



# DELIVERABLE D.T2.1.2

Sustainable risk management strategies  
for CH protection

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With the contribution of all partners



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## 1. INTRODUCTION

This document outlines the proposals for improvement of management strategies at each pilot site, with particular insights on the potential integration of results from INTERREG, FP and H2020 projects capitalized in STRENCH. The proposals are developed outlining their feasibility in the context of the selected case studies in order to better tailor them in view of a consequent implementation in risk reduction plans at local level.

This output relates to *A.T2.1 Strength- weakness in managing cultural heritage at risk due to climate change and natural hazards* and *A.T.2.3 Cooperation among stakeholders involved in the decision making for cultural heritage protection*. The proposals here presented are elaborated in relation to the criticalities present at each site, as determined in *D.T2.1.1 Criticalities of CH landscapes for landslides, flash floods, wind storms and fire*.

The document is composed of seven sections which present the sites involved in the pilot study. Each section includes a site description, an overview of current management strategies implemented at the site and finally a proposal of possible improvements with insight on challenges and opportunities which may arise from their integration into local risk reduction plans.



## 2. CULTURAL LANDSCAPE WACHAU, AUSTRIA

### 2.1. Site description

The Cultural Landscape Wachau (UNESCO World Heritage Site) stretches between the towns Melk and Krems along the Danube River for approximately 36 km. The Outstanding Universal Value of the Wachau is defined as follows:



“Criterion (ii): The Wachau is an outstanding example of a riverine landscape bordered by mountains in which material evidence of its long historical evolution has survived to a remarkable degree. Criterion (iv): The architecture, the human settlements, and the agricultural use of the land in the Wachau vividly illustrate a basically medieval landscape which has evolved organically and harmoniously over time”. [1]

The Wachau cultural landscape is composed of an iconic mix of landscapes characterized by terraced viticulture, traditional small scale fruit cultivation, historic towns filled with a multitude of heritage sites most of which are built directly on the banks of the Danube River and backed against steep mountainous terrain. This topography creates numerous risks for the region, which encompasses nearly all criticalities described in the STRENCH Deliverable D.T2.1.1 “Criticalities of CH landscapes for landslides, flash floods, windstorms and fire”.

The location of several historic towns (Melk, Duernstein, Spitz, Stein, Krems, Weissenkirchen etc.) directly on the banks of river Danube and at the foot of the descending mountains of the valley, makes them vulnerable to Danube floods, landslides from the steeply ascending walls of the Danubian water gap and flash floods from tributary creeks.

The old towns of Melk, Duernstein, Krems and Stein are medieval in their structures. Bricks, stones and wood are the main building materials, with wood being especially in the roof constructions and first floors. This fact makes them very vulnerable to fire, especially since in the medieval cores of the towns the houses and roofs are built in a way in which the buildings neighboring each other are directly joined, without gaps, which would hinder the spread of fire.

Climate change and increased tendency to extreme weather events such as sudden frost after long warm spring like periods, hail, early spring storms etc. pose a significant risk to the famous blossoming of the Wachau apricot trees and cause significant crop failure.



The widespread terraced viticulture of the Wachau region results in a variety of hazards ranging from loss of biological cover due to increased periods of drought (L1) to increased soil erosion in areas with extensive tourist paths causing an abuse due to mass tourism (L2); a prominent example is the medieval town of Duernstein. Severe hazards such as landslides, flash floods and rock fall (L3-L4) threatening both the landscape itself and CH assets are commonplace.

There are several hamlets within the surrounding mountainous area of the Wachau valley which can be described as being in a generally good condition due to the long-standing use as tourist attractions. Obsolete built infrastructure (H1) and inappropriate urban regulation for building and construction (MC4) are a potential threat to the iconic landscape.

While manmade risks include a lack of emergency plans (MC5), these are being partially counteracted by the activities of the Center for Cultural Property Protection at Danube University Krems and the local and regional fire brigades, which have identified cultural heritage as a topic gaining importance. One example being the cultural property emergency exercise KOLOMANI 18 which was part of the ProteCHt2save project. Conducted at the Benedictine Monastery of Melk, a renowned site in the Wachau area filled with historic treasures, the exercise created a synergy of all stakeholders while shaping, and actively field-testing emergency response plans [2].

## 2.2. Current risk management strategies

At the moment, there is no general plan for the protection of cultural heritage in Austria, neither on regional nor local level. The owners themselves are responsible and there is no liability to inform the authorities on existing plans. No national guideline for the development and implementation of such plans exists. One of the aims of the Danube University is to raise awareness for the necessity of cultural heritage protection both from man-made and natural disasters and to contribute to the development of guidelines for emergency preparedness plans for movable and immovable heritage. For the ten UNESCO World Heritage sites in Austria (this includes the Wachau cultural landscape) management plans do exist, which alas do not necessarily take issues of cultural heritage protection into account.

National, regional and local emergency plans aim at fighting different natural catastrophes. Concerning the threats water and fire these national plans include the Flood Action Programme [3] and the Hochwasserrisikomanagementplan [4], which aim at reducing the threats of floods which are a particularly prominent threat in the Wachau region. A regional plan encompassing Lower Austria is the 1st DRB (Danube River Basin) Flood Risk Management Plan which aims at the Danube river basin in general [5]. In the Wachau region local plans feature dams and mobile flood protections [6].

The arguably most prominent risk for CH encountered in the Wachau region is flooding from the river Danube and rivulets flowing into the Danube. A proven countermeasure has been the installation of mobile flood protection as performed in the historic Wachau city of Krems-Stein from 1994 until 1996. Before the installation, previous existing dams could only prevent occurring flooding for water levels lower than the recorded 17 years average flooding of the Danube River. The mobile flood protection was built to withstand massive floods occurring



every 100 years on average. One of the prerequisites for the flood protection was that it must not obstruct the sight towards and the connection to the Danube riverside. Therefore, a mobile flood protection solution was chosen. When a flooding event is predicted or imminent, the mobile system consisting of steel pillars housing aluminium stop logs is erected. The aluminium stop logs are stacked to a height according to the flood threat. It can be raised up to 1.60 metres (not including the permanent wall), which is the calculated height of a flood occurring every 100 years on average. This system managed the flood of 2002 well enough but only barely withstood the flood of 2013, during which the mobile flood protection had to be further heightened by pilings and bags on top of the aluminium stop logs. Stone-clad flood control walls and dams, together with a drainage network with a flood control pumping station, complete the flood protection system. The overall length of the flood protection system for Krems-Stein is 1670m. It consists of 247 steel pillars and ca. 2600 aluminium stop logs, which are stored with the fire brigade in Krems. It is the fire brigades which erect the barrier, if necessary support by the Austrian Armed Forces. The pictures below show a demonstration of the system in January 2018.



Photo: M. Drdacky, 2018

In Austria the voluntary fire brigades also fight floods and their consequences together with the local population. They of course have firefighting plans and information on the most hazardous and vulnerable items in their area of responsibility concerning their eponymous threat, fire. In Krems-Stein, which has two medieval city centres with houses and roofs interconnected, the local fire brigades have developed a plan for what they call “Case Zulu”, fire in the old towns of Krems and Stein. In August 2017 a large fire happened in the outskirts of Krems and the lessons learned are currently adopted into the modified firefighting plan.

Thus, the fire brigades are the ones on the spot who already work for the protection of cultural heritage and who can expand their possibilities for protecting cultural heritage together with the civilian owners of movable and immovable heritage, if training and education is made possible. Qualified personnel, material and equipment can be supplied by the Notfallverbund Österreichischer Museen und Bibliotheken, an initiative started by the Kunsthistorisches





Museum Wien (the National Art Museum in Vienna). This Notfallverbund consists of different museums, archives and libraries all over Austria and pledges non-bureaucratic assistance to members in need.

