geological Survey of the Slovak Republic** is currently in force [20]. Monitoring of slope deformations is performed within the **Partial Monitoring System** (PMS) "Geological factors" in subsystem 01 - Landslides and other slope deformations. The PMS is part of the Monitoring System of the Environment of the Slovak Republic, which was approved by the Government Resolution no. 620 (September 7, 1993). Monitoring of geological factors is provided by the State Geological Institute of Dionýz Štúr. The PMS is focused on geological hazards, harmful natural or anthropogenic geological processes that endanger the natural environment. Monitoring of slope deformations is based on observation and subsequent evaluation of the state of activity or landslides, eventually control of slope deformations after implementation of remediation measures. Monitoring offers objective information necessary for decision-making, management, control, scientific research activities and for the public. Government administration and local/regional self-government and relevant legal and natural persons are being informed about monitoring results. The selection of monitored sites is

continually adjusted according to the current society-wide requirements as well as the monitoring of the assessed stability state of the observed sites.

In 2019 a total of 43 sites were monitored for various types of slope movements (Figure 4.1).



Legend:
I – sliding; II – earth creep; III – topple fall, rockfall (stability of rock cuts); IV – special sites,

Figure 4.1. The monitoring sites of slope deformations in the Slovak Republic. State Geological Institute of Dionýz Štúr [21].

Table 4.1. Violation of territory by slope deformations in Bratislava [22].

Number of deformations	District area [ha]	Area of violation territory [ha]				Failure [%]
		Total	Arable land	Forest soil	Other	
18	36 800	11.1	1.0	0.4	9.8	0.03

According to the Geological Act [23], the Ministry of the Environment of the Slovak Republic is obliged to ensure the carrying out of the engineering geological survey, monitoring of geological factors of the environment and remediation of the geological environment to avert, mitigate or eliminate the consequences of natural disasters. Therefore were issued recommended procedures to ensure the activities of the municipality in case of emergency or occurrence of an extraordinary event in connection with the occurrence of slope deformations in accordance with Act no. 42/1994 Coll. on Civil protection of the population [24], as amended and in accordance with the Geological Act.

In the period 1997-2006, the Ministry of the Environment of the Slovak Republic with the aim of comprehensive processing of data from the registration and mapping of slope deformations and surveys focused on slope deformations and their mapping provided a geological task – Compilation of Atlas of slopes stability maps of Slovakia at scale 1: 50 000 [22]. This atlas is

accessible on the geo server of the State Geological Institute of Dionýz Štúr. It contains the maps showing areas where there is a risk of slope deformation and provides detailed regional analyses of slope deformations in the Slovak republic in relation to the territorial units of so-called engineering geological regions and areas. For the needs of both the professional and laic public, it provides data on the area disruption by slope deformations in the form of passports and summary tables.

With the preparation of the Atlas of slope stability maps of the Slovak Republic, the Ministry of the Environment of SR initiated a project to compile **maps of geological environmental** factors for selected regions of Slovakia. Engineering-geological maps are the foundation of the maps of environmental geofactors, which include a map of susceptibility to slope movements. In these maps, the areas of interest are divided into stable, potentially unstable and unstable areas and evaluated in terms of the occurrence of slope deformations and the susceptibility of these areas to the development of slope movements. Maps of the area susceptibility to slope movements cover 73% of the territory of the Slovak Republic. The activation of slope deformations associated with extreme precipitation and floods in the Slovak Republic has recently caused significant damage in the affected areas.

4.2. Regional

The **Prevention Program of Landslide Risk Management (2014-2020) – update** [25] was approved by Government Resolution no. 738/2013 and represents a strategic document in the field of slope deformations. One of the objectives of this program is to support adaptation to climate change and mitigate the negative impacts of these changes by supporting the prevention, exploration and remediation of emergency landslides directly related to excessive rainfall. The program sets aims to improve the prevention and management of landslide risks. Landslides and slope streams represent 94.5% of the total number of registered slope deformations. Figure 4.2 shows the area (in hectares) disturbed by slope deformations on the territory of the Slovak Republic.

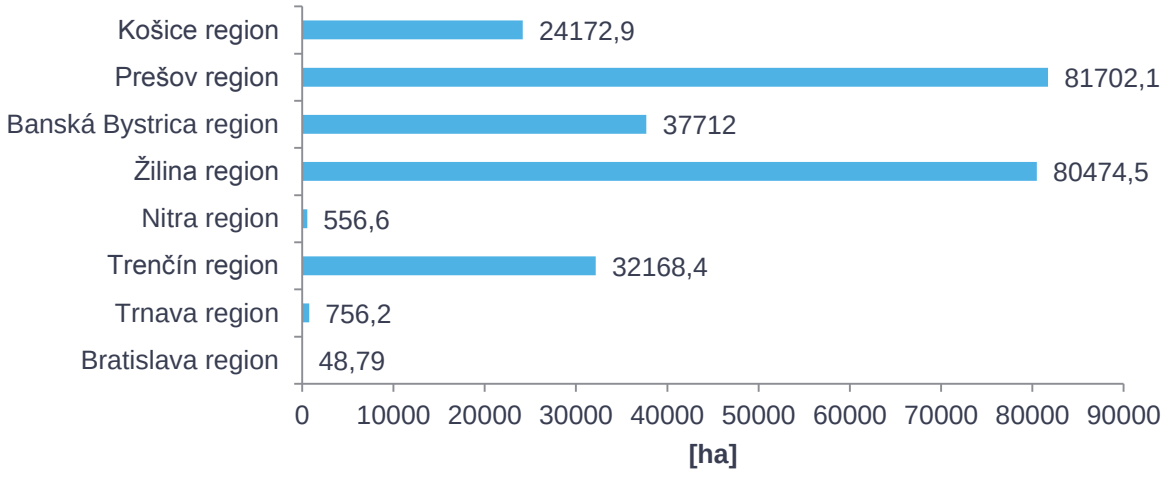


Figure 4.2. Violation of territory by slope deformations in Slovak regions. Ministry of the Environment of Slovak Republic [25].

In the Slovak Republic, there is no database focused on the damage caused by extraordinary events [11]. Vulnerability analysis is not carried out as part of the national level risk analyses. Some of its parts are part of the described assessment of the likely occurrence of potentially significant flood risk.

4.3. Local

In the Slovak Republic, there is no complex database focused on the damage caused by extraordinary events. Damages to the property of municipalities and towns are most often reimbursed by the state, either from the special reserve of the Prime Minister or from the relevant ministries. In order to approve the expended funds, a commission of the Regional Office, which is competent for the impacted municipality, is established. The municipality proves damages by invoices from suppliers, photo documentation, invoices for the rental of construction machinery and machines, etc. The reported amount of damage does not always correspond to reality, as in many cases, volunteers help in emergencies in municipalities [15]. Financial compensation may be requested by a natural person under the Civil Protection Act [24] when damage to property or dwellings, including equipment, has been incurred as a result of an emergency. Based on this application, the municipality shall, in cooperation with the relevant District Office, assess the extent of the damage and the social situation of the applicant. Citizens are indemnified by commercial insurance companies, of course, provided they have taken out insurance. Insurance companies keep own damage records and use the information to build own maps of risk areas [15].

5. Governance framework for climate change adaptation

This section looks at the governance framework for climate change adaptation of relevance to the City of Bratislava. It identifies the relevant policies, strategies, visions and action plans for climate change adaptation in Bratislava at the different governance levels. As Bratislava is a signatory of “Mayors Adapt” and the “Covenant of Mayors” the priority was to conduct a city level risk-based vulnerability assessment within two years of signing.

With support from the Horizon 2020 project RESIN, Bratislava City was able to elaborate on the results of the risk-based vulnerability assessment into a comprehensive Atlas of climate change impacts on Bratislava City. The document focuses on the impacts and risks of climate change to the City´s population and critical infrastructure (road infrastructure and built-up areas). Leading the working group for this assessment was the Office of the Chief City Architect. The group of experts included the Department of Landscape Ecology at the Faculty of Natural Sciences, the University of Comenius in Bratislava, Fraunhofer institute IAIS, different departments of the City Council (such as the Environmental and Spatial planning departments), Bratislava self-governing region, Bratislava Water Company, pilot city boroughs and many others.

The vulnerability and impact chain assessments were done in 2018, and the date from 2016 up to 2018, depending on availability. The method utilized the IVAVIA tool (IVAVIA – Impact and Vulnerability Analysis of Vital Infrastructures and Built-up Areas) which enables stakeholders to participate in the qualitative phase of the assessment for developing impact chains (see Figure 5.1.). Several stakeholder workshops were conducted throughout the qualitative phase (the first workshop focused on heatwaves, whereas the second focused on pluvial flooding, the third on droughts, and the last workshop focused on the weighting of indicators), where the most relevant impacts of climate change, drivers (also stressors not related to climate change), attributes of coping capacity and sensitivity were identified by the participants.

Before starting the indicator identification and data acquisition process in the quantitative phase, the various identified attributes nominated in the stakeholder workshops underwent a thorough review to filter out unsuitable and duplicated attributes, re-categorize attributes to correct for misunderstandings during the workshop (e.g. low awareness the participants listed “low implementation of building-level adaptation measures for reducing the impacts of rainfall” as a sensitivity indicator although it is a rather general observation with no specific spatial data supporting this claim), and reducing the number of attributes to a more manageable number in order to facilitate result validation. Following this process, initial indicators for each attribute and the required data were defined and identified, so that the final vulnerabilities and risks could be calculated. Furthermore, the assessment also included non-climatic stressors; however, these were not included in the qualitative part of the assessment done with the IVAVIA tool.

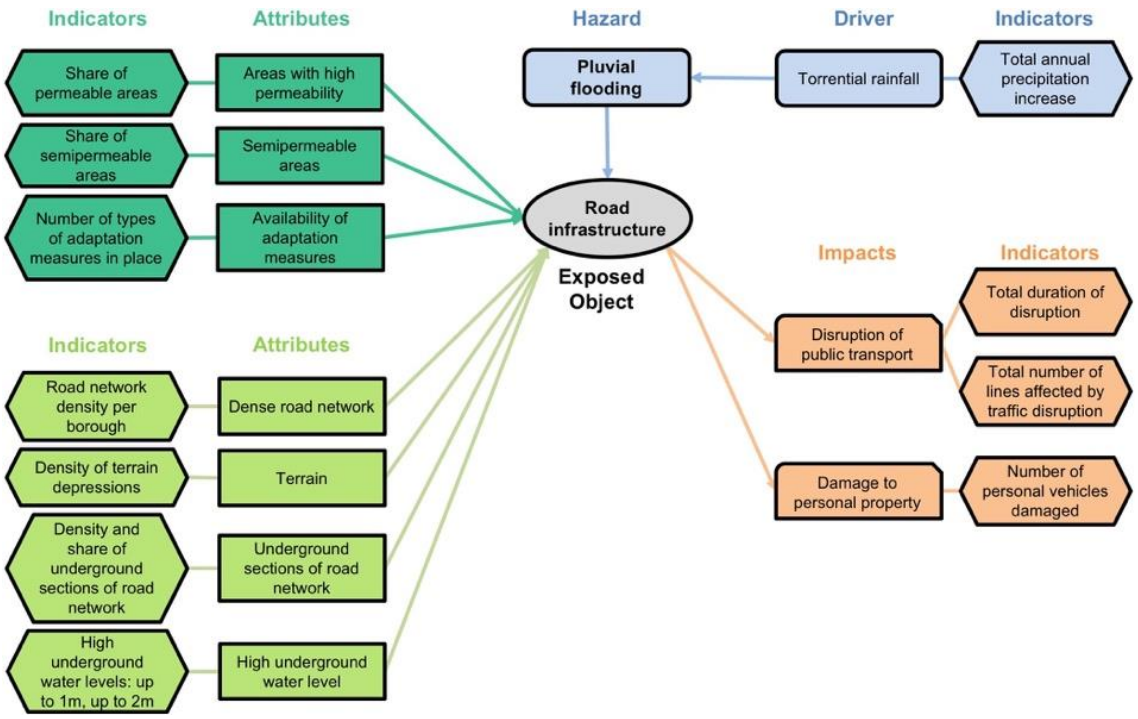


Figure 5.1. Simplified impact chain for the hazard-exposure combination "pluvial flooding on road infrastructure" in the city of Bratislava. Hazards and drivers in blue, exposed object in grey, coping capacity in green-blue, sensitivity in green, and impacts in orange. Rectangles: Attributes; Hexagons: indicators [26].

Several obstacles were identified in the process of conducting the vulnerability assessment, the most relevant being the availability (or lack) of data, as well as the capacity to conduct such assessment (both skill- and resource-wise). As the assessment focused mostly on vulnerable population and infrastructures, no specific attention was paid to cultural heritage, and the assessment did not differentiate between buildings in terms of their cultural or historical importance.

5.1. International

Under the **United Nations Framework Convention on Climate Change (1992),** 197 Parties to the Convention promised to take joint action to stabilize greenhouse gas concentrations in the atmosphere at a level that will prevent dangerous anthropogenic interference with the Earth's climate system. In accordance with Article 4 of the Convention, the signatory countries have also committed themselves to make every effort to develop adaptation strategies and to support climate change research and its consequences.

