

Summary of the study

“Riverbanks: how to achieve a coexistence of biodiversity, recreation and flood retention”



Project Partner:

Kuldīga District Municipality

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Introduction

The study is developed by the interregional cooperation program INTERREG EUROPE 2014-2020 within the project “UrbanLinks 2 Landscape - UL2L” in 2019-2020.

It is the project’s main objective to increase the knowledge base and skills and to deliver tools that allow the evaluation of urban gardening, health care and selected ecosystem services compared to other uses of open spaces and consequently the enhancement of policies that support action plans and measures to use the limited natural capital sustainably.

The partnership jointly identified main challenges in Kuldīga, which are of overall importance for the project:

- preparation of a comparative overview of the use of rivers and rivers in historical urban areas, or adjacent to watercourses: situation, problems and solutions. Evaluation of the plans and projects implemented and proposals for the transfer of experience.
- research on the importance and use of the Venta river and the rivers in Kuldīga as a pilot area (the river from the new bridge to the Veckuldīga castle mound), its impact on the urban environment with detailed analysis of the period from the end of the 19th century to the present.
- perform assessment of the landscape and ecology of the river Venta and the riverbank in the Kuldīga area.
- develop proposals and recommendations for the development of the river Venta and the riverbank in the urban environment, balancing biodiversity, recreation and water management aspects.

The study document is structured in two parts: a description of the current situation with conclusions and a proposal section. Separate recommendations for the development of rivers and riverbanks in the urban environment are prepared. The prepared proposals will be applicable to other cities with a similar situation - location in a historic urban environment that is permeable to, or accessed by, watercourses.

The research was developed by Kuldīga District Municipality in cooperation with Ltd “Grupa93”, involving geology and hydrogeology expert MSc.Env.Eng. Inga Gavēna, certified freshwater habitat expert Dr.Biol. Laura Grinberga, certified forest and grassland habitat expert MSc.Geogr.

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1 Study area

Kuldīga is located in the western part of Latvia, 150 km from Riga, 100 km from Liepaja and 50 km from Ventspils. Kuldīga is crossed by the Venta river, the total length of which is 346 km (of which 178 km in the territory of Latvia), the basin area is 11,800 km², in the territory of Latvia 6,600 km².

The pilot area covers the valley section of the Venta river in the city of Kuldīga with its bank slopes, terraces and the adjacent main bank (see Figure 1). The length of the river in the study area ~6 km.

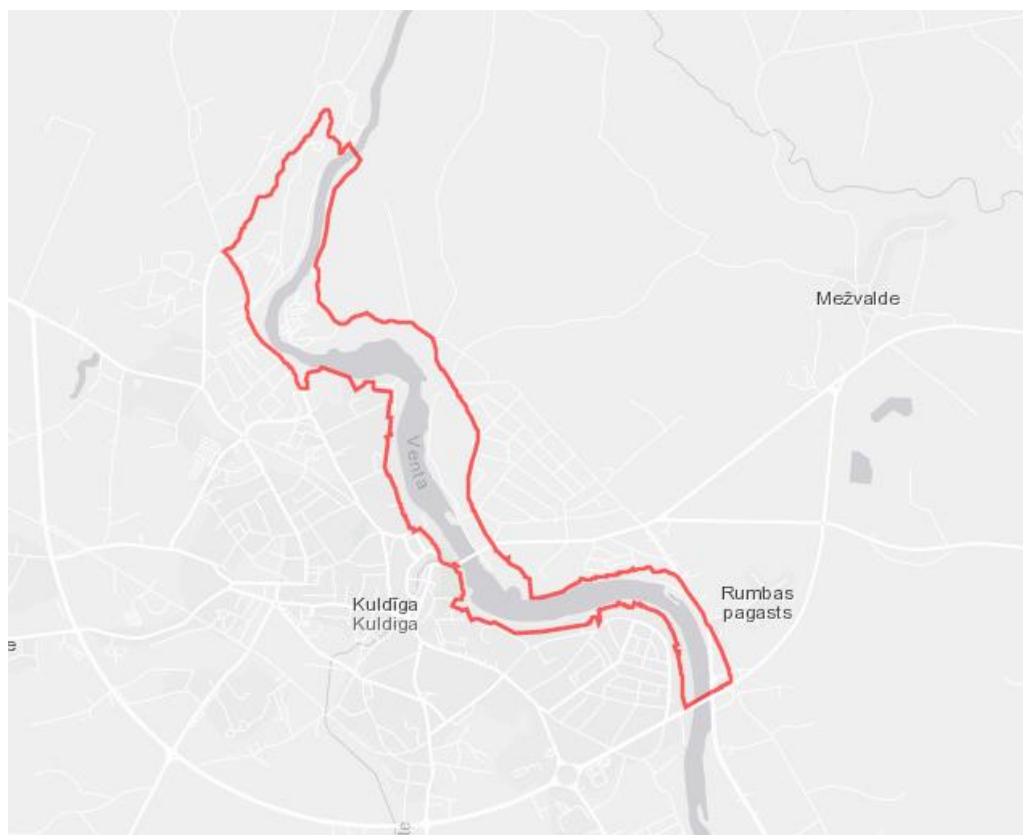


Figure 1 Study pilot area (map prepared by Grupa93)

The set of cultural and natural values determines that the landscape of the Venta river valley is one of the most unique and outstanding landscapes in Latvia visually aesthetically.