A series of floods in the Wachau region affecting especially the cities Krems and Stein have shown that the measures adopted so far are very efficient for fighting the floods of the river Danube and its tributaries. However, it must be stated that cultural heritage protection in the Wachau region is so far not included in the outlines of any official emergency preparation plans. Existing plans, especially those dealing with floods and fire, do help protect cultural heritage, but it is not their explicit aim, nor is the topic explicitly included.

In the course of the Interreg project ProteCHt2save the Center for Cultural Property Protection at the Danube University Krems hosted an emergency exercise at the State Gallery of Lower Austria which houses important pieces of art from famous artists such as Schiele and Kokoschka. The Gallery is situated in the Wachau region in the historic city of Krems and is highly exposed to possible flooding by the Danube river. The exercise aimed to check the sustainability and effectiveness of the preparation strategy. This strategy was designed to coordinate a second line of defence aiming for a crash evacuation of CH objects at the site should the afore mentioned mobile flood barrier fail or be overwhelmed by extreme flooding. Regarding this specific emergency scenario, it should be noted that the developed strategy of CH evacuation against extreme flooding retains validity for most of the CH objects in case of fire. As a result of the project ProteCHt2save the municipality of Krems has signed a Memorandum of Understanding aiming at including cultural heritage protection measures in future developments and at raising awareness on the topic in general.

The objectives for the exercise were defined as

- a) Checking the emergency system developed for the State Gallery Lower Austria
- b) Cooperation fire fighters and museum personnel
- c) Awareness of fire fighters / first responders for cultural heritage protection

Emergency exercises such as these are developed together with relevant stakeholders. Especially the fire brigades as the most likely first responders are included in the development. The map below does not take the mobile flood protection into account and shows the flood zones (lighter shade of blue) in a worst-case scenario. The biggest risk concerning flood is the possibility that the mobile elements might break when a heavy item brought downstream the flooded Danube crashes into the mobile section or if the water rises even higher as experienced in 2013 and the mobile protection is simply not high enough [9].



Figure: Areal view of Stein on the left and Krems on the right with their medieval city centres and main museums [10].

### 2.3. Proposal for local risk reduction plans

The Wachau cultural landscape is a riverine landscape encapsulated by mountains on each side of the Danube river. The picturesque yet flood-prone historic towns filled with CH sites are built directly on the banks of the Danube River while the steep mountainous terrain is used widely for terraced viticulture. This topography creates numerous hazards and criticalities for the region, many of which have been defined in the STRENCH Deliverable D.T2.1.1 “Criticalities of CH landscapes for landslides, flash floods, windstorms and fire”.

The widespread terraced viticulture within the Wachau region is exposed to a variety of hazards such as harsh weather and drought (criticality: solar overheating) resulting in loss of biological cover (L1). As tourist destination the Wachau region is exposed to abuse of the landscape and increasing soil erosion (L2) due to mass tourism (criticality: tourist paths), as seen in the popular tourist destinations such as Duernstein. Hazards such as landslides, flash floods and rock fall (L3-L4) are an issue throughout the region threatening CH assets and the cultural landscape (criticality: CH assets at descending hills of the valley & landscape located on or under unstable rock cliffs). Man made hazards include (criticality: inappropriate urban regulation for building and construction) slowly diminishing the site’s characteristics and authenticity (MC4) threaten the remnants of “a basically medieval landscape which has evolved organically and harmoniously over time”<sup>1</sup> as described by the UNESCO. The density of CH sites in the Wachau region brings forth the hazard of impossible to rescue artifacts or prevention for protect sites in case of emergency (MC5) (criticality: lack of emergency plans). To counteract these criticalities and hazards the following

<sup>1</sup> <https://whc.unesco.org/en/list/970>>, accessed Feb02 2021





actions have been identified as productive measures for increasing the overall preparedness and awareness for CH protection in the Wachau region:

- Cultural heritage protection in the Wachau region is so far not included in the outlines of any official emergency preparation plans in Austria. An adaption of existing emergency plans to include cultural heritage protection would be a prerequisite in order to “naturalize” heritage protection into emergency preparation and safeguarding.
- Further lobbying for making cultural heritage protection plans mandatory.
- Advanced awareness raising with stakeholders and broad public regarding the threats to cultural heritage and the benefits of preparedness plans.
- Bring together existing tools from numerous projects and research and make them available in a collected and easily accessible way to those who might need them, including emergency responders.
- Develop tailored training / awareness raising videos / material for pilot sites / categories of cultural heritage and regions that are threatened by the same threats.
- Further development of scenario-based training exercises with emergency responders, local authorities and involved stakeholders aiming to test the capabilities of an emergency system while fostering awareness and cooperation are needed.

A main challenge identified is the raising of awareness and the including of cultural heritage protection in official emergency preparation plans in Austria. This challenge can partially be met by the possibilities offered when bringing together existing tools from projects and making them available in easy-and-ready-to-use solutions, especially when combined with tailored training and promotional material. Training for emergency responders which is advertised on a broad basis has shown to create huge interest; this interest is again fostering the awareness of the stakeholders on the different levels and thus, in the long durée may pave the path towards a mandatory inclusion of cultural heritage protection measures in emergency preparedness plans on all levels.



## 3. KOLIĆI, CROATIA

### 3.1. Site description

Under specific circumstances, usually in combination with geomorphological, hydrological and weather situations present in a given place, natural dangers are intensified to catastrophic extents in the form of natural disasters. In the STRENCH project only small water catchment floods, especially flash floods, landslides, wind storms and fires are discussed in detail.

Hamlet Kolići in Dugopolje, Croatia, is an example of a settlement with preserved traditional architecture and authentic construction methods typical for the area of Adriatic Croatia. According to the typology of cultural heritage and due to its position, Kolići belongs to the category of a hamlet in mountainous areas.



Located in the mountain, as well as in the Mediterranean area, Kolići hamlet is threatened by a significant exposure to intensive sunlight and a high risk of drought and forest fires that can endanger and damage the cultural heritage in this area which includes prehistoric mounds along the ancient road as well as a ruined medieval settlement. These hazards pose an increasing threat to this area, especially due to climate change. They can have significant consequences for the cultural, historical and artistic values of an area, can affect the safety of citizens and have negative consequences for local economies related to the development of tourism. Hamlet Kolići is surrounded by easily burning vegetation, which is why this area is particularly vulnerable and requires special attention during valorization and preservation. Geomorphologically, the site is located in a sensitive karst area. Since hamlet is located on the slopes, it is also endangered by the slope processes. Hamlet Kolići is mainly made of stone material that has a certain resistance to natural and human disasters, but the vegetation that surrounds it does not withstand the increasing droughts and fires in this area.

To sum up, the main criticalities of this area include: exposition to intensive sunlight which is typical of the Mediterranean area, location of hamlet at the foot of slopes, e.g. at the foot of the descending hills, obsolete built infrastructure and ruins in abandoned hamlets. Speaking of man-made criticalities, there are present: the lack of mapping of the site conditions, lack of knowledge or experience with management of CH site, lack of monitoring and risk evaluation methodology, lack of integrated tools for decision support as well as non-use or limited use of external sources



of financing. At the same time, the main hazards of this areas include fire, drought, abuse, and neglected maintenance.