In 2013, the European Commission published the **"EU Strategy for Adaptation to Climate Change"**, along with several accompanying documents. The strategy was approved by the EU Environment Council on 18 June 2013. The strategy outlines a framework and mechanisms to increase EU preparedness to the impacts of climate change and to improve the coordination of adaptation activities. At the same time, it represents a long-term strategy to increase the EU's resilience to the adverse effects of climate change at all levels and in line with the Europe 2020 objectives. In 2018, the European Commission's Directorate-General for Climate Action

evaluated the implementation of the European adaptation strategy based on input from the Member States. The implementation evaluation report, together with the Member States' fact sheets, was published on the Commission's website, which will serve as a foundation for updating the strategy expected in 2020.

Regulation of European Parliament and of the Council 2018/1999 of the Energy Union and Climate Action. This Regulation sets out the necessary legislative foundation for reliable, inclusive, cost-efficient, transparent and predictable governance of the Energy Union and Climate Action (governance mechanism), which ensures the achievement of the 2030 and long-term objectives and targets of the Energy Union in line with the 2015 Paris Agreement on climate change following the 21st Conference of the Parties to the United Nations Framework Convention on Climate Change (the 'Paris Agreement'), through complementary, coherent and ambitious efforts by the Union and its Member States, while limiting administrative complexity. The goal of a resilient Energy Union with an ambitious climate policy at its core is to give Union consumers, including households and businesses, secure, sustainable, competitive and affordable energy, and to foster research and innovation by means of attracting investment, which requires a fundamental transformation of Europe's energy system. Such a transformation is also closely linked to the need to preserve, protect and improve the quality of the environment and to promote the prudent and rational utilisation of natural resources through the promotion of energy efficiency and energy savings and the development of new and renewable forms of energy.

5.2. National

The resolution of the Government of the Slovak Republic no. 148/2014 required the submission of an update of the national adaptation strategy to the Government's deliberations in light of the latest scientific knowledge in the field of climate change. In 2017, the Slovak Republic's Ministry of Environment started preparing a strategy update aimed at assessing the current state of adaptation and planned activities in key areas and sectors, defining a general vision for the adaptation of the selected areas and sectors and updating the set of adaptation measures and the framework for their implementation. The **Strategy of adaptation of the Slovak Republic to climate change – update** was approved on 17 October 2018 by the Government Resolution no. 478/2018 [27]. A vulnerability assessment is available on a national level from 2011 and needs to be updated [28].

The main objective of the updated adaptation strategy is to „increase resilience and improve the readiness of the Slovak Republic to face the adverse effects of climate change and to establish an institutional framework and coordination mechanism to ensure effective implementation of adaptation measures at all levels and in all areas". This is to be achieved by implementing partial objectives such as: implementing adaptation measures and monitoring their effectiveness, strengthening the trickle-down of objectives and recommendations of the adaptation strategy into other levels of governance, provision of incentives for entrepreneurship oriented at climate change adaptation/mitigation, promoting synergies between adaptation and mitigation measures while reflecting the objectives of the 2030 Agenda for Sustainable Development, the UN Framework Convention on Climate Change and the Paris Agreement.

The objectives of the Strategy should be put in practice by the forthcoming **Action Plan for adaptation,** which is to be submitted to the Government of the Slovak Republic by 31.12.2020 for approval. The preparation of the National **Adaptation Action Plan** began in 2018, with a public participation process where also municipalities were largely involved, and Bratislava participated in all its stages. The plan will include short-term measures for the period 2020-2022 and medium-term for the period 2022-2025 with a view to 2028 will be identified. The measures will be prioritized according to the importance, feasibility and availability of financial resources. The Action Plan should contribute to better translating adaptation measures into sectoral policies of the relevant sectors. It should also include a proposal for a monitoring system for vulnerability, a proposal for a system of the mid-term evaluation of the adaptation process in the Slovak Republic, including the monitoring of cost-benefit links, and a platform for publishing and sharing positive experiences [29].

Referring to the multi governance system in the Slovak Republic, it is mainly the cities and city boroughs which are responsible for implementing the objectives of the National Strategy on Adaptation in practice. However, there are currently still many obstacles preventing this, such as: inconsistencies in the legislature (the Strategy supports the implementation of sustainable urban drainage, but the legislation on water management prevents this), discrepancies between the permissions (and guidelines they contain) on this legislature to different investment activities (construction, reconstruction, etc.). These permissions are issued by the municipality as the competent authority in the first phase (to get what is called territorial permission – meaning the investment project is in-line with the current masterplan) and the city boroughs in the second stage (building permission) and heavy dependence on external funding for implementation of adaptation/ mitigation measures.

Another relevant policy for linking health and with climate change impacts is the Action Plan for the Environment and Health of the Population of the Slovak Republic no. V [30]. It reports that climate change is also likely to affect the spread of diseases in the future. In the Slovak Republic, we are increasingly confronted with restrictions on drinking water supplies due to droughts, torrential rains or floods. With increasing levels of knowledge about the presence of new contaminants and their potential health effects, new chemicals need to be included in the monitoring, and their implications for human health should be investigated.

A WHO / EURO questionnaire study [31] involving member states of the European region showed that countries consider the increase in temperature, heatwaves and prolongation of the pollen season by approximately 10-11 days as the greatest risk in terms of climate change. The results have shown that the most vulnerable groups, as perceived by EU countries in the poll, are the elderly, chronically ill and socially isolated and the urban population in general. In terms of health impacts, vector and rodent-borne diseases, water and food-borne diseases, as well as cardiovascular and respiratory diseases, were the most common (see Figure 5.2).

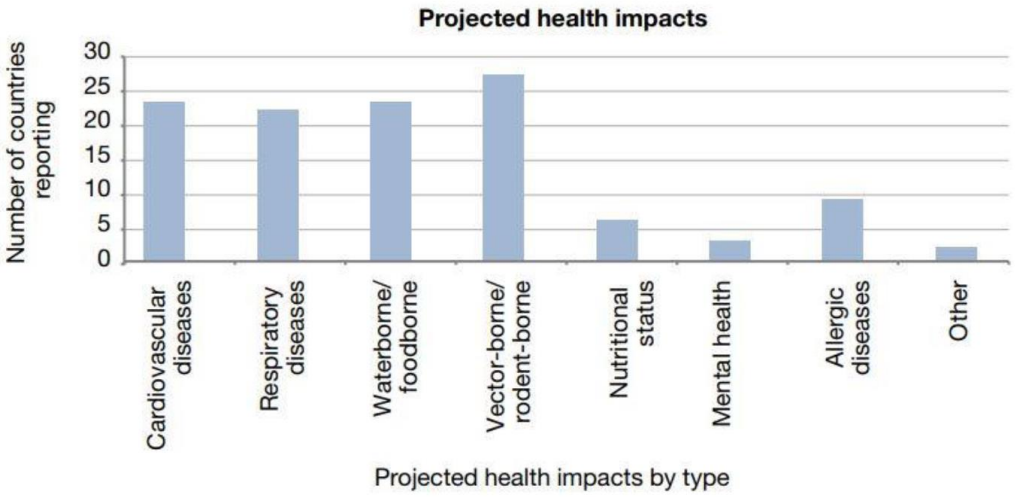


Figure 5.2. Results of the international questionnaire study by WHO – Projected health impact [36]

Another partially linked document to climate change adaptation is the **„Greener Slovakia" - a Strategy for Environmental Policy of the Slovak Republic until 2030** [32]. Adopted in 2019 with the Resolution no. 87/2019, this strategy paper defines a vision for 2030 considering possible, likely and desired future developments. The document identifies the underlying systemic problems, sets targets for 2030, proposes framework measures to improve the current situation, and also includes basic outcome indicators that allow the results to be verified. The basic vision is to achieve better environmental quality and a sustainable circular economy based on the consistent protection of environmental components, using as few non-renewable natural resources and hazardous substances as possible, leading to improved public health.

Action Plan for solving the consequences of drought and water scarcity [33] aims to prevent drought through preventive measures, eliminating the negative effects of climate change. Drought is a natural phenomenon; however, water shortage is strongly conditioned by anthropogenic activity. The Action Plan is a separate document that builds on Act No. 364/2004 Coll. on Waters, as amended. Drought and water scarcity is part of the update of the Water Plan of the Slovak Republic; although it is not currently classified as a significant impact that may have an impact on the status of surface and groundwater bodies. A separate chapter on drought is in the Greener Slovakia report (Strategy of Environmental Policy of the Slovak Republic 2030). **Slovak Water Policy Framework for 2015-2021** [34] does not include solutions to the impacts of climate change. This document represents a standard strategy, which was later replaced by the framework document **Orientation, Principles and Priorities of the Slovak Republic Water Management Policy by 2027** [35], see text below. Water policy currently applied in the Slovak Republic is based on Directive 2000/60 / EC of the European Parliament and of the Council of 23 October 2000, which established a framework for Community action in the field of water policy transposed into law no. 364/2004 Coll. on Waters, as amended. The water management policy of the Slovak Republic is drawn as a set of principles, priorities and instruments for the determination of effective measures, the correct application of which will lead to the achievement of environmental objectives for ensuring the

protection of water and its sustainable use by 2021, or by 2027. Another key document is the **Water plan of Slovakia** (update 2015) [36].

Regarding mitigation of negative climate change impacts, the Slovak Republic submitted a proposal of the I**ntegrated National Energy and Climate Plan 2021-2030** [37] to the European Commission, where the country proposed a contribution of 19.2% to the renewable energy target. The Ministry of Economy of the Slovak Republic will take all available steps to further accelerate the development of RES, especially in heat production, between 2021 and 2030, and in 2030 the Slovak Republic is to approach a higher share of the use of renewable energy sources.

5.3. Regional

River basin management plans, including programs of measures, are a tool to achieve the objectives set out in the national water policy. On a regional level, the water policy for Bratislava is implemented by the **Management Plan of the Danube River Basin** [38] with milestones for implementation by 2021, or by 2027 elaborated as part of the Water plan of Slovakia [36].

The framework document “Orientation, principles and priorities of the Slovak Republic water management policy by 2027” identified the need for creating a so-called **Timetable and factual and communication plan for the 3rd cycle of river basins’ management plan preparation** [39]. It is the key current document of water policy implementation in Bratislava.

Urban-landscape study for protection against torrential rain in the Small Carpathian region [40] deals with the issue of torrential rainfall in the Bratislava self-governing region. The document maps available adaptation measures and proposes the further implementation of measures based on the manifestations of climate change based on torrential rainfall and precipitation data from the Small Carpathian region. The study is the basis for territorial development and decision-making processes at the regional level.

Framework for protection and use of surface and groundwater sources in Bratislava self-governing region, 2017 [41] deals with issues of groundwater resources management and their pollution within the Bratislava self-governing region. The concept also marginally addresses the issue of climate change manifestations in relation to threats affecting the quantity and quality of groundwater resources. The concept is the basis for territorial development and decision-making processes at the regional level.

5.4. Local

Land-use plan for Bratislava, capital of the Slovak Republic (2007) and later amendments no.1-7. The aim of the land-use plan is to systematically and comprehensively address the spatial arrangement and functional use of land and lay down its principles. It proposes the material and chronological coordination of activities, which influence the environment, ecological stability, and cultural-historical values of land, land development and landscape in accordance with the principles of sustainable development [42].

Program of Economic and Social Development of the capital city Bratislava for the years 2010-2020 (2009, a binding document approved by the City Council Regulation No. 1020/2010 in July /2010). The city of Bratislava is committed to addressing the issue of climate change and related appropriate adaptation measures since 2010 in the approved Program of Economic and Social Development for the years 2010-2020 (City Hall of Bratislava, 2009). In 2015, the programme was updated in terms of its financial aspects in 2015 and a binding document approved by the City Council Regulation no. 351/2015 on 10 December 2015). Several measures approved in the financial part relate or directly support adaptation and mitigation measures to adverse effects of climate change as well as protection and enhancement of cultural heritage [43].

Strategy of Adaptation to Adverse Impacts of Climate Change on the territory of Bratislava, capital of Slovak Republic (elaborated by the members of the project Steering Committee, City Hall, 2014). The strategy was elaborated by a Project Steering Committee. It consisted of a chairman, (the chief architect), and a number of other members, who are employees of Bratislava City Hall, i.e. representatives from the departments of strategy project management and financial resources, the environment, territorial system coordination, social affairs, transport, infrastructure etc., as well as representatives of scientific organizations (i.e. Geographical Institute of the Slovak Academy of Sciences and Comenius University in Bratislava) and non-governmental organizations [44].

The Strategy of Adaptation summarises potential risks and gives guidance for the prevention/mitigation of the consequences of climate change risks. It was approved by the deputies of the City Assembly in Bratislava in September 2014. The objective of the Strategy of Adaptation is to ensure appropriate mechanisms are available for the city to counter the increased risk of climate change impacts, reduce vulnerability by appropriate adaptation measures within individual sectors (areas), and provide the necessary information and tools to facilitate the process of decision making and management. It was complemented by the **Action for adaptation to adverse impacts to climate change in Bratislava (2017),** which contains 27 adaptation measures that are to be implemented and monitored in the period between 2017-2020 to support the implementation of the vision and goals of the Strategy for adaptation to climate change in Bratislava. It defines competent departments, organisations of the city, boroughs, as well as competencies, timelines and available/estimated financial resources. The different sectors are: health and wellbeing, social care, green and blue infrastructure, rainwater and drinking water resources, transport, urbanised areas, and energetics [45]. Cultural heritage is not highlighted in the document; therefore, the new Action Plan for adaptation and mitigation should also for the first time put more focus on increasing the resilience of cultural heritage in addition to other sectors.

6. Expected impacts of climate change-related and natural hazards

The purpose of this section is to report and review the preliminary collection of relevant information about hazards, exposed elements, as well as impacts provided by ARCH city partners in collaboration with their local research partners, in order to offer an initial overview on the risks that might affect the selected historic areas and their communities. This section is structured as follows: a description of the methodology is provided, followed by a Risk Profile Table, outlining hazards, exposed elements, impacts, and corresponding resilience-building measures already planned or implemented to date. Next follows a review, interpretation, and validation of the information provided in the Risk Profile Table. Finally, an outlook is provided concerning further risk analysis work in the context of the ARCH project.

6.1. Methodology

In order to elicit relevant information for risk analyses from city partners, ENEA, Fraunhofer, ICLEI, and Tecnalia developed a Risk Profile Table template (see Part 6.2 below) based on the central risk components identified in the 5th Assessment Report of the Intergovernmental Panel on Climate Change: hazards, exposed elements, impacts (physical, societal, functional, economic, and intangible), as well as corresponding resilience-building measures already planned or implemented to date. This template was filled out by city partners and provides a starting point from which to conduct more detailed risk analyses. Furthermore, it serves as a starting point for the data, models, methods, and tools to be developed during the project.

The information provided in the Risk Profile Table was reviewed and harmonised by ENEA in order to provide a comparable description across all city cases and ensure relevance to (and validity for) similar on-going[1] and/or future initiatives and projects in the field of disaster risk reduction, climate change adaptation, and cultural heritage preservation.

The following standards, reference material, and tools were identified as most suitable for this exercise:

- The City Climate Hazard Taxonomy[2] for classification of hazards;
- The UNDRR QRE Tool[3] and ISO standard 37120 for the classification of exposed elements and impacts; and

[1] E.g. United Nations Office for Disaster Risk Reduction: *Words into Action guidelines: National disaster risk assessment*. UNDRR, 2017. Online: https://www.undrr.org/publication/words-action-guidelines-national-disaster-risk-assessment

[2] https://www.c40.org/researches/city-climate-hazard-taxonomy

[3] https://www.unisdr.org/campaign/resilientcities/toolkit/article/quick-risk-estimation-qre

- The ICOMOS CCHWG[4] classification and INSPIRE[5] directive for the classification of heritage assets.

Based on the harmonised information, initial proposals for risk analysis focus actions (e.g. which methods and tools to apply for which part/issue of a historic area) were formulated by ENEA. The initial proposals will be further defined during the co-creation process and in exchange with the relevant local stakeholders.

[4] https://adobeindd.com/view/publications/a9a551e3-3b23-4127-99fd-a7a80d91a29e/g18m/publication-web-resources/pdf/CCHWG_final_print.pdf

[5] INSPIRE, Infrastructure for Spatial Information in EuropeD2.8.III.2 Data Specification on Buildings – Technical Guidelines (5.3.1.1.4. Classification of buildings, pages 43-45).

6.2. Risk profile table

Heritage site (historical area)	Hazard[6]	Exposed element [7]	Impacts					Corresponding resilience-building measure	Notes/Evidence
			Physical	Societal	Functional	Economic	Intangible	Description (please indicate specific S or general G)	
Monument preservation reserve (location: area in the historical city centre)	Pluvial flooding Drought Heatwave	Buildings (and architecture) and other tangible cultural heritage Citizens and visitors Road network Urban greenery	Damage to buildings caused by flooding, moisture (especially underground levels) Increased morbidity of trees (drought/heatwave)	Loss of access to services such as transport Need to shorten working hours due to unsuitable working conditions inside (heatwave)	Disruption to services, e.g. transport services or sewage system Disruption to the operation of institutions,	Loss of tourism revenue due to a decrease in visitors Loss of business income due to damaged premises Loss of income due to shortened working hours	Loss of cultural heritage value resulting from physical damage Loss of heritage integrity of the area	Action plan for adaptation to climate change in Bratislava – in place. (S and G) Manual for public space – currently being developed at by MIB (Metropolitan Institute of Bratislava) (S and G)	[7] [46] [47] [48]
Celtic acropolis with roman architecture (location: Bratislava Castle area)	Pluvial flooding Drought Heatwave	Tangible cultural heritage – archaeological remains of the Celtic acropolis *in situ*	Damage to the archaeological remains	-	-	Disruption of tourism service provided on-site	Loss of cultural heritage value resulting from physical damage	limit the number of visitors allowed inside (to address humidity and resulting fungus growth caused by the breathing of many people)	[49] [50] [51]
Celtic kiln (location: in monumental reserve, underground)	Pluvial flooding – moisture entry and resulting fungal growth (interior)	Tangible cultural heritage (archaeological remains *in situ*)	Moisture/fungal damage to the kiln	-	-	Loss of tourism service provided on-site	Loss of cultural heritage value resulting from physical damage	Replacement of pavement on the courtyard above the kiln with a waterproof pavement with better spillway channels	[52] [53]

[6] Note: the UN Office for Disaster Risk Reduction (UNDRR)'s Resilience Scorecard defines 'hazard' as 'a process, phenomenon or human activity that may cause loss of life, injury or other health impacts, property damage, social and economic disruption or environmental degradation'. Of these, the ARCH project is addressing natural and climatic hazards.

[7] Note: the UN Office for Disaster Risk Reduction's Resilience Scorecard defines 'exposure' as 'the situation of people, infrastructure, housing, production capacities and other tangible human assets located in hazard-prone areas'.

Heritage site (historical area)	Hazard[6]	Exposed element [7]	Impacts					Corresponding resilience-building measure	Notes/Evidence
			Physical	Societal	Functional	Economic	Intangible	Description (please indicate specific S or general G)	
Devín Castle (in Devin city borough – not the city centre)	Pluvial flooding Drought Heatwave Slope movements & landslides Erosion NW winds	Buildings (and architecture), excavations, finds of objects and other tangible cultural heritage Citizens and visitors Local natural habitats	Erosion of dolomite cliff threatening loss of the upper castle Erosion of dolomite cliff combined with extreme rain and heat worsen the erosion of the castle walls	-	Damage to castle walls, underground caves and expositions Dolomite cliff disruptions (fissures and cracks) Loss of biodiversity Disruption of tourism service provided on-site Disruption of archaeological research	Loss and disruption of tourism service provided on-site	Loss of cultural heritage value resulting from the fall of the cliff	Controls introduced on amount of visitors allowed Conservation of damaged masonry Protection against humidity, wind and deterioration	[54]
St. James´s chapel	Pluvial flooding – moisture entry (interior),	Tangible cultural heritage (archaeological remains in situ)	Moisture/fungal damage to the archaeological remains	-	-	-	Loss of cultural heritage value resulting from physical damage	Planned conservation activities after finishing archaeological research	[55] [56]
Celtic Metal casting and coin minting workshop, Panská Street 19	Pluvial flooding – moisture entry (interior),	Tangible cultural heritage (archaeological remains *in situ*)	Moisture/fungal damage to archaeological remains	The exhibition will be closed if there will be fungus	-	Disruption of tourism service provided on-site	Loss of cultural heritage value resulting from physical damage	Renovation of the wall plaster caused by the humidity- in the basement spaces, disinfection against fungus Planned activities from Bratislava City Gallery for the 2020 year, such as the reconstruction of the underground levels of buildings where the Celtic mint is being stored.	[57]
Fisherman´s gate	Pluvial flooding and underground water – moisture entry (interior),	Tangible cultural heritage (archaeological remains *in situ*)	Moisture/fungal damage to archaeological remains of fortification walls and tower can cause erosion	The site was designed Europa Nostra heritage 2003	Possible damage to upper layers of the pedestrian zone, loss of tourist sight	Disruption of tourism service provided on-site	Loss of cultural heritage value resulting from physical damage	Protection against humidity and deterioration, Functional protection, planning of yearly management control from the site of the Old City Borough	[58]

6.3. Preliminary classification of hazards, exposed elements and impacts

The purpose of this section is to review, interpret, validate, and harmonise the information provided in the Risk Profile Table as a sound basis for the project to address Bratislava's risks to cultural heritage induced by climate change and other hazards. The section provides a preliminary, qualitative screening of:

a) hazards;

b) elements exposed to those hazard; and

c) main impacts that the identified hazards might cause on the identified exposed elements.

The Risk Profile (Part 6.2 above) supported the identification of the elements mentioned above for different cultural heritage areas selected by Bratislava as a focus for the ARCH project, in two different boroughs, i.e. the **Old town city borough** and the **Devín city borough.**

Within the two selected boroughs, Bratislava City has a special interest in different cultural heritage areas, cultural landscapes, buildings and structures, as reported in Table 6.1 below:

Table 6.1. Cultural heritage areas, cultural landscapes, buildings and structures identified by Bratislava City as a focus for the ARCH project.

Old town city borough	Location
Monument preservation zone	Wider historical city centre, Old Town borough
Monument preservation reserve	Historical city centre, Old Town borough
Celtic acropolis with roman architecture	Bratislava Castle, Old Town borough
Celtic kiln	Monumental reserve, Old Town borough
St. James´s chapel and charnel house	Monument preservation zone, Old Town borough
Celtic Metal casting and coin minting workshop	Monumental reserve, Old Town borough
Fisherman´s Gate	Monument preservation zone. Old Town borough
Devin city borough	**Location**
Devín Castle	Devin borough

6.3.1. Hazards

Bratislava City is well aware of the hazards that are affecting the selected sites. Within the "Risk Profile Table" *pluvial flooding, droughts and heatwaves*, have been identified as the hazards affecting all the cultural heritage areas and elements of interest listed in Table 6.1 above.

The aforementioned extreme meteorological conditions are causing moisture to enter the buildings of interest (i.e. St. James´s chapel and the Celtic Metal casting and coin minting workshop). This can be regarded as an induced-hazard. Further than *pluvial flooding, droughts*

and heatwaves, the Devín Castle is affected by slope movements and landslides, erosion and wind.

The hazard clusters identified in Bratislava, for the cultural heritage sites of interest include: ***Meteorological, Geophysical, Biological*** (see Table 6.2 below). Although not specifically reported within the Risk Profile Table, human-induced pollution is also included in Table 6.2 as a possible hazard that Bratislava might like to consider (this possibility was mentioned by the City of Bratislava during the ARCH project 1st General Assembly in June 2019).

Table 6.2. Hazard clusters and manifestations identified in Bratislava. Italic characters are used to identify hazards that, although not included in the Risk Profile Table, Bratislava might be interested to analyse.

Hazard Cluster	Hazards	Manifestations
Meteorological	Extreme precipitation	Pluvial flooding, heavy rain, heavy snow, monsoons, blizzards, hail
	Wind	Tornados, cyclones, severe winds
	Extreme heat	Heatwaves, droughts
Geophysical	Mass movements	Landslides, avalanches, rockfalls, subsidence
Biological	Pests and plagues	Moths, mites
	Fungi action	Moisture, mould
Human-induced	Pollution	Soil pollution, water pollution, air pollution

6.3.2. Exposed Elements

The exposed elements identified by Bratislava City within the Risk Profile Table are herein reorganised according to the following categories:

- Natural Environment;
- Built Environment: critical Infrastructures and Buildings;
- Cultural heritage;
- Services (essential or basics and productive);
- Human and social aspects.

In Table 6.3, the cultural heritage category subsumes all exposed elements that are in themselves heritage, i.e. exposed elements declared as heritage are only categories as such and not as any of the other categories.

Table 6.3. Exposed elements identified in Bratislava.

Exposed Element Categories	Exposed Element Types
Natural Environment	Ecosystem
	Urban greenery
Built Environment	Buildings and architecture
	Road, railroad and other critical infrastructures
Cultural Heritage	Tangible cultural heritage
	Intangible elements
	Archaeological remains
Services, essential and productive	Essential and basics services
	Productive services
Human and Social Aspects	External people (e.g. tourists,)
	Local people

Table 6.4 reports in further detail the exposed elements categorised as cultural heritage. Here, reference has been made to the six categories identified by the ICOMOS Climate Change and Cultural Heritage Working Group, CCHWG (2019). In Bratislava, exposed cultural heritage elements include: archaeological resources, such as archaeological finds and archaeological sites (i.e. Celtic acropolis with Roman architecture, Celtic Metal casting and coin minting workshop, Celtic kiln); buildings and architectural structures (i.e. Devín Castle, St. James´s chapel) and groups of separate or connected buildings (i.e. Monument preservation zone); cultural landscapes, such as combined works of nature and humankind (i.e. Monument preservation reserve). Intangible heritage is also mentioned in the Risk Profile Table, however, the kinds of intangible heritage are not specified (see Table 6.4 for possible kinds).

Table 6.4. Exposed cultural heritage elements identified in Bratislava (highlighted in bold), and further cultural heritage categories and types identified in the ARCH project, that Bratislava City might like to consider.

Exposed Cultural Heritage Categories	Exposed Cultural Heritage Types
Moveable heritage	works of monumental sculpture and painting
Archaeological resources	archaeological finds
	archeological materials
	archaeological sites
	archeological monuments
	stratigraphic tests
	stratigraphic finds
Buildings and structures	architecture (castle, chapel, workshop)
	groups of separate or connected buildings
	historical nuclei
Cultural landscapes	parks/gardens
	combined works of nature and humankind
Associated and traditional communities	
Intangible heritage	oral traditions
	performing arts

	social practices
	rituals
	festive events
	knowledge and skills to produce traditional crafts
	knowledge and practices concerning nature and universe

6.3.3. Impacts

The identification of impacts in the Risk Profile Table for Bratislava is quite exhaustive.

Table 6.5 below reports, in a concise way, the different impacts identified for the five categories of impacts, included in the Risk Profile Table (i.e. Physical, Functional, Societal, Economic and Intangible) for the different exposed elements categorised according to the classification reported in Table 6.3.