### 3.2. Current management strategies

Management strategies currently enforced at Dugopolje, dealing with hazards include:

- Disaster risk assessment in the Republic of Croatia - The Disaster Risk Assessment for the Republic of Croatia is a national document that provides risk assessments for extreme natural events, industrial accidents, plant and animal diseases, epidemics and pandemics for the entire territory of Croatia. The risk assessment refers to the consequences for the economy, society, natural and cultural heritage.
- Disaster and major accident risk assessments for the Split-Dalmatia County - The document refers to the organization of civil protection as a system of organizing participants, operational forces and citizens to achieve the protection and rescue of people, material and cultural goods and the environment at risk and under the influence of disasters.
- Civil Protection Action Plan of the Municipality of Dugopolje - Civil Protection Action Plan of the Municipality of Dugopolje provides a description of the area of the Municipality of Dugopolje from the aspect of vulnerability to natural risks, as well as an action plan in a case of disasters.
- Strategic plan of the Ministry of Culture 2019-2021 - Strategic plan of the Ministry of Culture for the period 2019-2021 defines the general goal related to protection and preservation cultural heritage as one of the activities of cultural heritage management. A special goal of the Strategy is to ensure an optimal model of protection and management of cultural property with regard that the current system of cultural property management is based on an extensive network of institution that are responsible for the management of certain types of cultural property.
- Strategy for protection, preservation and sustainable economic use of the cultural heritage of the Republic of Croatia - The strategy for the protection, preservation and sustainable economic use of cultural heritage is a fundamental document for setting long-term goals and guidelines for the preservation, protection and use of cultural heritage as well as the manner of their implementation. The same also wants to be achieved more efficiently and successfully managing the protection and preservation of cultural heritage, which is especially necessary due to major accidents and disasters. The Ministry of Culture of the Republic of Croatia is the competent body at the national level for the preservation of cultural heritage as a whole and to determine the framework for its sustainable use.
- Master plan for tourism development of Split-Dalmatia County (2017-2027) with strategic and operational plan - The main goal of the Master plan is to define the strategic and operational concept of tourism development according to the principles of sustainable development. The emphasis is on the development of cultural tourism which is enabled by wealth and diversity cultural heritage in the County. The need for effective cultural management is also emphasized, however, the strategy does not define the approach and manner of the management.
- Spatial plan of the Municipality of Dugopolje - The Spatial plan does not strictly define the cultural heritage management plan, but there are defined measures for the preservation, protection, arrangement and use of cultural property in the Municipality. It is stated that the cultural goods recorded in this plan must be included in a professionally acceptable



manner in future development of the Municipality and the County. Although the cultural assets management plan itself is not defined by this document, the process of protection and preservation of cultural property is, as one segment of management, in detail prescribed by the spatial plan.

### 3.3. Proposal for local risk reduction plans

The following points aim at setting the framework for a proposal to be integrated in the local risk reduction plans:

- improve capacities of the public and private sectors to mitigate the impacts of climate change and natural hazards – refers to all identified criticalities
- improve know-how on the process of definition of priorities of intervention and strategies - refers to all identified criticalities
- improve coordination of stakeholders involved in the decision making for cultural heritage protection – participatory approach (application of the BENEFIT results - <https://www.interreg-central.eu/Content.Node/BhENEFIT.html>) – refers to all identified criticalities
- improve the use of the GIS solutions (application of the PROTECHT2SAVE results - <https://www.interreg-central.eu/Content.Node/ProteCHt2save.html>) – refers to the criticalities: exposition to intensive insolation, location of hamlet at the foot of slopes, the lack of mapping of the site conditions, lack of integrated tools for decision support
- development of management plans according to climate scenarios (application of the NOAH'S ARK results - <https://cordis.europa.eu/project/id/501837>) - refers to the criticalities: lack of knowledge or experience with management of CH site, lack of monitoring and risk evaluation methodology, lack of integrated tools for decision support

However, in order to materialize the listed proposals, it is necessary to raise the level of awareness of the local public and local authorities about climate change-related hazards. In particular, speaking about the Kolići site, one of the challenges also involves a lack of knowledge about the value of the cultural landscape and the preserved architectural and construction heritage. Combining activities to strengthen the capacity of local authorities with the public awareness activities, it is possible to make significant progress in the process of cultural heritage protection. By overcoming these challenges, conditions will be provided for quality participatory cultural heritage management, implementation of strategies for the protection of cultural heritage from risks caused by climate change and implementation of GIS solutions in smart heritage management.





## 4. TROJA, CZECH REPUBLIC

### 4.1. Site description

Troja valley represents an important part of Prague with precious cultural and natural heritage protected by legal documents at various administrative levels. The natural conditions of the valley create on one side its specific and highly appreciated character, on the other side represent a fragile element sensitive to various natural and man-made hazards and threats.



In the Troja valley territory, the Vltava river with its natural wild water rapids is the most critical element which brings repeated river floods threats. Even though a part of the Troja district is protected with a combination of stable and temporary water barriers, a large part of the area still remains unprotected. In this are a large historical park called “Stromovka” is located as well as the National Heritage of the Baroque Troja Château with a historical garden, a recreation and sport area with local objects of cultural importance, (e.g. a private





“Troja Horse” Gallery, historic Troja Water Mill, historic brewery), a part of the Prague Zoological gardens, a large Troja hamlet area with detached houses and gardens in Podhoří and the historic “fisherman village”. The river is on the north side bordered with steep slopes or rock cliffs with rather narrow valleys of local creeks or dry unpaved paths. A part of the slopes has been transformed in the terraced landscape of vineyards or in the Prague Botanical gardens. Large areas of original greenery are protected as natural heritage reserves. The western edge creates a part of a larger suburban park.

The hazards include:

- Flash flood in the narrow valleys and paths.
- Windstorm in the parks and gardens, usually with synergy with high water.
- Flood events in large basin highly impacted on the unprotected buildings and moveable heritage.
- Harsh weather actions on the greenery of parks and gardens (e.g. drought periods, biotic hazards).

#### 4.2. Current risk management strategies

The endangered area contains several parts managed by different Prague municipalities or Prague Magistrate, therefore, no overall general strategy has been developed and individual governments ensure risk management in different ways. However, the major part under discussion is governed by the local Troja municipal office and this office follows a united risk management strategy.

For the most critical hazard, i.e. the flood events, the emergency plan has been applied. It consists in a system of measures from the disaster alert and warning, through actions till remedial and re-occupation activities. The National Environment Agency (EA) and Met Office provide flood warnings up to five days in advance. These warnings are coupled with specific on site systems to provide a useful system of escalation tide to specific actions. All important cultural heritage facilities have their individual flood emergency plans. Careful attention is also paid to preventive and resilience measures, mainly the preparing to the event by means of training and exercising. Within the ProteCHt2save a special manual for the owners, managers and users of cultural heritage assets was developed and distributed in the community. This tool has been accepted for training of emergency and rescue team of the whole Prague.

The flash flood situation is typically initiated during failures of the rain water drainage system channeling the rain water from a dense housing estate above the Troja valley. The management is out of the capacity of the local government and the main strategy consist in negotiations with the neighbor government aiming at an increased and reliable capacity of



the rain water drainage. On the local level the drainage on local steep paths is secured by means of technical measures –a system of mountain gullys regularly cleaned.

All buildings are provided with fire emergency plans and equipped with relevant extinguishing means.

The preparedness of the site for the harsh weather impact represents the less developed strategy due to the rather infrequent occurrence as well as less visible consequences. Occasionally winter covers are applied against the frost or icing. Irrigation is applied in regularly cultivated areas. The built heritage is periodically inspected and maintained without regular plans and guidelines.

### 4.3. Proposal for local risk reduction plans

Troja valley is characterized by the following criticalities, as identified in D.T2.1.1, which should be subjected to improvements:

- Flash flood
- Presence of fall line water channels (creeks, narrow valleys, paths, ...)
- Presence of large paved impermeable areas with insufficient drainage above the critical water channels
- Obsolete or malfunctioning built infrastructure
- Shallow or no pavement of water channeling paths.
- Windstorms and harsh weather
- Sensitive trees and plants in the gardens – icing, frost, synergic effects
- Site with deep or highly fluctuating underground water table level– drought
- Site exposed to intensive insolation
- Weather sensitive species – abiotic agents
- Weather sensitive species – biotic agents
- Isolated trees
- Free standing sculptures
- Flood events (river flood)
- Isolated unprotected buildings of various vulnerability
- Sites occasionally inundated with long term duration
- Sites occasionally inundated with water stream
- Heritage contents in the buildings (gallery, family heritage, ...)