Table 6.5. Physical, Functional, Societal, Economic and Intangible impacts identified in Bratislava for the different exposed elements.

Exposed Element		Physical	Functional	Societal	Economic	Intangible
Natural Environment	Ecosystem	Loss of biodiversity				
	Urban greenery	Increased morbidity of trees	Loss of protection against erosions			
Built Environment	Buildings and architecture	Damage to buildings due to flooding (especially underground levels)			Loss of business income due to damaged premises	
	Road and other critical infrastructures	Flooding of urban road and paths	Outage of critical services			
Cultural Heritage	Tangible cultural heritage	Moisture and fungus cause damage			Loss of tourism revenue due to decrease in visitors	Loss of cultural Values
	Archaeological remains					
	Intangible elements					
Services, essential and productive	Essential and basics services			Reduced /Loss of access to critical services		
	Productive services					
Human and Social Aspects	External people (e.g. tourists,)					
	Local people		Non-suitable	Fewer working hours due	Loss of income due to	

Exposed Element		Physical	Functional	Societal	Economic	Intangible
			working conditions in office and working buildings due to heatwaves	to not suitable working conditions	shortened working hours	

6.4. Outlook and implications for future ARCH work

As stated in Chapter 5 of this report, the "new action plan to adverse climate change-induced impacts in Bratislava" will put more focus on increasing the resilience of cultural heritage. The on-going and planned work within the ARCH project can provide critical and operative inputs to inform and support the implementation of such an action plan.

Towards that and following up on the information provided in the Risk Profile Table at Part 6.2 above, ARCH work for Bratislava City is envisaged to be conducted at different levels of analysis for the different exposed elements identified in Bratislava.

Table 6.6 below provides initial ideas of possible examples of the work that can be undertaken as part of the ARCH project. What is proposed in Table 6.6 will need, of course, to be discussed and agreed with Bratislava City and ARCH research partners; and will be subject to data availability[8].

Table 6.6. Possible analysis and possible tools to be implemented for ARCH work in Bratislava City.

Boundaries of Study Areas	Possible Analysis	Possible Tools
Bratislava City & Suburbs (including Old Town City, Devín city boroughs).	Impact Chain Analysis Thematic maps	IVAVIA impact chain creator (Adapted for ARCH) ARCH DSS (i.e. CIPCast)
Old Town City borough	Scenario simulations	ARCH DSS
- Monument preservation zone - Monument preservation reserve - Celtic acropolis with roman architecture	Scenario simulations with dynamic data integration from sensors and satellite images	ARCH DSS Satellite Images and Sensors

[8] In regard to the latter, some preliminary information has already been provided by Bratislava City, in response to a questionnaire developed by scientific partner INGV and distributed to all ARCH city partners in October 2019.

Boundaries of Study Areas	Possible Analysis	Possible Tools
- St. James´s Chapel, - Devín Castle - Celtic Kiln - Fisherman´s Gate	3D Building model with identified damage pattern and dynamic monitoring of damage Finite element analysis of the buildings to support retrofitting interventions	Sensors Photogrammetry 3D models

As for a large-scale territorial analysis (i.e. covering the whole Bratislava City & city boroughs), it may be possible to build on previous data collected as part of an earlier project RESIN[9], where Bratislava conducted risk analysis supported by ARCH consortium partner Fraunhofer, as well as to make use of the indexes defined in RESIN, which have been summarised for Bratislava into an ad-hoc Atlas. Also, starting from the Bratislava case study, that already used it, it would be great to adapt the IVAVIA risk-based vulnerability assessment methodology[10] that was conceived and defined as part of the RESIN project, to the proposed objectives of ARCH.

Towards that, it would be necessary to expand the hazards and the exposed elements that, currently, IVAVIA considers. As an example, for the implementation of IVAVIA in Bratislava mainly meteorological hazards were considered with special focus on precipitation and temperature; as far as the exposed elements and possible induced impact on them, main focus was on critical infrastructures and on vulnerable people.

For its use in Bratislava and more generally in the whole ARCH project, the possibility to analyse the impacts induced by further hazards (i.e. geophysical, biological and human-induced hazards as far as Bratislava is concerned) would need to be embedded into IVAVIA as well as the possibility to have a special focus on:

- further exposed elements and especially on cultural heritage exposed elements (both tangible and intangible, listed in Table 6.4) and
- direct and indirect/cascading impacts (both tangible and intangible) that climate change and other hazards might induce on cultural heritage exposed elements.

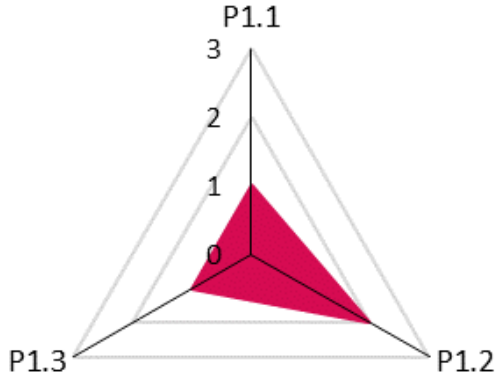
As a first step, of the adaptation process of IVAVIA to ARCH, a possibility could be to use Table 6.5 of this report as a reference to support a co-creation discussion with Bratislava stakeholders to expand on the possible expected impacts; information in several cells in Table 6.5 is still missing.

[9] See more at https://resin-cities.eu/home/
[10] See more at https://resin-cities.eu/resources/ivavia/

7. Preliminary resilience assessment

The following resilience assessment was developed using the preliminary version of the UNDRR Disaster Resilience Scorecard for Cities. The preliminary assessment was conducted within the framework of a webinar between the municipality of Bratislava, MÚOP, and Fraunhofer on January 28, 2020. As the original Scorecard is aimed at city-level, not all questions were immediately applicable on the level of historic areas or single heritage assets. Wherever possible, answers were provided for the historic areas under examination (e.g. with regard to hazard scenarios). For all other questions, answers were provided on city-level (e.g. with regard to city masterplans). The results give a first indication of the overall resilience of the city with some – but not exclusive – focus on the historic areas examined by ARCH. In addition, the application of the Scorecard will be used as input for the development of the ARCH Resilience Assessment Framework specifically focused on historic areas. Lastly, the preliminary resilience assessment results presented in the baseline reports should not be employed to develop resilience action plans, as not all necessary stakeholder groups were involved in the assessment process.

7.1. Essential 01: Organize for resilience



P1.1	Does the City master plan (or relevant strategy/plan) adopt the Sendai Framework?	1
P1.2	Is there a multi-agency/sectoral mechanism with appropriate authority and resources to address disaster risk reduction?	2
P1.3	Is resilience properly integrated with other key city functions / portfolios?	1

Figure 7.1. Results Essential 01.

Regarding Essential 01, Bratislava achieves a resilience score of 3/9. While the city has a master plan, it is not compliant with the Sendai Framework. Instead, there is an additional regional DRR plan for Bratislava consisting of emergency instructions, which is - as all Slovak Republic DRM plans - compliant with Decision No. 1313/2013/EU of the European Parliament (score of 1 for P1.1). Organisation and coordination for DRR is well addressed; all lead agency teams are well established, properly resourced and with authority to act, but there is no consistency in the resourcing of the main DRR stages (score of 2 for P1.2). Lastly, resilience is only integrated into other key city functions on an ad hoc basis during or after a disastrous event (score of 1 for P1.3).

7.2. Essential 02: Identify, understand and use current and future risk scenarios

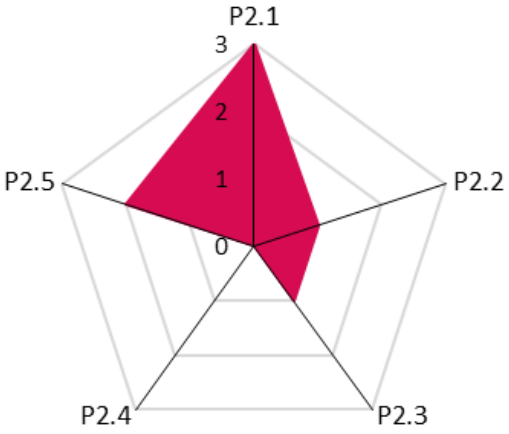
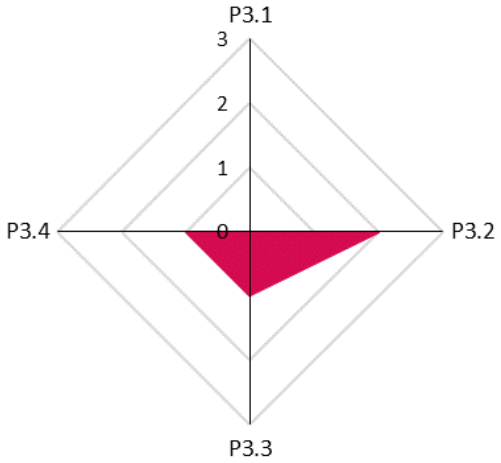


Figure 7.2. Results Essential 02.

P2.1	Does the city have knowledge of the key hazards that the city faces, and their likelihood of occurrence?	3
P2.2	Is there a shared understanding of risks between the city and various utility providers and other regional and national agencies that have a role in managing infrastructure such as power, water, roads and trains, of the points of stress on the system and city scale risks?	1
P2.3	Are their agreed scenarios setting out city-wide exposure and vulnerability from each hazard, or groups of hazards (see above)?	1
P2.4	Is there a collective understanding of potentially cascading failures between different city and infrastructure systems, under different scenarios?	0
P2.5	Do clear hazard maps and data on risk exist? Are these regularly updated?	2

For Essential 02, Bratislava achieves a resilience score of 7/15. The city understands its main hazards and has a well-established monitoring network. Depending on the hazard, related data are periodically updated and maintained by related industries / stakeholders. For example, the city's air pollution data is monitored every hour. The data is monitored and published by the Slovak Hydrometeorological Institute, and large and medium-sized polluters, like oil refinery and car manufactures, regularly share their pollution data with the city. Furthermore, climate change impact data will be available this year (score of 3 for P2.1). Individual system risks are known by the respective utility providers, but not systematically shared in a forum among relevant stakeholder groups in order to understand cascading effects. Furthermore, risks are not defined for heritage sites (score of 1 for P2.2). Due to the application of the IVAVIA assessment in the H2020 RESIN project, single disaster scenario information are available for some hazards. In general, for heritage sites, Slovak Republic recommends procedures in case of emergencies (score of 1 for P2.3). There is no general analysis and understanding of cascading effects and impacts (score of 0 for P2.4). Hazard maps will be published in a risk atlas and shall be updated regularly afterwards (score of 2 for P2.5).

7.3. Essential 03: Strengthen financial capacity for resilience

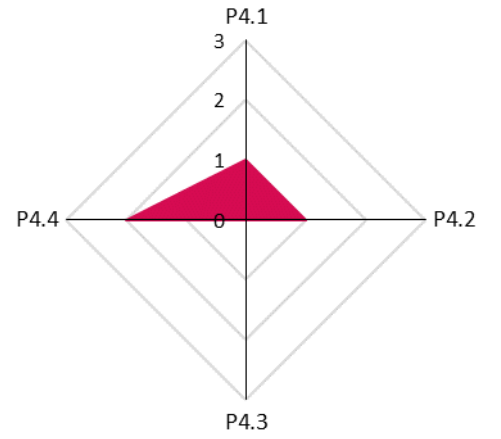


P3.1	The city / lead agencies understand all sources of funding, and the "resilience dividends", are well connected, understand all available routes to attract external funding and are actively pursuing funds for major resilience investments.	0
P3.2	Does the city have in place a specific 'ring fenced' (protected) budget, the necessary resources and contingency fund arrangements for local disaster risk reduction (mitigation, prevention, response and recovery)?	2
P3.3	What level of insurance cover exists in the city, across all sectors – business and community?	1
P3.4	What incentives exist for different sectors and segments of business and society to support resilience building?	1

Figure 7.3. Results Essential 03.

For Essential 03 Bratislava achieves a resilience score of 4/12, which indicates room for improvement. Currently, there is little knowledge about available funding approaches for resilience measures. While there is a multi-level DRM structure (national, regional, and municipal), any resources for funding are usually only pursued on the national level with the local agencies having only a limited awareness of additional funding opportunities (score of 0 for P3.1). The city financial plan allows for DRR activities. Enough budget is available for civil protection and crisis management coordination, supported by finance measures of the state for reconstruction (score of 2 for P3.2). The level of insurance coverage varies significantly by sector (score of 1 for P3.3). Only a limited number of incentives for the support of resilience-building exist, such as small grants for sustainable drainage systems for private households (up to 1000 € per applicant) or the environmental grant programmes of the Bratislava regional authority (up to 12 000€ per application) (score of 1 for P3.4).

7.4. Essential 04: Pursue resilient urban development

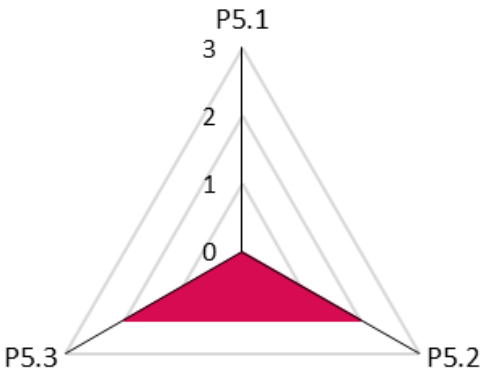


P4.1	Is the city appropriately zoned considering, for example, the impact from key risk scenarios on economic activity, agricultural production, and population centres?	1
P4.2	Are approaches promoted through the design and development of new urban development to promote resilience?	1
P4.3	Do building codes or standards exist, and do they address specific known hazards and risks for the city? Are these standards regularly updated?	0
P4.4	Are zoning rules, building codes and standards widely applied, properly enforced and verified?	2

Figure 7.4. Results Essential 04.

Regarding Essential 04, Bratislava achieves a resilience score of 4/12, which leaves room for improvement. Zoning plans exist for the city and the boroughs; hazard and risk analysis is conducted by the Ministry of Interior as well as regional authorities for the municipalities. However, a more detailed and small-scale land-use zoning plan is needed for the heritage sites (score of 1 for P4.1). Resilience approaches for new urban developments are promoted, but only in an inconsistent way. Since the law on building codes does not support actions for resilience against climate change, the city is only able to give recommendations for appropriate urban development approaches. For the development of heritage sites, a different law, the law of heritage protection is applied (Act 49/2002 Coll. By the National Council of the Slovak Republic) (score of 1 for P4.2). There are no relevant building codes and standards that address any specific hazards of the city, which is furthermore a state-wide problem (score of 0 for P4.3). Zoning rules and building codes and standards are applied and enforced in more than half of the occurring cases in the city, but these are often not properly enforced (score of 2 for P4.4).

7.5. Essential 05: Safeguard natural buffers to enhance the protective functions offered by natural ecosystems



P5.1	Beyond just an awareness of the natural assets, does the city understand the functions (or services) that this natural capital provides for the city?	0
P5.2	Is green and blue infrastructure being promoted on major urban development and infrastructure projects through policy?	2
P5.3	Is the city aware of ecosystem services being provided to the city from natural capital beyond its administrative borders? Are agreements in place with neighbouring administrations to support the protection and management of these assets?	2

Figure 7.5. Results Essential 05.

For Essential 05 Bratislava reaches a score of 4/9. The city has showcased until recently little awareness and understanding of the functions and services that natural capital provides for it (score of 0 for P5.1), amongst topics such as mobility and development. However, green and blue infrastructure are getting more and more integrated and promoted through city policy for the past two years; for example, a report on urban greenery was developed, and a manual for greenery is currently under development as well as an Action plan for adaptation to climate change was adopted in 2017 (score of 2 for P5.2). The city is aware of the functions provided by natural capital beyond the city administrative border, and it cooperates well with neighbouring administrations such as the Bratislava regional authority, regional office of state nature conservancy and the transboundary national park protection (SK-AT-HU) (score of 2 for P5.3).

7.6. Essential 06: Strengthen institutional capacity for resilience

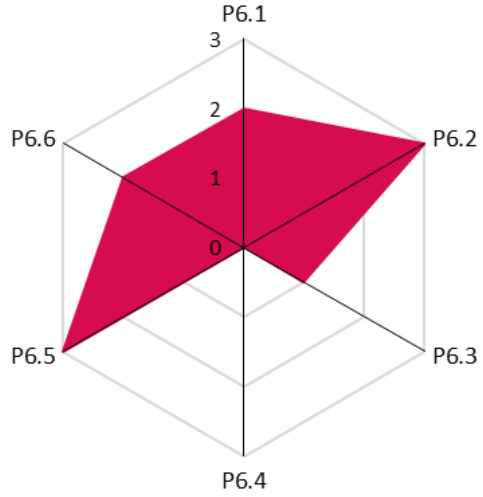


Figure 7.6. Results Essential 06.

P6.1	Does the city have clear access to all the skills and experience it believes it would need to respond to reduce risks and respond to identified disaster scenarios?	2
P6.2	Does a co-ordinated public relations and education campaign exist, with structured messaging and channels to ensure hazard, risk and disaster information (that can be understood and used) are properly disseminated to the public?	3
P6.3	Extent to which data on the city's resilience context is shared with other organizations involved with the city's resilience.	1
P6.4	Are there training courses covering risk and resilience issues offered to all sectors of the city including government, business, NGOs and community?	0
P6.5	Are training materials available in the majority of languages in common use in the city?	3
P6.6	Is the city proactively seeking to exchange knowledge and learn from other cities facing similar challenges?	2

Regarding Essential 06, Bratislava achieves a score of 11/18. The city can quickly access most of the skills required to identify and respond to identified disaster scenarios. In general, the coordination and organisation of risk responses is designed in a multi-level governance fashion; from state ministries and regional authorities to municipalities and city boroughs (score of 2 for P6.1). This also ensures proper dissemination of hazard, risk, and disaster information via fully co-ordinated campaigns (score of 3 for P6.2). Up to now, some of the city's data layers are shared, e.g. via the risk atlas. A department for data management & policy was created mid-2019 and is in charge of creating a data portal and providing interpretations (score of 1 for P6.3). Training materials are available in the common language Slovak for all city hall employees (score of 3 for P6.5). Bratislava understands the importance of sharing knowledge with other cities and is involved in regional networks (score of 2 for P6.6).

7.7. Essential 07: Understand and strengthen societal capacity for resilience

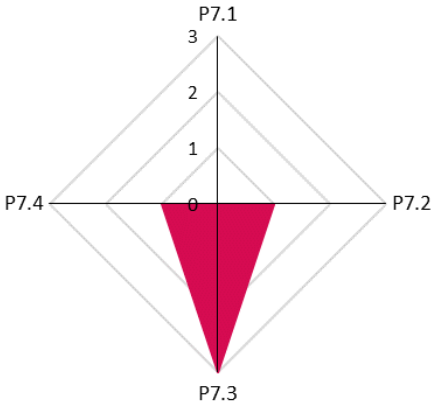


Figure 7.7. Results Essential 07.

P7.1	Are "grassroots" or community organizations participating in risk reduction and post-event response for each neighbourhood in the city?	0
P7.2	Are there regular training programmes provided to the most vulnerable populations in the city?	1
P7.3	What proportion of businesses have a documented business continuity plan that has been reviewed within the last 18 months?	3
P7.4	How effective is the city at citizen engagement and communications in relation to DRR?	1

Bratislava achieves a score of 5/12 for Essential 07, which partly offers space for improvement. There is very little involvement from grassroots organisations in the city for risk reduction and post-event responses due to the low number of severe disasters in the last years (score of 0 for P7.1). However, there are NGOs taking care of climate change adaptation and decarbonisation. There are no training programs provided to the most vulnerable populations in the city (score of 1 for P7.2). A large share (60 – 100%) of mostly larger corporations and businesses have documented and usually very comprehensive business continuity plans (score 3 for P7.3). The city engages citizens and communicates DRR via some channels such as the National Integrated Rescue System (IRS), which provides information in the event of threats to life, property, or the environment (score of 1 for P7.4).

7.8. Essential 08: Increase infrastructure resilience

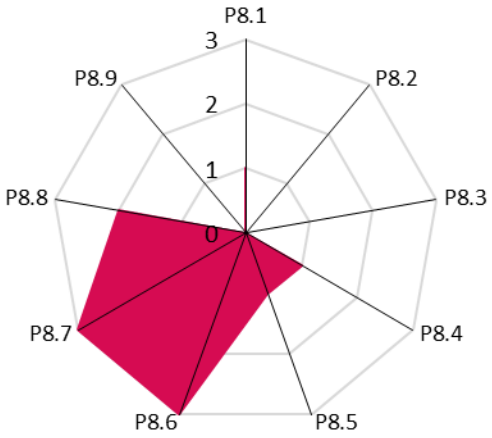


Figure 7.8. Results Essential 08.

P8.1	Is critical infrastructure resilience a city priority, does the city own and implement a critical infrastructure plan or strategy?	1
P8.2	Is existing protective infrastructure well-designed and well-built based on risk information?	0
P8.3	Would a significant loss of service for these two essential services be expected for a significant proportion of the city under the agreed disaster scenarios?	-
P8.4	Would a significant loss of service be expected for a significant proportion of the city in the 'worst case' scenario event? In the event of failure would energy infrastructure corridors remain safe (i.e. free from risk of leaks, electrocution hazards etc.)?	1
P8.5	Would a significant loss of service be expected for a significant proportion of the city in the 'worst case' scenario event? In the event of failure would transport infrastructure corridors remain safe (i.e. free from risk of flood, shocks etc.) and passable?	1
P8.6	Would a significant loss of service be expected for a significant proportion of the city in the 'worst case' scenario event?	3
P8.7	Would there be sufficient acute healthcare capabilities to deal with expected major injuries in 'worst case' scenario?	3
P8.8	% of education structures at risk of damage from "most probable" and "most severe" scenarios	3
P8.9	Will there be sufficient first responder equipment, with military or civilian back up as required?	0

For Essential 08, Bratislava reached a score of 10/27 leaving major room for improvement. The city understands the risks for some major infrastructure types; however, CI operators use only their forums to exchange on risks and cascading effects (score of 1 for P8.1). Significant parts of the city are unprotected from known risks and hazards, e.g. there is no protection from pluvial flooding (score of 0 for P8.2).

For the preliminary assessment, there was no available information with regard to loss of service for the water (potable and sanitation) infrastructure (score of - for P8.3) and only very

limited information with regard to the loss of service for the energy infrastructure (score of 1 for P8.4). These areas will need to be revisited during a more detailed assessment.

From the most probable scenario, pluvial flooding, some loss of service would be expected for the transport infrastructure (score of 1 for P8.5), but no loss of service for communication infrastructure (score of 3 for P8.6). The healthcare and education systems of Bratislava are well-positioned to deal with the hazards faced by the municipality as more than 90% of major injuries can be treated within six hours under the “most severe” scenario (score of 3 for P8.7), and no teaching facilities would be at risk under the “most probable” scenario (score of 2 for P8.8). Lastly, Bratislava’s first responders are not well equipped to deal with the “most probable” scenario (score of 0 for P8.9). This is contrary to the national rescue system that is very well prepared and equipped.

7.9. Essential 09: Ensure effective disaster response

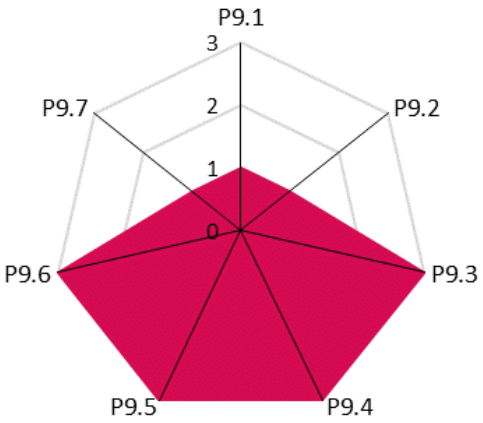
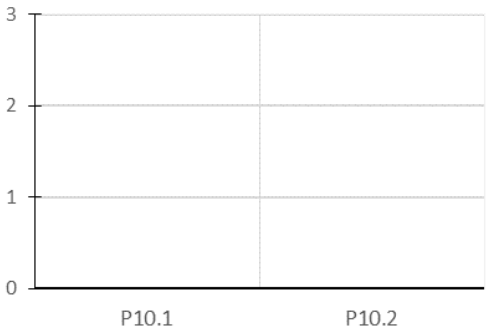


Figure 7.9. Results Essential 09.

P9.1	Does the city have a plan or standard operating procedure to act on early warnings and forecasts? What proportion of the population is reachable by early warning system?	1
P9.2	Is there a disaster management / preparedness / emergency response plan outlining city mitigation, preparedness and response to local emergencies?	1
P9.3	Does the responsible disaster management authority have sufficient staffing capacity to support first responder duties in surge event scenario?	3
P9.4	Are equipment and supply needs, as well as the availability of equipment, clearly defined?	3
P9.5	Would the city be able to continue to feed and shelter its population post-event?	3
P9.6	Is there an emergency operation centre, with participation from all agencies, automating standard operating procedures specifically designed to deal with “most probable” and “most severe” scenarios?	3
P9.7	Do practices and drills involve both the public and professionals?	1

For Essential 09 Bratislava achieves a resilience score of 15/21. The early warning systems of the city can reach over half of the population via different channels such as sirens, smartphone applications, radio stations, TV, websites (score of 1 for P9.1). The Slovak state legislation provides acts on, e.g. protection of civilians, management of the state in conflicts etc. Furthermore, the Ministry of Interior of the Slovak Republic provides an emergency response handbook. However, the acts and plans are not joined up (score of 1 for P9.2). The responsible disaster management authorities have sufficient staffing capacity, on the national as well as the regional level (score of 3 for P9.3). In addition, the equipment and relief supply needs are clearly defined (score of 3 for P9.4), and the necessary supplies of food and basic relief items exceeds estimated needs under the “most severe” scenario. These are provided by city boroughs – via general and special shelters – which are coordinated on city level (score of 3 for P9.5). The city boroughs are coordinated by city crisis committees that are able to deal with the “most severe” scenario (score of 3 for P9.6). Lastly, according to Act 42/1994, several practices and drills are designed and performed for a few scenarios (score of 1 for P9.7).

7.10. Essential 10: Expedite recovery and build back better



P10.1	Is there a strategy or process in place for post-event recovery and reconstruction, including economic reboot, societal aspects, etc.?	0
P10.2	Do post-event assessment processes incorporate failure analyses and the ability to capture lessons learned that then feed into design and delivery of rebuilding projects?	0

Figure 7.10. Results Essential 10.