The STRENCH project has introduced new cultural heritage categories and a wider scope of risks compared to the previous projects. Therefore, some already successful results of the previous projects are worth to be capitalised and amended and new strategies should be



involved. In particular the following points of improvement of local protection measures can be suggested:

- Revision and expansion of the Manual for owners and managers focused on a wider scope of criticalities (capitalisation of the Interreg CE ProteCHt2save project results).
- Preparation of practical guidelines for planning regular inspection and maintenance of heritage sites and objects taking advantage of the results of the RUINS project (capitalisation of the Interreg CE RUINS project results).
- Establishment of strategies for preventive, protective and remedial actions aiming at safeguarding of cultural heritage in landscape, parks and gardens facing global threats of climate change and development pressures including mass tourism.

The feasibility of implementation of this proposal at local level needs to be closely evaluated in order to integrate it into cultural heritage protection plans. Generally speaking, opportunities for a successful implementation can be seen in the predisposition of local authorities and managers to policy change, as shown by their involvement in previous project (e.g. ProteCHt2save) and continued participation to local focus groups. This surely represents a significant advantage for developing tailored protection measures at the pilot site. On the other end, the location of Troja valley within the metropolitan territory of the city of Prague can definitely present conspicuous challenges of administrative nature, with multiple and heterogeneous constraints to policy changes which need to be addressed.



## 5. DISTRICT OF FORCHHEIM, GERMANY

### 5.1. Site description

The District of Forchheim (DoF) is located at the northern part of Bavaria, Germany, and is part of the Nuremberg metropolitan region. The DoF comprises parts of the nature park “Fränkische Schweiz” (Franconian Switzerland) and has a long settlement history. Consequently, it covers cultural and natural heritages such as a characteristic mountain and hilly cultural landscape with a high density of castles and ruins, striking rock formations and caves, deep valleys formed by rivers, but also carp ponds, beer cellars, lived traditions and meadow orchards. Due to its favorable site conditions, the largest contiguous sweet cherry growing area in Central Europe has evolved in and around the district. Moreover, there is hardly another region in Central Europe that has as many beer cellars and medieval fortifications as parts of the Franconian Switzerland. For instance, so far 172 fortifications have been recorded in this cultural landscape most of which were destroyed in the many historic wars and riots, which took place in the region. These ruins inspired some of the most important representatives of German Romanticism and have become fascinating tourist destinations.



Natural and climate related hazards such as drought, heat, pluvial floods, storms, late frost events, fire and pests affect the cultural landscape and monuments mentioned above. Main criticalities to the cultural heritage in the DoF are i) strong winds, solar overheating / frost exposed slopes ii) location of hamlets at the foot of slopes, e.g. at the foot of the descending hills of a valley iii) shallow located archaeological remains, iv) ruins in abandoned hamlets/ ruins on rock cliffs, v) site exposed to intensive solar light, vi) sites with deep or highly fluctuating underground water table and vii) pests.

### 5.2. Current risk management strategies

Due to the variety of natural and climate related hazards in the DoF, a wide range of risk management measures are implemented, e.g.

- Disaster prevention organizations are trained for hazards like flash floods, storms and wildfire. The organizations are fundamental for the protection of humans, their goods and important infrastructure in case of emergency.



- A fruit growing experimental station was installed by the District Council Forchheim to study recent challenges of fruit growing such as the adaption to climate change and fighting pests. The obtained results are then communicated to the local farmers.
- A map with floodplains of centurial floods was created for whole Bavaria including the DoF. This provides important information on areas in the DoF which are susceptible to floods. The obtained results are used to inform inhabitants and to plan high-water protection measures.
- A map of georisks was drawn up for the DoF to identify areas which might be affected by landslides and rockfall
- Many ruins are touristically tapped to prevent vandalism and neglect. Additionally, the Bavarian Office for the Preservation of Cultural Heritage monitors and takes care of the preservation, maintenance and public perception of cultural heritage in the DoF. Many cultural heritages are mapped and listed in a Web-GIS tool to increase awareness and perception.

### 5.3. Proposal for local risk reduction plans

Inspired by ProteCHt2save the creation of a climate change adaption strategy to better coordinate and implement trans-disciplinary climate adaption and mitigation measures is strived for. Such a strategy shall include, among other aspects:

- Management strategies to reduce damages from flash floods such as early warning systems and decentralized high water protection measures. In particular the decentralized high water protection measures are very effective in reducing risks to the criticalities i) *Location of hamlets at the foot of slopes, e.g. at the foot of the descending hills of a valley* and ii) *shallow located archeological remains*. Moreover, decentralized highwater protection measures may increase available water capacities during drought events as they aim to store water in the soils of a landscape and in retention areas. Consequently, these measures might reduce drought severity at *sites with deep or highly fluctuating underground water table*. Decentralized highwater protection measures are characterized by many small measures across a catchment area which need to be planned by experts. Thus, a lot of landowners must be both contacted and persuaded and, additionally, the financial support must be guaranteed to avoid the man made criticality *lack of funds*.
- Improved management strategies to combat frequent natural and climate related hazards such as pests, late frost, insolation damages and drought in fruit growing, agriculture and forestry. As shortly discussed above, decentralized highwater protection measures may be promising in reducing drought events as they aim to store water in soils and retention basins on site. While there are consulting offices for agriculture and forestry in the District of Forchheim, fruit growers do not have the opportunity to get external expertise from such institutions. Hence, the District Council Forchheim installed a fruit growing





experimental station to reduce the man made criticality *lack of knowledge or experience with management of CH site*. However, natural and climate related hazards are very challenging why the recommendations provided so far need to be further developed. Maybe protective measures against wind, solar heating and drying are interesting strategies to overcome the criticalities *strong winds, solar overheating/ frost exposed slopes and sites exposed to intensive insolation*. Nevertheless, the funding of these measures, the persuasion of land owners and the lack of information on the efficiency of those measures will probably complicate their implementation.

- Reduce risk of damages due to windthrow. A consequent monitoring and management of trees surrounding built CH and other buildings will reduce damages due to windthrow. Being aware of the man made criticality *incorrect technical solutions*, it is important in case of windthrow to not damage the built CH such as burial mounds while the trees are removed by machine. Workshops, awareness events and communication are indispensable but feasible to implement these improvements that are linked to the criticalities *misinformation and lack of communication and social engagement*.
- Fire prevention actions and ensuring sufficient extinguishing water. As drought conditions became more frequent and severe in the District of Forchheim, the risk of (vegetation) fire increased due to climate change. Consequently, it is of great importance to prevent fire incidents by making the public aware of this risk and, in case of fire, to ensure a sufficient infrastructure with extinguishing water across the District of Forchheim. These measures may prevent *ruins in abandoned hamlets* from destructive damage. Their implementation is considered to be feasible as they need hardly financial expenses and a plan on extinguishing water resources in the rural areas of the District of Forchheim already exists which is a good basis for further development.
- Closer collaboration with disaster prevention organizations and the Bavarian Office for the Preservation of Cultural Heritage. The above mentioned aspects all illustrate the importance of disaster prevention organizations which, thanks to their work, often minimize damages to persons, infrastructure and CH. Moreover the Bavarian Office for the Preservation of Cultural Heritage is an important contact regarding the conditions of CH and the protection status. The collaboration with both organizations must be intensified due to the increased number of climate-related hazards and men-made criticalities. Since the District of Forchheim, disaster prevention organizations and the Bavarian Office for the Preservation of Cultural Heritage follow the same interests and aim, the suggested improvement of a closer collaboration seems to be easily implementable.
- Organization of awareness rising events on climate related hazards and CH protection. As the criticalities *misinformation and lack of communication and social engagement* indicate, awareness rising events and factual communication are essential ingredients of a climate adaption strategy.