For Essential 10, Bratislava achieves a score of 0/6 leaving a lot of room for improvement. There are no processes or strategies in place for post-event recovery and reconstruction; solutions and lessons-learnt are unplanned and are usually on an ad-hoc basis (score 0 for P10.1 and P10.2).

7.11. Overall resilience of Bratislava

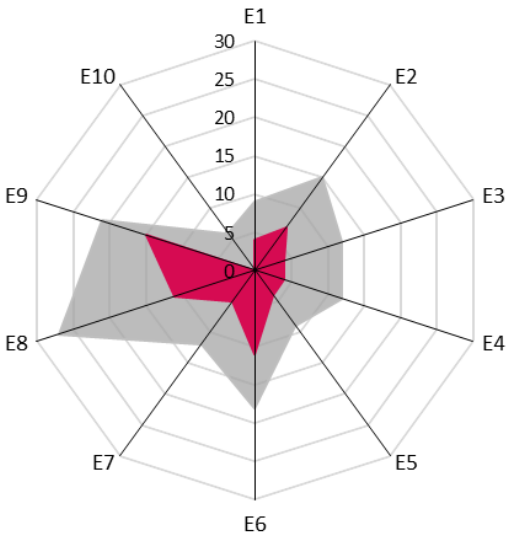


Figure 7.11. Combined results for Essential 01-10 for Bratislava.

Overall, Bratislava achieves a resilience score of 66/141 with significant room for improvement in all Essentials, except for Essential 06 and Essential 09.

Bratislava has good institutional capacity for supporting in case of emergencies. Due to the national and regional institutional structures, an emergency response is provided in a fast manner and with sufficient resources. However, there is potential for using available data for planning future scenarios and evaluating cascading effects. There are several legislative acts for disaster response and existing emergency plans, but these could be combined to plan and structure emergency responses in a more comprehensive way. There is room for further evaluation and application of resilience actions for the city and its infrastructure. Especially for the heritage sites, there is a great potential for defining, planning and incorporating resilience actions.

8. Conclusions

The tangible and intangible heritage of Bratislava covers architectural, monumental, archaeological, and natural heritage. It is characterized by complex settlement arrangements with a high density of cultural monuments, which are mainly at risk from pluvial flooding, erosion, heatwaves and other extreme weather events. For the ARCH project, Bratislava City has proposed the following study sites: the medieval town centre which gained the status of monument preservation reserve in 1995, the unique Devin Castle on the dolomite cliff above the Danube River, and Celto-Roman structures on the Bratislava Castle hill. Findings from the research that will be undertaken at the monument preservation reserve (protecting the wider city core since 1992) and findings from the Devin Castle can be transferred to other outdoor tangible heritage sites such as the antique Gerulata castellum. The research sites are impacted by different hazards and represent different categories of exposed objects (not only in terms of size): Natural Environment, Built Environment: critical Infrastructures and Buildings; Cultural heritage; Services (essential or basics and productive); local population and visitors to Bratislava.

The historical monument preservation reserve is greatly threatened by pluvial flooding, as the majority of objects are preserved in situ. Additional threats come from moisture and humidity, and there is a risk of closing the sights to the public as it could pose danger visitors in addition to the monuments. At Devín castle, it is unknown how much time is left for the cliff to finally erode to the extent that the castle will have to be closed for visitors. The remaining castle walls are also threatened by the cliff movement as well as by the rapidly changing temperatures. It would be useful for the Bratislava City Museum, Bratislava City, and the Devín city borough to know the trends of rock erosion and how they may be affected by different climate change scenarios. This helps the stakeholders determine which adaptation measures are most suitable and to what extent they need to be implemented. Therefore, developing adaptation pathways for the mitigation of the currently non-ideal situation at the historical monument reserve and the mitigation of erosion at the Devín Castle are priorities for the City and its stakeholders. (Municipal Monument Preservation Institute, Bratislava City Gallery and Bratislava City Museum).

After carrying out a first vulnerability assessment in 2018 to prioritise the most vulnerable sectors and population groups, a second risk-oriented vulnerability assessment was undertaken as part of a previous Horizon 2020 project (RESIN), which analysed the impacts of recent heatwaves and pluvial flooding on the population and selected critical infrastructure. Bratislava would like to take a further step and focus on additional sectors, such as cultural heritage protection, to be able to adapt the historical centre and other valuable tangible cultural heritage sites to the impacts of future scenarios of climate change. The current Action Plan for Climate Change Adaptation reaches the end of its term in 2020, and a new Action Plan is already under preparation. The preparation phase of the Action Plan provides a good opportunity for testing and co-creating the tools of the ARCH project.

This report has identified gaps between the governance frameworks reviewed, such as the absence of direct links between cultural heritage and climate change adaptation. The updated national strategy for adaptation to climate change and the forthcoming Action Plan for adaptation raise the topic of cultural heritage protection as well as the absence of relevant

legal tools for enforcing adaptation measures by local authorities. One possible solution to this would be a new act on climate change adaptation and the mitigation of impacts. This would also, to a certain extent, amend existing legislation on building and construction, spatial planning, cultural heritage protection and others.

As Bratislava has been growing along the banks of the Danube River for centuries, it has sometimes had a “troubled relationship” with this international river. The City has often been threatened by floods from the Danube, which led to the fortification of flooding barriers against a 100-year flood in Devin city borough and against a 1000-year flood in the historical centre. The overall topic of fluvial flooding and the resulting disaster risk management is very well elaborated in the existing governance frameworks on all levels of governance (also including compensation mechanisms). However, similar policies should be developed to help prevent and deal with other hazards caused by climate change – especially pluvial flooding from intensive rainfall and heatwaves. There is room for further evaluation and application of resilience actions for the city, its population, cultural heritage and infrastructure.

In the field of adaptation to negative impacts of climate change, the first meetings with local stakeholders launched under the umbrella of the ARCH project identified a future need for a paradigm shift in cultural heritage protection. This is because adaptation measures need to be implemented in order to ensure and make historical centres places worth living, working and visiting even during very hot days and nights. Suitable adaptation measures can also help preserve cultural heritage and increase its resilience to climate change impacts of greater intensity in the future.

Bratislava City, together with its municipal organisations and its local stakeholders, have a reasonable amount of knowledge, experience and data that can be provided to facilitate the process of evaluating the cascading effects of climate change impacts on (not only) cultural heritage sites, planning adaptation pathways and choosing the appropriate resilience actions.

9. Bibliography

[1] “DATAcube (in Slovak),” Statistical office of the Slovak Republic, 2019. [Online]. Available: http://datacube.statistics.sk. [Accessed 30 January 2020].

[2] B. Bleha, B. Šprocha and B. Vaňo, “Study of demographic potential of the Bratislava the Capital City of the Slovak Republic (in Slovak),” 2017. [Online]. Available: https://bratislava.blob.core.windows.net/media/Default/Dokumenty/Str%C3%A1nky/Chcem%20vediet/%C5%A0t%C3%BAdia%20demografick%C3%A9ho%20potenci%C3%A1lu%20Bratislavy.PDF. [Accessed 2 April 2020].

[3] “Bratislava in numbers (in Slovak),” Statistical institute of the Slovak Republic, Bratislava, 2019.

[4] Infostat - Demographic Research Centre, “http://www.infostat.sk/,” [Online]. Available: http://www.infostat.sk/vdc/en/index.php?option=com_wrapper&view=wrapper&Itemid=46. [Accessed 22 April 2020].

[5] R. Vlačuha and Y. Kováčová, “EU SILC 2017/ EU SILC 2017 Poverty indicators (in Slovak, in English),” Statistical office of the Slovak Republic, 2018.

[6] EUROSTAT, “ec.euroba.eu/eurostat,” [Online]. Available: https://ec.europa.eu/eurostat/statistics-explained/index.php/Glossary:At-risk-of-poverty_rate. [Accessed 22 April 2020].

[7] E. Streberová, D. Lückerath, M. Šteflovičová, M. Šteflovičová, J. Pecho, M. Bogen, M. Kozová, E. Pauditšová, I. Konrad and V. Kasala, Atlas of risk-based vulnerability assessment of the impacts of climate change in Bratislava (in Slovak), Bratislava: Hlavné mesto SR Bratislava, 2020 (forthcoming).

[8] J. Holec, M. Garaj and J. Pecho, “Effects of the character of bulit-up area on the air temperature regimes in Bratislava (in Slovak),” Slovak hydrometeorological institute, Bratislava, 2018.

[9] “Act on the protection of monuments and historic sites No. 49/2002 Coll, amendments made by Act No. 479/2005, Act No. 208/2009, Act No. 262/2011, Act No. 180/2013 Act No. 38/2014 Z. z. and Act No. 104/2014,” National Council of the Slovak Republic, 2002.

[10] “ Act No. 42/1994 Coll. on civil protection of the population (in Slovak),” National Council of the Slovak Republic.

[11] M. Blišťanová, “Analysis of Natural Hazard Assessments in the Context of the National Strategy for Adaptation to Climate Change (in Slovak),” Journal of Global Science, vol. 2, no. 4, 2017.

[12] “Directive 2007/60/EC of the European Parliament and of the Council on the assessment and management of flood risks,” European Parliament and European Concil.

[13] “Act No. 7/2010 Coll. as amended by later regulations on the prevention of floods (in Slovak),” National Council of the Slovak Republic.

[14] European Commission´s Communication on flood prevention, protection and mitigation, Brussels: European Commission, 2004.

[15] L. Mahdoň, “Compensation of financial costs of municipalities and citzens during extra ordinary events (in Slovak),” in "Solving crisis situations in specific environments" - 21. international conference, 25-26.5.2016, Žilina, 2016.

[16] “Preliminary flood risk assessment in the Slovak Republic – update 2018 (in Slovak),” Ministry of the Slovak Republic, Bratislava, 2018.

[17] D. Lešková and et al, “Report on the floods in 2018,” Slovak Hydrometeorological Institute, Hydrological information and forecasting service, Bratislava, 2019.

[18] K. Hlavčová, J. Szolgay, D. Halmová, J. Parajka and S. Kohnová, “Changes in the hydrological regime of Slovak rivers and basic adaptation measures to climate change in water management,” in National Climate Program of the Slovak Republic 12/08: Consequeqences of climate change and adaptation measures., Bratislava, 2008.

[19] K. Mikulová, P. P. Šťastný, J. Pecho and et al., National Climate Program of the Slovak Republic. Climatological norms for the period 1981-2010 in Slovakia (in Slovak), Bratislava: Ministry of the Environment SR, Slovak Hydrometeorological Institute, 2019.

[20] Concept of Geological Research and Geological Survey of the Slovak Republic (in Slovak), Ministry of the Environment of the Slovak Republic, 2017.

[21] Partial monitoring system "Geological factors" - Subsystem 01 – Landslides and other slope deformations (in Slovak), Bratislava: State Geological Institute of Dionýz Štúr - Ministry of the Environment of the Slovak Republic, 2016.

[22] J. Šimeková und e. a. al., Atlas of Slope Stability Maps SR (scale 1:50 000) (in Slovak), State Geological Institute of Dionýz Štúr, 2017.

[23] Act No. 569/2007 Coll. on Geological Works (Geological Act) as amended by futher regulations (in Slovak), National Council of the Slovak Republic, 2007.

[24] “Act No. 42/1994 Coll. on Civil protection of the population as amended by futher regulations (in Slovak),” National Council of the Slovak Republic, 1994.

[25] Prevention program of landslide risk management (2014-2020) – update (in Slovak), Ministry of the Environment of the Slovak Republic, 2018.

[26] D. Lückerath, S. E. M. Bogen, E. Rome, O. Ullrich and E. Pauditšová, “Climate Change Impact and Vulnerability Analysis in the City of Bratisalva: Application and Lessons Learned,” In: Nadjm-Tehrani S. (eds) Critical Information Infrastructures Security. CRITIS 2019. Lecture Notes in Computer Science, vol. 11777, 2020.

[27] “Strategy of adaptation of the Slovak Republic to climate change - update (in Slovak),” Ministry of the Environment of the Slovak Republic, Bratislava, 2018.

[28] J. Minďaš, V. Páleník and P. Nejedlík, “Impacts of climate change and possible adaptation options for different sectors (in Slovak),” EFRA, Zvolen, Bratislava, 2011.

[29] “Adaptation to climate change,” Ministry of the Environment of the Slovak Republic, [Online]. Available: https://www.minzp.sk/klima/politika-zmeny-klimy/adaptacia-zmenu-klimy/. [Accessed 7 April 2020].

[30] “Action Plan for the Environment and Health of the Population of the Slovak Republic no. V (in Slovak),” Ministry of healthcare of the Slovak Republic, Bratislava, 2018.

[31] “Public health and climate change adaptation policies - final report,” World health organisation, Copenhagen, 2018.

[32] “Greener Slovakia: Strategy for Environmental Policy of the Slovak Republic until 2030 (in Slovak),” Ministry of the Environment of the Slovak Republic, Bratislava, 2019.

[33] “Action Plan for solving the consequences of drought and water scarcity (in Slovak),” Ministry of the Environment of the Slovak Republic, Bratislava, 2018.

[34] “Slovak Water Policy Framework for 2015 (in Slovak),” Ministry of the Environment of the Slovak Republic, Bratislava, 2006.

[35] “Proposal of Orientation, Principles and Priorities of the Slovak Water Policy until 2027 (in Slovak),” Ministry of the Environment of the Slovak Republic, Bratislava, 2015.

[36] “Water plan of Slovakia (in Slovak),” Ministry of the Environment of the Slovak Republic, Bratislava, 2015.