## 6. LAKE BALATON, HUNGARY

### 6.1. Site description

The importance of natural protection and preservation is shown by the fact that most of the 180 settlements of the Lake Balaton Recreational Area / Lake Balaton Region are located on the area of the so called “Balaton-Uplands National Park”. Within this area there are 11 Landscape Protection Areas, 10 natural heritage sites and 9 forest reserves. There are also 3 Ramsar sites (ie wetland sites designated to be of international importance under the Ramsar Convention), which must be maintained and preserved in good ecological conditions.

The importance of the geological, topological and aesthetic values of the area is shown by the fact that the Bakony-Balaton Unesco Global Geopark is a member of the European Geopark Network. 81 settlements of this area are involved in geoparks, which contain significant historical, cultural and ecological values. The volcanic formations of the Tihany Peninsula received an European Diploma in 2003.



As a coherent system of the most valuable natural areas, a significant part of 29 Natura 2000 sites are located in the area south of the lake, with a uniformly regulated ecological network aimed at ensuring the long-term survival of natural habitats.

In addition, municipalities have designated 116 locally protected nature areas, e.g. rows of trees, forests, gardens, parks, lakes, lookouts and lawns.

In addition to the natural values, the area is also extremely rich in terms of cultural heritage. 2935 buildings (agricultural, industrial, residential, public and religious), unique landscapes, historical gardens and sculptures enjoy national or local protection:



County	National protection	Local protection	Protected total
Somogy	318	1.230	1.548
Zala	139	317	931
Veszprém	606	325	456
<b>Total</b>	<b>1.063</b>	<b>1.872</b>	<b>2.935</b>

There were a total of 2278 damage events in the last two years:

- 478 occurred in vegetation,
- 550 buildings,
- 540 roads,
- 127 floods,
- 580 storms.

These heavily affected the protected natural environment. Old buildings close to the shorelines suffered damages because of high water levels on the south shores of Lake Balaton. High cliffs and the buildings above them were damaged due to the combined effect of rain and wind.

Local protected monuments are at greater risk due to their condition. The main hazard indicators are water level changes and the effects of windstorms, which are more frequent in the recent years.

Traffic accidents also have to be considered due to the risk of potential water pollution, as the lake and the surrounding rivers, wetlands are of national and international importance.

Wildfires endanger forests categorised as high fire risk and the grasslands, reed and peat habitats in Natura 2000 sites.

## 6.2. Current risk management strategies

As a result of climate change, protected trees (walnut, chestnut and pine) are being affected by unprecedented biological effects.

Based on a risk assessment (risk matrix), each settlement is classified as one of three disaster management categories (class 1: 20 settlements, class 2: 66, class 3: 94 settlements). Each of them has a municipal emergency plan. The main danger areas (flash flood, local water damage, inland water risk, dangerous trees, drainage problems, monumental buildings, high cliff, soil erosion) were examined according to danger cycles.

There is an independent storm warning system installed at Lake Balaton, which provides thorough information, including a three-stage alarm in case of an incoming storm.

Forest areas are classified into one of three fire risk levels, with a total fire ban imposed during hazardous periods. The application of the fire hazard index is still under development, while the soil moisture index is in place.

To prevent landslides on so called high cliffs, the affected areas are examined as a part of three categories (active surface movement, potentially endangered, safety zone).



### 6.3. Proposal for local risk reduction plans

In order to define a proposal for improvement of local protection plans, the following points can be outlined:

- **Drought:** constant meteorological monitoring and maintenance of Natura 2000 sites.
- **River and lake flood, inundation:** constant hydrological monitoring based on the cooperation between hydrological, meteorological and disaster management experts in the whole region (especially in Baranya and Veszprém counties). Further development of the flood protection and warning system.
- **Wind storm**
  - Further development of the storm early warning system already in place at Lake Balaton. Development of targeted training and/or background material for the cultural and natural heritage sites, especially about how climate change in general and high wind speeds in particular can be detrimental to these sites (buildings, Natura 2000 areas etc.).
  - Look for new ways to strengthen the cooperation between disaster management and meteorology because emergency responders need to know how to allocate resources in case of a storm. The nowcasts presently issued by the meteorological experts are very helpful, but it is always good to have a more precise, more targeted forecast (if at all possible).
- **Landslide and rock fall:** monitoring of the critical areas and raising awareness about the dangers of the so-called loess soil in the area. This is a field where also public awareness must be raised:
  - the affected areas must retain a minimum foliage (in other words, tell the public not to cut all the vegetation from the landslide affected areas),
  - the water drainage systems must be kept clean (in order to avoid water buildup and erosion in the so-called “high cliff” areas)
  - any activities that heavily affect the soil itself (excavations, digging etc.) must be kept at a minimum and/or completely halted.

Furthermore, results from relevant projects should be capitalised:

- SEERISK – Joint Disaster Management risk assessment and preparedness in the Danube macro-region, 2007-2013 – this is a project which is based on risk assessment in connection to climate change and weather hazards (including floods, wind storms and wildfires). The project is relevant because it featured the city of Siófok (located at Lake Balaton) as a pilot site.
- INCA Central Europe - Integrated nowcasting system for the Central European area, 2007-2013 – this is a project which is based on the cooperation of meteorological and disaster management experts in connection with weather hazards. It was crucial to establish a tighter cooperation between meteorological and disaster management experts in Hungary and especially in Somogy county (which is partly a Balaton region area).
- S12 661053 PROFORCE – Bridging of Probabilistic Forecasts and Civil Protection, 2013-2015 – this is a project which is based on the cooperation of meteorological and disaster management experts in connection with weather hazards. It furthered the approach which was started by the previous project (see INCA).



- CE1146 CULTURECOVERY, 2017-2020 this project aimed to improve the sustainable use of cultural heritage and resources. The project supported cooperation between public and private organizations in Central Europe, which was able to contribute to institutional capacity building through the use of innovative models, strategies and practical measures for the protection and sustainable use of intangible cultural heritage. As a result of the project, the concept of the Balaton Eco-Museum was developed. (An eco-museum is a landscape developed into an open-air interactive museum that integrates the specific natural environment of the area, their ecosystem services and cultural values, thus providing significantly more than “traditional” museums: presenting and preserving their natural and cultural heritage.) In addition, the historic gardens and parks in the Lake Balaton area were surveyed; and arboretums and botanical gardens as well.





## 7. VILLA GHIGI, ITALY

### 7.1. Site description

The Villa Ghigi Park is a historical park owned by the Municipality of Bologna, located on the hills close to the city, just 2 km far from Piazza Maggiore (the heart of the centre of Bologna). Its surroundings host important historical and architectural sites, such as the Convent of the Observance, the neoclassical Villa Aldini (built in the early nineteenth century in place of the ancient sanctuary of the Madonna del Monte), the Eremo di Ronzano and the former Monastery of San Michele in Bosco (today Rizzoli Orthopaedic Institute). The park is very popular and visited by citizens and tourists. Since more than 40 years, it is the place of educational activities run by the Villa Ghigi Foundation, which has had its headquarters in the park since the early 2000's . The Foundation takes care of the park management on the basis of an agreement with the municipal administration (the agreement does not include the architectural heritage of the park). The green area extends for about 29 hectares on the right side of the valley of the Rio Fontane, a tributary of the Aposa stream, in an ancient agricultural estate with a seventeenth-century manor, now abandoned. The difference in height ranges from 104 meters at the bottom of the Rio Fontane valley to 243 meters at the highest point of the park, towards the top of the Ronzano hill. The park has three entrances, does not have official operating hours and is not fenced in. Until 1970 the villa was inhabited by the Ghigi family, the last private property. In 1974 the green area, purchased by the Municipality of Bologna after a limited donation in the previous decade, was opened to the public.



Today the park still retains the rural settings of the past and is characterized by a rich mosaic of different environments, offering an exemplary synthesis of the Bolognese hilly landscape, as well as of its dynamics and difficulties. Next to the great naturalistic value associated with its meadows, hedges, shrubs and strips of forest, a remarkable heritage of rural biodiversity is also present, linked to the numerous species of fruit trees of ancient cultivars typical of the Bolognese hills. Furthermore it hosts interesting ornamental components, concentrated mainly in the garden surrounding Villa Ghigi, with centuries-old trees and typical essences of the parks of the historic Bolognese houses. The park is located on the edge between the hills of Bologna and the urbanized



area grown on the valley of the Aposa stream in the second half of the twentieth century. These characteristics also directly affected the ancient estate, since part of the land in via San Mamolo and Martucci was divided and used for building.

The park, despite its rather small size, concentrates most of the criticalities and vulnerabilities that characterize the entire territory of the hill of Bologna. In recent years, increasingly frequent cases of intense rainfall, concentrated in very short times, are causing problems for regulation of surfaces and hydrogeological instability, with landslides affecting also viability, and hydraulic risk with localized flash flooding. They are located especially in correspondence with one of the secondary entrance of the park (via Martucci), where a small watercourse, created during the urbanization of the road, begins to flow underground. The heavy rains, moreover, often cause damages and problems of paths and the main dirt road inside the park (in clay and gravel, it dates back to the time of the Ghigi estate).

Among the identified dangers, cases of strong wind and intense or "out of season" snowfalls caused the breaking of branches or subsidence of entire trees. It must be noted that the park is home to several centuries-old tree specimens, many at the end of their life cycle, which are particularly sensitive to the mechanical stress due to strong winds or snow weight. In some environmental conditions, they can represent a real danger for the visitors to the park. An isolated thunderstorm episode, linked to lightning occurred some years ago, struck the top of a Himalayan cedar (*Cedrus deodara*), nipping it and causing a long wound to the trunk (of which an evident scar remains today). The tree, planted by the Ghigi family in front of the villa, is about 150 years old and has recently been included in the list of monumental trees of Italy (pursuant to art. 7 of Law 10/2013). For several years, it has been subject to different types of care interventions; other activities are scheduled in the coming years to prolong its life as much as possible.

The changed climatic conditions of recent years (and the consequent problems of high temperatures, water crisis and drought) are compromising the vegetative and phytosanitary state of the vegetation cover. In particular, this affects some tree specimens of the park that are more sensitive and less adaptable to the current climatic trends. A group of beech trees (*Fagus sylvatica*), the so-called "beech forest" remaining from an area built at the end of the nineteenth century by the Ghigi family, took benefit in the past by the northern exposure of its slope and the cool and humid microclimate, however these conditions have now completely changed. Critical conditions are also highlighted on other secular trees in the park, with the arrival of various pathogenic organisms and an acceleration of the senescence processes, which are causing partial drying up to the death of the specimens. In particular, the decay of many oak specimens (*Quercus pubescens*), also known as the "decline of the oak", has led to the drying up of some impressive specimens. In general, the park's monumental tree heritage is seriously compromised, with the consequent loss of the most valuable plant component of the green area. In recent years, however, an important plant enrichment programme is taking place, thanks to the planting of many trees and shrubs, and also thanks to the involvement of citizens.



## 7.2. Current risk management strategies

### ***Long term increase of temperature + (Long term drought and solar overheating and excessive radiation)***

New plantings have been done to increase the tree and shrub heritage and promote the ecosystem services provided by the vegetation cover, so improving the climatic conditions (reduction of climate-altering emissions), as well as mitigating air pollution.

Implementation of good agronomic and arboriculture practices includes: proper planting techniques of trees and shrubs with the use of polymers with high water retention, use of tree nursery materials of good quality, use of mulch, use of shelters to protect trunks from excessive sunlight.

Cycles of rescue irrigation, limited to young trees and shrubs recently planted - to ensure their rooting and development, are associated to the use of low water consumption systems (drip irrigation), activated according to weather conditions and actual needs. It must be underlined the presence of a weather station, that returns real-time data about rainfalls, humidity and snowfalls. Monitoring of newly planted trees, verification of the presence of significant pathogens and possible interventions of localized care, are also performed, according to the principles of organic farming.

### ***Inundation and high water presence***

Interventions carried out according to the annual management plan of the park concern: monitoring the condition of the surface water network and the network of roads (dirt roads, "cavedagne" and paths); routine maintenance work to clean ditches, drains and hydraulic structures (manholes, tanks, grates, pipes, "section-breaking" structures on the roadway, points of entry into the urban sewage system, etc.), with additional work in the event of heavy and/or prolonged rainfall. Extraordinary measures include the opening of new ditches to reinforce the surface water network (based on the historical layout visible in ancient documents), the construction of drainage ditches and other measures to improve the reception of surface water based on natural solutions (NBS, nature-based solutions). Following exceptional rainfall events, interventions are done to restore efficiency of the hydrographical and dirt tracks and paths networks, cleaning the riverbeds of materials and sediment carried by the water.

As regards landslides, specialized investigations (geological, hydrogeological and geotechnical) have been done for assessing the stability conditions of slopes and the main critical situations. Monitoring of the park is carried out with particular attention to the dynamics relating to landslides in progress. Consolidation works with naturalistic engineering techniques are also important to be mentioned, together with the improvement interventions on the surface hydrographical and viability networks, including the creation of drainages. The Foundation also runs maintenance of trees and shrub surfaces, important for their capacity to intercept rainwater and reduce the risk of instability of slopes. Finally, small equipment are used to avoid erosion or instability.

### ***Snow and icing***

Interventions carried out according to the annual management plan of the park concern: monitoring conditions of the arboreal heritage, with particular regard to the most vulnerable areas concerned with falling trees (main roads and paths, border bands) and to the more sensitive and potentially dangerous plants (evergreen trees and shrubs, mature and senescent trees, monumental trees). Periodic visual and instrumental stability analyses (Visual Tree Assessment) are run on selected trees: annual pruning and felling of dry trees in precarious conditions of stability; care interventions on trees important for size, bearing, or rarity (anchors, static and



dynamic consolidations); extraordinary interventions following harmful snowfalls, starting from the timely removal of plants crashed to the ground along the main road network and in vulnerable sectors; temporary or permanent closure of road sections, more sensitive and vulnerable to falling trees. In order to preserve the main road network, specific snow poles are applied during the winter period in correspondence with the "sectional" elements of the driveways, in order to direct the snow plows and protect the road surface and related structures.

#### ***Wind and windstorms***

Interventions carried out according to the annual management plan of the park concern: monitoring conditions of the tree heritage, with particular regard to the sectors most vulnerable to falling trees (main roads and path network, rest areas and other highly frequented areas, border bands) and to potentially dangerous trees (isolated specimens, with static and structural problems, senescent and/or monumental trees); periodic visual and instrumental stability analysis (Visual Tree Assessment) on selected trees; annual program of pruning and felling of dry trees and in precarious conditions of stability; care interventions on trees significant for size, bearing, specific rarity (anchors, static and dynamic consolidations); extraordinary interventions, following damaging weather events, for improving the safety of the park (timely removal of plants crashed to the ground along the main roads and in the most vulnerable areas); temporary or permanent closure of road sections more sensitive and vulnerable to falling trees.