[37] “31] Integrated National Energy and Climate Plan 2021-2030 (in Slovak),” Ministry of Economy of the Slovak Republic, Bratislava, 2019.

[38] “Management plan of the Danube river basin - an update (in Slovak),” Ministry of the Environment of the Slovak Republic, Bratislava, 2015.

[39] “Timetable and factual and communication plan for the 3rd cycle of river basins management plan preparation (in Slovak),” Ministry of the Environment of the Slovak Republic, Bratislava, 2019.

[40] “Urban-landscape study to protect against storm rainfall in the Small Carpathian region (in Slovak),” Bratislava self – governing region, Bratislava, 2014.

[41] “Concept of protection and utilization of surface and ground water sources in Bratislava self – governing region (in Slovak),” Bratislava-selfgoverning region, Bratislava, 2017.

[42] ''Land-use plan for the territory of Bratislava the Capital City of the Slovak Republic (in Slovak),'' Bratislava the Capital City of the Slovak Republic, Bratislava, 2007.

[43] „Programme of social and economic development in Bratislava City (in Slovak),“ Bratislava the Capital City of the Slovak Republic, Bratislava, 2010.

[44] “Strategy for Adaptation to Adverse Impacts of Climate Change in the Territory of Bratislava City (in Slovak),” Bratislava the Capital of the Slovak Republic, Bratislava, 2014.

[45] “Action plan for adaptation to adverse impact of climate change in the territory of Bratislava City (in Slovak),” Bratislava the Capital City of the Slovak Republic, Bratislava, 2017.

[46] D. Výberči, J. Pecho, Faško and O. Bochníček, “Warm and cool spells in Slovakia, in the period 2017-1951, in the context of climate change (in Slovak),” Meteorological journal, vol. 21, p. 101 – 108.

[47] D. VÝBERČI, M. ŠVEC, P. FAŠKO, H. SAVINOVÁ, M. TRIZNA und M. E., „The effects of the 1996–2012 summer heat events on human mortality in Slovakia (in Slovak),“ Moravian Geographical Reports, Bd. 23, Nr. 3, pp. 101-108, 2015.

[48] D. Výbeči und J. Pecho, „Longterm changes in selected variables of excessive heat stress in summer in Slovakia (in Slovak),“ GEOGRAPHIA CASSOVIENSIS, Bd. X, Nr. 2, pp. 193-203, 2016.

[49] M. Musilová and M. J., “3D Reconstruction of Roman buildings from the 1st century BC on the Celtic Hillfort in Bratislava, Urban Archaeology,” in Proceedings of the 20th International Conference on Cultural Heritage and New Technologies, Vienna, 2015.

[50] M. Musilová, “Structural analysis of the Celto-Roman Masonry Building on Bratislava Castle Hill -A preliminary study. In: M. Karwowski, P. C. Ramsl (Hg.),,” in Boii - Taurisci, Materialien des internationalen Seminars 14-15. Juni, 2011, Oberleis-Klemen, 2016.

[51] M. Musilová, „Keltská akropola na Bratislavskom hrade/L´acropoli celtica nel castello di Bratislava (in Slovak and Italian),“ pp. 77-94, 2016.

[52] B. Lesák and A. Vrtel, “Archeologický výskum v Áponnyiho paláci v Bratislave (in Slovak),” Pamiatky a múzeá, p. 43–48, 2009.

[53] M. Musilová, “Výsledky archeologického výskumu Starej radnice v Bratislave v rokoch 2008-2010 (in Slovak),” Zborník k životnému jubileu PhDr. V. Plachej: Devín Veroniky Plachej, pp. 197-212, 2017.

[54] M. Illáš, “Vzťah predrománskeho kostola na Devíne k dalmátskej architektúre - Relation of the pre-Romanesque Church at Devín to Dalmatian Architecture (in Slovak),” in KONŠTANTÍNOVE LISTY , vol. 2, 2018, pp. 14-34.

[55] P. Šimončičová Koóšová, “Farnosť sv. Vavrinca v kontexte stredovekej Bratislavy, Parish of St. Lawrence in the Context of medieval Bratislava (in Slovak),” Harmadyova, K. ed. Devín veroniky Plachej, pp. 213-225, 2017.

[56] J. Hoššo, B. Lesák and M. Musilová, “Výskum cintorínovej kaplnky sv. Jakuba v Bratislave (in Slovak),” in Avans v roku 1994, Nitra, 1996, pp. 90-92.

[57] D. Rexa, “Výskum Pálffyho paláca na Nálepkovej ulici v Bratislave.,” in AVANS v roku 1984, Nitra, 1985, p. 204–205.

[58] M. Musilová, “Znovuobjavená Rybárska brána a jej gotické predbránie na freske Possonia vo Florencii (in Slovak),” ARS 49 - Časopis Ústavu dejín umenia SAV, pp. 50-67.

10. Annex

10.1. Key documents governing cultural heritage management (See Chapter 3)

Name of document	Type of document	Level	Binding / non-binding	Author(s)	Year published	Timeline for future revision/update	Link (if available)	Summary of content
Convention for the Protection of the Architectural Heritage of Europe	Agreement	International	Binding	Council of Europe	1987		https://www.coe.int/en/web/conventions/full-list/-/conventions/treaty/121	Legally binding instrument which sets the framework for an accurate conservation approach within Europe. The main purpose of the Convention is to reinforce and promote policies for the conservation and enhancement of Europe's heritage.
European Landscape Convention	Agreement	International	Binding	Council of Europe	2000		https://www.coe.int/en/web/conventions/full-list/-/conventions/treaty/143	Promotes the protection, management and planning of the landscapes and organizes international co-operation on landscape issues. Aware that the landscape contributes to the formation of local cultures and that it is a basic component of the European natural and cultural heritage, contributing to human well-being and consolidation of the European identity

Name of document	Type of document	Level	Binding / non-binding	Author(s)	Year published	Timeline for future revision/update	Link (if available)	Summary of content
European Convention on the Protection of the Archaeological Heritage (Revised)	Agreement	International	Binding	Council of Europe	1995		https://www.coe.int/en/web/conventions/full-list/-/conventions/treaty/143	This revised Convention updates the provisions of a previous Convention adopted by the Council of Europe in 1969. The new text makes the conservation and enhancement of the archaeological heritage one of the goals of urban and regional planning policies. It is concerned in particular with arrangements to be made for co-operation among archaeologists and town and regional planners in order to ensure optimum conservation of archaeological heritage.
Convention on the Protection of the Underwater Cultural Heritage	Agreement	International	Binding	UNESCO	2001		https://unesdoc.unesco.org/ark:/48223/pf0000126065	Intended to enable States to better protect their submerged cultural heritage. provides widely recognised practical rules for the treatment and research of underwater cultural heritage.

Name of document	Type of document	Level	Binding / non-binding	Author(s)	Year published	Timeline for future revision/update	Link (if available)	Summary of content
Convention Concerning the Protection of the World Cultural and Natural Heritage	Agreement	International	Binding	UNESCO	1972		https://whc.unesco.org/en/conventiontext/	Provides a permanent framework – legal, administrative and financial – for international cooperation in safeguarding humankind´s cultural and natural heritage and introduces the specific notion of a “world heritage” whose importance transcends all political and geographic boundaries.
Convention for the Safeguarding of the Intangible Cultural Heritage	Agreement	International	Non-binding	UNESCO	2003		https://ich.unesco.org/en/convention	Considers the importance of intangible cultural heritage as a mainspring of cultural diversity and a guarantee of sustainable development. It recognizes that the processes of globalization and social transformation, alongside the conditions they create for renewed dialogue among communities, also give rise to grave threats of deterioration, disappearance and destruction of the intangible cultural heritage, in particular owing to a lack of resources for safeguarding such heritage

Name of document	Type of document	Level	Binding / non-binding	Author(s)	Year published	Timeline for future revision/update	Link (if available)	Summary of content
Declaration of the National Council of the Slovak Republic on the protection of cultural heritage	Policy/regulation	National	Binding	The National Council of the Slovak Republic	2001		https://www.nrsr.sk/web/?sid=nrsr/dokumenty/vyhlasenia	Recognizes that cultural values created by previous generations are threatened by natural causes of deterioration and decay, changes in lifestyle, transformation of social and economic conditions, decline and disappearance of traditional crafts and techniques, and the application of technologies which are often incompatible with the nature of these cultural assets.
Strategy for the Conservation of Monuments	strategy	national	binding	Ministry of Culture of the Slovak Republic	2017	2023	http://www.culture.gov.sk/extdoc/7244/Strategia_ochrany_pamiatkoveho_fondu_2017-2022	aims to create such conditions and tools for the protection of monuments, which will guarantee their authenticity and integrity under current conditions, and which will contribute to improving the construction and technical condition of the heritage fund. In the area of territorial protection, it mainly promotes cultural heritage protection interests through spatial planning tools.

Name of document	Type of document	Level	Binding / non-binding	Author(s)	Year published	Timeline for future revision/update	Link (if available)	Summary of content
Guideline of the Ministry of Culture of the Slovak Republic on the protection of national cultural monuments in crisis situations	guideline/regulation	national	binding	Ministry of Culture of the Slovak Republic	2008		https://www.pamiatky.sk/Content/Data/File/pamiatkovy_vyskum/MK-30102008-1011546.pdf	Regulates the procedure of legal entities and natural persons responsible for the special protection of movable national cultural monuments in the context of preparation for crisis situations; and during crisis situations.
Strategy for Development of Local and Regional Culture and Culture of National Minorities of the Slovak Republic by 2030	strategy/policy	regional	binding	Ministry of Culture of the Slovak Republic	2019	2030	https://www.slov-lex.sk/legislativne-procesy/SK/LP/2019/471	The main priorities include improving the quality of public libraries, creating a legislative framework to ensure the support of cultures of national minorities, creating tools for coordinating and optimizing the performance of professional activities of regional cultural institutions, expanding regional activities of departmental organizations and intensifying the heritage.

Name of document	Type of document	Level	Binding / non-binding	Author(s)	Year published	Timeline for future revision/update	Link (if available)	Summary of content
Development Strategy for Culture in the Bratislava self-governing region for years 2015-2020	strategy	regional	binding	The Bratislava self-governing region	2015	2020	https://portal.egov.region-bsk.sk/c/document_library/get_file?groupId=20182&fileEntryId=94896	
Framework for development of culture in Bratislava	strategy/policy	local	non-binding	Bratislava	2016			
Cultural policy concept of Bratislava-Staré Mesto	strategy/policy	local	binding	Bratislava-Staré Mesto	2016	2020	https://www.staremesto.sk/data/MediaLibrary/32/32119/Koncepcia_kultura_2016.pdf	Cultural policy concept of Bratislava-Staré Mesto document emphasises support for the socio-economic use of cultural potential of the Old Town as well as for public and cultural activities and better involvement and cooperation among individual departments of the Office district and city district organizations.

10.2. Key documents governing climate adaptation (See Chapter 4)

Name of document	Type of document	Level	Binding / non-binding	Author(s)	Year published	Timeline for future evaluation/update	Link (if available)	Summary of content
Paris Agreement	Agreement	International	Binding	UNFCC	2015-2016		https://unfccc.int/process-and-meetings/the-paris-agreement/the-paris-agreement	The Paris Agreement builds upon the Convention and for the first time brings all nations into a common cause to undertake ambitious efforts to combat climate change and adapt to its effects, with enhanced support to assist developing countries to do so. As such, it charts a new course in the global climate effort.

Name of document	Type of document	Level	Binding / non-binding	Author(s)	Year published	Timeline for future evaluation/update	Link (if available)	Summary of content
United Nations Framework Convention on Climate Change	Agreement	international	binding	The United Nations	1992		https://unfccc.int/process-and-meetings/the-convention/what-is-the-united-nations-framework-convention-on-climate-change	The ultimate objective of the Convention is to stabilize greenhouse gas concentrations at a level that would prevent dangerous anthropogenic (human induced) interference with the climate system. It states that such a level should be achieved within a time-frame sufficient to allow ecosystems to adapt naturally to climate change, to ensure that food production is not threatened, and to enable economic development to proceed in a sustainable manner.
EU Climate Change Adaptation Strategy	Strategy	International (Europe)	Non-binding	European Commission	2013	Framework and mechanisms for improving the EU's preparedness for current and future climate impacts.	Last evaluated in 2018. Update likely 2021.	https://ec.europa.eu/clima/policies/adaptation/what_en#tab-0-1

Name of document	Type of document	Level	Binding / non-binding	Author(s)	Year published	Timeline for future evaluation/update	Link (if available)	Summary of content
Evaluation of the EU strategy on adaptation to climate change	Report	European Community	Non-binding	European Commission	2018		https://ec.europa.eu/clima/policies/adaptation/what_en#tab-0-1	This report examines the process and the results of the evaluation of the strategy COM/2018/738, including the lessons learned from its implementation.
Vulnerability and impact chain assessments	guideline	local	non-binding	The Office of the Chief City Architect	2018			The vulnerability and impact chain assessments is based on a qualitative as well as a quantitative analysis and assessment. It focuses mainly on the topics of extremely hot days and nights, heatwaves, extreme precipitation and periods of drought. The assessment also included non-climatic stressors
Resolution of the Government of the Slovak Republic no. 148/2014	regulation	national	binding	The Slovak Republic's Ministry of Environment	2014		https://rokovania.gov.sk/download.dat?id=D20E6A6330264DAC9318C4430DFD570B-9788FA292E5DD18CE9C181288B0A8535	The resolution of the Government of the Slovak Republic no. 148/2014 required the submission of an update of the national adaptation strategy to the Government's deliberations in light of the latest scientific knowledge in the field of climate change.