#### ***Lightning***

Please see: Wind and windstorms and Snow and icing

#### ***Synergic biotic and weather effect and Mature and aging trees***

Please see: Wind and windstorms and Snow and icing

#### ***Climate change and adaptation of plant species***

The choice of new plants mainly addresses rustic trees and shrubs, with low water requirements, and more resistant to drought conditions, heat waves and pathogenic organisms. Many interventions are done to protect the biodiversity of the park and its adaptability to climate change and extreme weather events. They include: differentiated mowing of lawns and release on site of the vegetal remains; conservation of old and potentially dangerous trees (in fenced areas with reduced access to minimise risk of falling and damages to people or things); creation of piles of wood and other materials as a refuge for certain species of wildlife (micro-mammals, reptiles, birds, etc.); the reuse of timber derived from trees felled in the park, for the creation of new furnishings.

#### ***Wildlife***

To counteract the increase in wildlife and prevent the damage caused by its presence, fences of various types and heights have been created to protect the areas of particular interest (vegetable garden, orchard, vineyard, forest). For newly planted trees, shelters are used to protect their throne. Herbaceous species repellent for certain animals are being tested (for example *Helycrisum italicum* and *Allium* spp. against wild boar).

#### ***Other sustainable risk management strategies and interventions***

The Villa Ghigi Foundation guarantees a constant monitoring of the green areas, takes care of relations with the municipal administration and other local stakeholders, coordinates the ordinary and extraordinary activities, carried out with the support of an operational staff almost always available. The Foundation also maintains a constant dialogue with park visitors, citizens and residents of the area. A dedicated section (Vivere il parco) has been created in the Foundation website, promoting new events and supporting the participation of citizens, schools, families and several stakeholders, and also including information about the vulnerability of the area and



problems connected to climate change, as well as evolutionary dynamics of natural and anthropic environments. Currently, the opportunity of organizing a group of motivated citizens used to frequently visit the park, is under evaluation, to strengthen control and monitoring the green area, and maintain a direct dialogue with the visitors. Unfortunately, the limitations due to the Covid-19 pandemic slowed this process down, like many other initiatives planned by the Foundation.

### 7.3. Proposal for local risk reduction plans

#### ***Inundation and high water presence***

- Hydrological and hydraulic monitoring of the park and the surrounding area (valley of the Rio Fontane, valley of the Aposa stream) in agreement with the related bodies (Municipal Administration, Consorzio Bonifica Renana, etc.).
- Structural and management interventions, in agreement with the related authorities, to improve the access to the park in via Martucci where, in the event of exceptional rain, the ducted section of the small stream is no longer sufficient to receive intense flows (with consequent overflows along the road and in the neighbouring areas).
- Arrangement of the main viability of the park using new eco-sustainable, filtering and transpiring flooring, that respects the landscape characteristics of the area (see HICAPS WP-T1 Development of strategy and action plans on evaluation of cultural heritage - D.T1.2.4 Local Action Plan, Objective B10).
- Activation of early warning and safety procedures in case of extreme weather events, in agreement with the municipal administration and authorities in charge of emergency and civil protection management. The procedures include the closure of the most vulnerable areas (in particular the entrance in via Martucci), and warnings to be issued to neighbouring residents, to prevent damages due to severe rain events.
- Information and communication activities: a section on the website of the Villa Ghigi Foundation is dedicated to weather information (connected to the weather-rain gauge station installed in the park) and provides warning notices in case of critical situations.

About landslides:

- Continuing the hydrogeological monitoring in agreement with the responsible authorities (Municipal Administration, Consorzio della Bonifica Renana, etc.) and preparation of specific improvement measures for managing critical situations.
  - Continuing drainage and naturalistic engineering interventions to support correct regulation of surface waters and stability of the slopes (mitigating the risks of instability) as well as to preserve traffic.
  - Activation of early warning and safety procedures in case of extreme weather events, in agreement with the municipal administration and with the authorities in charge of emergency and civil protection management.
  - Continuing extraordinary interventions in line with what described in paragraph 8.2.
- Current risk management strategies: opening new ditches to enhance the surface hydrographical network according to the historical structure known from historical documents, construction of drainages and other interventions to improve reception of surface waters based on natural solutions (NBS, Nature-based solutions).

#### ***Snow and icing***

- Creating a computerized and geo-referenced census of the park's arboreal heritage, to be integrated with the annual management plan drawn up by the Foundation, in order to facilitate





monitoring, identify priorities of interventions, improve safety of trees, optimize the economic resources available.

- Continuing interventions for caring the most valuable tree specimens (instrumental investigations, anchors, static and dynamic consolidations), also using innovative techniques, such as an anchoring system with metal poles fixed to the ground (without digging holes and using concrete) to protect the root systems of trees.

#### ***Wind and windstorms***

Please see: Snow and icing

#### ***Lightning***

Please see: Snow and icing

***Biotic agents*** (pests deteriorating branches and trunks, Fungicide diseases of leaves, buds and sprouts, Pests deteriorating leaves) + Synergic biotic and weather effects

- Starting relationships with R&D (University, C.N.R., Servizio Fitosanitario Regione Emilia-Romagna, etc.) to investigate dynamics concerned with the presence of harmful organisms for the vegetation (insects, fungi, etc.) and identify sustainable damage containment strategies.

#### ***Mature and aging trees***

- Interventions for caring the monumental trees (one of the programmatic objectives of the HICAPS Project \_ WP-T1 Development of strategy and action plans on evaluation of cultural heritage - D.T1.2.4 Local Action Plan, Objective B7). Among the trees, the Himalayan cedar (*Cedrus deodara*) is included in the list of monumental trees of Italy, already subject to care interventions as part of the pilot action of the HICAPS Project (HICAPS \_ WP-T2 Tool development and consensus building - D3.2 Handbook on landscape accessibility for all - Tools proposed by Villa Ghigi Foundation). The plant needs further interventions to consolidate the apical part of the trunk, whose stability was compromised years ago due to the nipping of its top produced by lightning. Another noteworthy specimen is the monumental downy oak (*Quercus pubescens*), dried a few years ago, whose imposing structure still stands out in a highly visible point of the park. A specific plan must be designed, without underestimating the potential risk associated to this tree, and the need for its safety regardless of the reuse that will be decided.

#### ***Climate change and adaptation of plant species***

- Continuing the plant enrichment process of the park, planting new trees and shrubs of different rustic species with low water requirements (see also HICAPS Project \_ WP-T1 Development of strategy and action plans on evaluation of cultural heritage - D.T1.2.4 Local Action Plan, Objective B8).
- Starting relationships with R&D (University, C.N.R., Servizio Fitosanitario Regione Emilia-Romagna, etc.) and the tree nursery organisations, to investigate and experiment new rustic plant species, with low water requirements, more resistant to prolonged drought conditions, heat waves and pathogenic organisms.
- Interventions of care and reorganization of the fenced forest and the "beech forest" (see also HICAPS Project \_ WP-T1 Development of strategy and action plans on evaluation of cultural heritage - D.T1.2.4, Local Action Plan Obiettivo, B4). In particular instrumental investigations will be started, together with extraordinary pruning, consolidation, as well as new planting of species selected on the basis of the defined criteria.

Concerning the strategy for the sustainable management of the park and the reduction of risks, the previous actions can be achieved in the medium-long term. Some uncertainties and challenges are still to be addressed and resolved, such as the restrictions caused by the ongoing COVID-19 pandemic. Administrative delays, impediments or possible changes in priorities of the Municipality



of Bologna may slow down the interventions and possibly affect the agreements, generally lasting two or three years, which regulate relations between the Villa Ghigi Foundation and the municipal administration as far as the management of the green area is concerned (the current agreement expires at the end of 2021, with the possibility of an extension for a further year). It will be necessary to find specific extraordinary financing, in agreement with the municipal administration, to tackle some of the most expensive and complex works.