Name of document	Type of document	Level	Binding / non-binding	Author(s)	Year published	Timeline for future evaluation/update	Link (if available)	Summary of content
Strategy of adaptation of the Slovak Republic to climate change	strategy/policy	national	binding	The Slovak Republic's Ministry of Environment	2018		https://www.minzp.sk/files/odbor-politiky-zmeny-klimy/strategia-adaptacie-sr-zmenu-klimy-aktualizacia.pdf	The main objectives of The Strategy of adaptation of the Slovak Republic to climate change – update is to „increase resilience and improve the readiness of the Slovak Republic to face the adverse effects of climate change and to establish an institutional framework and coordination mechanism to ensure effective implementation of adaptation measures at all levels and in all areas". This is to be achieved by implementing partial objectives.

Name of document	Type of document	Level	Binding / non-binding	Author(s)	Year published	Timeline for future evaluation/update	Link (if available)	Summary of content
National Action Plan for adaptation	strategy/policy	national	binding	The Slovak Republic's Ministry of Environment	2022	2026	https://www.minzp.sk/klima/politika-zmeny-klimy/adaptacia-zmenu-klimy/	The National Action Plan for adaptation should contribute to better translating adaptation measures into sectoral policies of the relevant sectors. It should also include a proposal for a monitoring system for vulnerability, a proposal for a system of mid-term evaluation of the adaptation process in the Slovak Republic, including the monitoring of cost-benefit links, and a platform for publishing and sharing positive experiences.
Conception of the Slovak Water Policy for 2015	strategy	national	binding	Ministry of the Environment of the Slovak Republic	2006	2015	https://www.minzp.sk/voda/koncepcne-aplanovacie-dokumenty/koncepcia-vodohospodarskej-politiky-slovenskej-republiky-do-roku-2015.html	

Name of document	Type of document	Level	Binding / non-binding	Author(s)	Year published	Timeline for future evaluation/update	Link (if available)	Summary of content
Proposal of Orientation, Principles and Priorities of the Slovak Water Policy until 2027	policy	national	binding	Ministry of the Environment of the Slovak Republic	2015	2027	https://www.minzp.sk/files/sekcia-vod/orientacia-zasady-priority-vodohosp-politiky-sr-do-r-2027_po-oprave-tlacovej-chyby.pdf	
Integrated National Energy and Climate Plan 2021-2030 (2019)	strategy	national	binding	Ministry of Economy of the Slovak Republic	2019	2030	https://www.economy.gov.sk/uploads/files/IjkPMQAc.pdf	
Greener Slovakia: Strategy for Environmental Policy of the Slovak Republic until 2030	Strategy	national	binding	Ministry of the Environment of the Slovak Republic	2019	2030	https://www.minzp.sk/files/iep/03_vlastny_material_envirostrategia2030_povlade.pdf	

Name of document	Type of document	Level	Binding / non-binding	Author(s)	Year published	Timeline for future evaluation/update	Link (if available)	Summary of content
Action Plan for solving the consequences of drought and water scarcity	strategy	national	binding	Ministry of Economy SR	2018		https://www.minzp.sk/voda/koncepcne-aplanovacie-dokumenty/h2odnota-je-voda-akcny-plan-riesenie-dosledkov-sucha-nedostatku-vody.html	
Water Plan of the Slovak Republic for 2022-2027	Strategy	national	binding	Ministry of the Environment of the Slovak Republic	2015	2027	https://www.minzp.sk/voda/koncepcne-aplanovacie-dokumenty/vodny-plan-slovenska-aktualizacia-2015.html	
Timetable and factual and communication plan for the 3rd cycle of river basins management plan	Guideline	national	binding	Ministry of the Environment of the Slovak Republic	2019	2027	https://www.minzp.sk/files/oblasti/voda/koncepcne-a-planovacie-dokumenty/casovy-vecny-harmonogram.pdf	

Name of document	Type of document	Level	Binding / non-binding	Author(s)	Year published	Timeline for future evaluation/update	Link (if available)	Summary of content
Action Plan for the Environment and Health of the Population of the Slovak Republic V	Strategy	national	binding	Ministry of the Environment of the SR, Ministry of Agriculture and Rural Development of the SR, Ministry of Economy of the SR, Ministry of Transport and Construction of the SR, Ministry of Education, Science, Research and Sport of the SR	2019		http://www.uvzsr.sk/docs/org/ohzp/ap_sr_4.pdf	

Name of document	Type of document	Level	Binding / non-binding	Author(s)	Year published	Timeline for future evaluation/update	Link (if available)	Summary of content
Concept of protection and utilization of surface and ground water sources in Bratislava self - governing region	guideline	regional	non-binding	Bratislava self - governing region	2017	-	http://www.region-bsk.sk/uzemne-planovanie-a-zivotne-prostredie-koncepcne-materialy.aspx	
Land-use plan for Bratislava, capital of the Slovak Republic	strategy/policy/regulation	local	binding	City Hall of Bratislava	2007		https://bratislava.sk/sk/uzemny-plan	The aim of The Land-use plan for Bratislava, capital of the Slovak Republic is to systematically and comprehensively address the spatial arrangement and functional use of land and lay down its principles.

Name of document	Type of document	Level	Binding / non-binding	Author(s)	Year published	Timeline for future evaluation/update	Link (if available)	Summary of content
Program of Economic and Social Development of the capital city Bratislava for the years 2010-2020	strategy/policy	local	binding	City Hall of Bratislava	2010	2021	https://bratislava.blob.core.windows.net/media/Default/Dokumenty/Str%C3%A1nky/Chcem%20vediet/Strategick%C3%A9%20dokumenty/Program%20hospod%C3%A1rskeho%20a%20soci%C3%A1lneho%20rozvoja.pdf	Program of Economic and Social Development of the capital city Bratislava for the years 2010-2020 creates an organizationally and financially viable development program with the maximum support of all interested partners, including municipalities of each city districts.
Strategy of Adaptation to Adverse Impacts of Climate Change on the territory of Bratislava	strategy/policy	local	binding	City Hall of Bratislava	2014		https://bratislava.blob.core.windows.net/media/Default/Dokumenty/Str%C3%A1nky/Chcem%20vediet/064_Adaptacne%20strategie.pdf	Strategy of Adaptation to Adverse Impacts of Climate Change on the territory of Bratislava summarises potential risks and gives guidance for the prevention/mitigation of the consequences of climate change risks.

Name of document	Type of document	Level	Binding / non-binding	Author(s)	Year published	Timeline for future evaluation/update	Link (if available)	Summary of content
Action for adaptation to adverse impacts to climate change in Bratislava	strategy	local	binding	City Hall of Bratislava	2017	2021	https://zastupitelstvo.bratislava.sk/data/att/14595.pdf	Action for adaptation to adverse impacts to climate change in Bratislava (2017), which contains 27 adaptation measures that are to be implemented and monitored in the period between 2017-2020 to support the implementation of the vision and goals of the Strategy for adaptation to climate change in Bratislava.

10.3. Key documents governing disaster risk reduction (See Chapter 5)

Name of document	Type of document	Level	Binding / non-binding	Author(s)	Year published	Timeline for future evaluation/update	Link (if available)	Summary of content
Sendai Framework	Agreement	International	Non-binding	United Nations Office for Disaster Risk Reduction (UNDRR)	2015	Valid until 2030. UNDRR is in charge of follow-up and review of the Sendai Framework by preparing periodic reviews on progress, among other actions.	http://www.unisdr.org/we/inform/publications/43291	Establishment of a global framework for action to prevent new and reduce existing disaster risks, based on 7 targets, 4 priorities for action with supporting rationale and 13 guiding principles.
EU law (Decision 1313/2013/EU)	Law	International (Europe)	Binding	European Parliament	2013		https://eur-lex.europa.eu/homepage.html	Decision No 1313/2013/EU of the European Parliament and of the Council on a Union Civil Protection Mechanism. It defines the activities to assist with the response to immediate adverse consequences of a disaster inside or outside the Union.

Name of document	Type of document	Level	Binding / non-binding	Author(s)	Year published	Timeline for future evaluation/update	Link (if available)	Summary of content
EU law (Decision 420/2019/EU)	Law	International (Europe)	Binding	European Parliament	2019		https://eur-lex.europa.eu/homepage.html	This decision defines an effective and coherent approach to the prevention of and preparedness for disasters and to promote the exchange of best practices within the Union Mechanism.
Directive 2007/60/EU	Guideline	International (Europe)	Binding	The European Parliament and The Council of The European Union	2007		https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=celex:32007L0060	The purpose of this Directive is to establish a framework for the assessment and management of flood risks, aiming at the reduction of the adverse consequences for human health, the environment, cultural heritage and economic activity associated with floods in the Community. It should be read together with Act no. 7/2010 Coll. on flood protection,

Name of document	Type of document	Level	Binding / non-binding	Author(s)	Year published	Timeline for future evaluation/update	Link (if available)	Summary of content
Instruction of the Director General of the Crisis Management Section of the Ministry of the Interior of the Slovak Republic	regulation	national	binding	Ministry of the Interior of the Slovak Republic	2007		https://www.minv.sk/?Dokumenty_na_stiahnutie_CO	Instruction of the Director General of the Crisis Management Section of the Ministry of the Interior of the Slovak Republic
Act No. 42/1994 Coll. on civil protection of the population	law	national	binding	The National Council of the Slovak Republic	1994		https://ec.europa.eu/echo/sites/echo-site/files/42-1994_civil_protection_act.pdf	Act No. 42/1994 Coll. on civil protection of the population define a natural disaster, analysis and identifies vulnerable areas as well as regulates the structure and content of the Territorial Analyses document in terms of possible extraordinary events of the Slovak Republic. The introductory part of the analysis focuses on geographical, demographic and economic characteristics of the territory.

Name of document	Type of document	Level	Binding / non-binding	Author(s)	Year published	Timeline for future evaluation/update	Link (if available)	Summary of content
Concept of sustainable exploitation of rock environment.	strategy	national	binding	Ministry of the Environment	2017	2020	https://www.minzp.sk/files/sekcia-geologie-prirodnych-zdrojov/koncepcia-geologickeho-vyskumu-geologickeho-prieskumu.pdf	The aim is to predict impending disasters. Summary of measures from engineering geological survey, monitoring of geological factors of the environment and remediation of geological environment to avert, mitigate or eliminate the consequences of natural disasters, including emergency landslides.
Landslides and slope deformations", Partial monitoring system "Geological factors", Subsystem 01 – Landslides and other slope deformations.	policy	national	non-binding	Ministry of the Environment	Every year from 1993	2020	https://apl.geology.sk/geofond/zosuvy/	The aim is to identify slope deformation and to predict impending disasters.

Name of document	Type of document	Level	Binding / non-binding	Author(s)	Year published	Timeline for future evaluation/update	Link (if available)	Summary of content
Prevention program of landslide risk management (2014-2020) – updating	strategy	national	non-binding	Ministry of the Environment	2014	2020	https://www.minzp.sk/files/sekcia-geologie-prirodnych-zdrojov/program-prevencie-manazmentu-zosuvnych-rizik-2014-2020-aktualizacia.pdf	
National Climate Program of the Slovak Republic	policy	national	non-binding	Ministry of the Environment SR, Slovak Hydrometeorological Institute	2019		-	
Preliminary flood risk assessment in the Slovak Republic – update 2018	policy	national	non-binding	Ministry of the Environment SR, Slovak	2018		http://www.minzp.sk/sekcie/temy-oblasti/voda/ochrana-pred-povodnami/manazmentpovodnovych-rizik/predbezne-hodnotenie-povodneho-rizika-2011.html	

Name of document	Type of document	Level	Binding / non-binding	Author(s)	Year published	Timeline for future evaluation/update	Link (if available)	Summary of content
Slope deformation and slope deformation susceptibility maps	guideline	national	non-binding	The State Geological Institute of Dionýz Štúr	2006		https://www.geology.sk/2018/03/01/zosuvy-na-slovensku/	These are maps showing areas where there is a risk of slope deformation, but there is no indication of the risk. However, the timeliness of the available data on slope deformations is critical, as the information in question has not been updated regularly since 2013.

Name of document	Type of document	Level	Binding / non-binding	Author(s)	Year published	Timeline for future evaluation/update	Link (if available)	Summary of content
Analysis of the territory of Bratislava Region	guideline	regional	non-binding	City Hall of Bratislava				Analysis of the territory of Bratislava Region assesses the territory in terms of possible risks of emergencies, exposure to exceptional weather and climatic events, areas of possible danger of slope deformations and seismic activity, areas of potential flood risk, areas of potential risk in case of water structure violation (including tailings ponds), areas of potential fire and explosion hazard, areas of potential danger to all modes of transport and areas of the potential risk of leakage of hazardous substance resulting from the characteristics of hazardous substances.

Name of document	Type of document	Level	Binding / non-binding	Author(s)	Year published	Timeline for future evaluation/update	Link (if available)	Summary of content
Urban-landscape study to protect against storm rainfall in the Small Carpathian region	guideline	regional	non-binding	Bratislava self-governing region	2014	-	http://www.region-bsk.sk/urbanisticko-krajinarska-studia-na-ochranu-pred-privalovymi-dazdami-v-malokarp-oblasti.aspx	
Atlas of climate change impacts on Bratislava City	guideline	local	non-binding	The Office of the Chief City Architect				Atlas of climate change impacts on Bratislava City focuses on impacts and risks of climate change to the City´s population and critical infrastructure (road infrastructure and built-up areas).