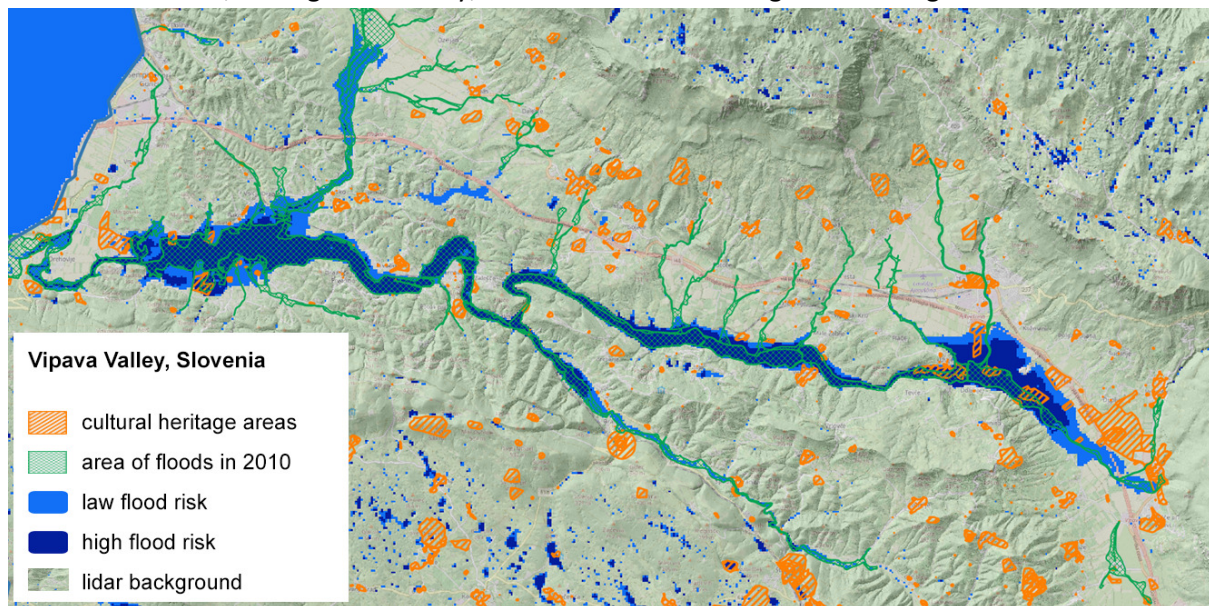


## 8. VIPAVA VALLEY, SLOVENIA

### 8.1. Site description

The Vipava Valley area has been a passageway between Italy and the Danube region for millennia. This cultural landscape has many prehistorical archaeological sites, monuments from the Antique, Gothic, Baroque periods, and other monuments from the 19th century.

Locals are tackling bora wind, floods, and landslides for centuries. Bora wind comes down from the mountain peaks to the valley with high speed and poses a hazard for building structure - roofs and facades, throughout history, this influenced the design of dwellings.



Map: Cultural heritage under flood risk, Vipava Valley. The Map presents also predictions of long term flood risk areas including anticipated scenarios of climate changes.

In the Vipava river basin, there are five significant flood risk areas concerning cultural heritage, human health, environment, and economic activity. According to the preliminary Slovenian hazard indication map, there is a likelihood of rare floods. The upper stream of the Vipava River and its tributaries were already regulated in the past. Flood protection is an issue in the lower part of the basin, where floods have become more frequent and several severe floods occurred in past years. These floods are a result of changes in the precipitation regime as a consequence of climate change. Let us also mention the landslides as a potential risk to cultural heritage areas. The north of the Vipava Valley is covered by a thin and unstable layer of flysch. For this reason, landslides are common on the steep slopes during heavy rainfall events.



## 8.2. Current risk management strategies

In Slovenia, the majority of responsibilities for immovable heritage protection are divided between the Ministry of Culture, municipalities, and the Institute for the Protection of Cultural Heritage of Slovenia. Public and private owners are fully responsible for the maintenance, management, and strategic development of cultural assets.

Cultural Heritage Protection Act requires that cultural heritage is taken into consideration in the preparation of all spatial plans and that spatial plans must include heritage protection measures. That means that monuments of local and of national importance registered archaeological sites and heritage protection areas are included and taken into consideration as obligatory components of spatial (zoning) plans at the national and local level.

The Environmental Protection Act sets a strategic environmental impact assessment procedure. An assessment of the impact on heritage of the potential development is an important part of the SEIA. SEIA is prepared for all categories: monuments, registered archaeological sites, and heritage protection areas. A strategic impact assessment on heritage is also mandatory for interventions to areas without heritage if such interventions could have a direct or indirect impact on heritage.

The protection of Slovenian cultural heritage is also regulated by the Act on Protection Against Natural and Other Disasters. This act defines the general framework for prevention and elimination of threats to cultural heritage and establishes principles for other heritage protection regulations, acts, and guidelines. The system of protection against natural and other disasters includes the protection of cultural heritage, with a view of reducing the number of disasters and preventing or reducing the number of casualties and other consequences of such disasters. Legislation on emergency preparedness is strict; however, these regulations do not apply specifically to cultural heritage.

Natural disasters as floods and wind are present in Vipava Valley for centuries hence are well tackled in national and local documents. The Vipava river basin is managed with the Vipava River Basin Management Plan and its Program of Measures according to the EU Water Framework Directive that has been completely integrated into Slovenian legislation through the Waters Act. There are also other sectorial strategic plans related to water management, as The Flood Risk Management Plan, Natura 2000 Management Programme, and other sectorial documents in agriculture and forestry.

## 8.3. Proposal for local risk reduction plans

In the Vipava valley, there are numerous different types of cultural heritage. Monuments of local and national importance are quite well preserved. There could be some criticalities as defined in the tables of the deliverable D.T2.1.1, e.g. mainly strong winds, worsening condition of the walls, shallow located archaeological remains, worsen the condition of the hamlet objects. These are general observations. As the process of cultural heritage protection and conservation demands communication and cooperation among different fields, we should mention also man-made criticality that is a lack of funds. This issue of communication, participation including different horizontal and vertical stakeholders, and holistic approach are tackled by the strategy for sustainable management of Historical Built Areas in the CE Region, prepared in the BhENEFIT project.



Historical Built Areas are defined as the result of a centuries-long process of evolution, a process, an expression of culture and history. Strategy can be considered as a plan of actions designed to develop and implement sustainable HBA. BhENEFIT aimed to strengthen the capacity to deliver integrated urban strategy and actions corresponding to the HBA challenges. The partnership prepared an adaptive strategy for the HBA management that bases on balanced governance and should compare and encompass various parameters that must be considered in an integrated, adaptive, and holistic approach. The main strategy's objectives:

- to enhance the participatory approach by including new professional players and communities in the decision-making process of HBA - a Common Heritage;
- to promote a cross-cutting approach with competencies and capacities to manage the complexity and the value of HBAs as crucial components of local development policies;
- to improve vertical and horizontal collaboration mechanism to make the HBAs management more effective and sustainable;
- to enhance the partnership principle by including all relevant and specific stakeholders in decision making;
- to encourage pooling and optimizing resources by including and mixing competencies and capacities, to manage complexity and value of HBAs as crucial components of local development policies;
- to introduce a trade-off mechanism to prevent and manage conflicts and develop balanced policies in HBA management.

The Bhenefit strategy could be complement with STRENCH topics that concerns more environmental issues (e.g. integrating prevention and elimination of threats to cultural heritage due to natural disasters or climate change into urban governance).





## 9. References

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