Due to the rich cultural heritage, this area is included in the Latvian National List of UNESCO World Heritage Sites.

The National Commission of Latvia of the United Nations Educational, Scientific and Cultural Organization (UNESCO) coordinates the operation of the UNESCO World Heritage Programme in Latvia and ensures the implementation of the UNESCO Convention on the Protection of Cultural and Natural Heritage.

On 28 February 2020, Kuldīga district municipality submitted an application that was prepared in accordance with the UNESCO Convention for the Protection of the World Cultural and Natural Heritage to UNESCO Latvian national committee and the nomination of the Latvian National List was accepted by the UNESCO World Heritage Center under the name “Kuldīga (Goldingen)”.

The main values of the nomination included in the Latvian National List of UNESCO World Heritage are the territory, buildings, objects of the “Kuldīga (Goldingen)”:

- The Old Town of Kuldīga integrates the medieval castle mound plateau and the medieval village Kalnamiests into a larger urban fabric created between the 16th and 18th century and later expanded, mostly outside the historic center, in the 19th and furthermore the 20th century. The proposed area covers the pre-19th century urban expansion and its significant environmental setting. The property is preserved mostly in its condition of the late 18th and early 19th century. It therefore includes the complete historic testimony of Courland retained until present, particularly legible in the unchanged urban layout, composition of urban volumes, architectural testimony and cityscape;
- Architectural Monument Red brick vault bridge (date: 1874);
- Venta Canal (date: 17th century-19th);
- The Alekšupīte river waterfall - the highest waterfall in Latvia - height 4,15 m (date: 17th century);
- Venta fall – the largest waterfall in Europe (width 240 m, height 1,8-2,2 m).

The vast majority of the area of the study (almost 90%, 186 ha) is occupied by a nature reserve “Ventas ieleja” that concentrates its natural values. In addition, the geological and geomorphological nature monument “Ventas rumba” and protected trees are still in the vicinity of nature.

The conservation status of the nature complex in Venta valley has already been established in 1957, with a special status in 1999: nature reserve status¹. The site is a protected nature area of European interest *Natura 2000*². A nature conservation plan for the area has been developed for the period 2010-2020³. The functional zoning of the territory and the individual requirements for protection and use of nature closures are determined by Cabinet Regulation No. 548 of 16 September 2014 on the “Individual Protection and Use Regulations of Natural reserve “Ventas ieleja””.

The nature heritage of the study area is one of the preconditions for the development of the landscape characteristic of the Venta valley. Venta valley landscape protection and development measures in the territory of the nature reserve “Ventas ieleja” have to be planned in the functional zones of landscape protection and nature park, because the protection and development of landscape structures and landscape elements of natural and aesthetic value is defined in the objectives.

2 Historical use of the Venta river and its riverbanks

In order to assess the possibilities for the use of rivers and rivers in the historical urban environment and to assess the possibilities of restoring historical uses, research needs to be carried out, taking into account socio-economic, ecological and landscape conditions, historical uses (use of water resources, geological, biological resources, including agricultural use of rivers, transport use, use of energy resources, building, recreation, etc.) and their impact on urban development.

The change of land use type (economic activity) in the study area has been closely related to the stages of historical development, when the growth of the city and its surroundings took place.

The use of the riverbanks was impacted also by expropriation of land for the dredging of the Venta river and other works related to the improvement of navigation conditions.

The development of Kuldīga was influenced not only by the Venta river as an important transport corridor, but also by the existence of the Venta fall as an obstacle. The Venta fall served both as a

¹Cabinet Regulation No 212 of 15 June 1999 — Provisions on nature closures in 1999

²The Law of the Republic of Latvia On Specially Protected Natural Areas. Annex “Latvian *Natura 2000* — List of nature protected areas of European interest” (version of Law 1993, 15.09.2005.)

³Nature conservation plan for the period 2010-2020. Estonian, Latvian & Lithuanian Environment Ltd, 2010.

fishing spot and was a natural barrier to navigating the Venta. This was the basis for the development of a transport hub (stop) in Kuldīga, which promoted the development of other services - the hospitality industry, warehouses, and the development of craft services.

Based on demand, the supply of accommodation for timber floating developed.

The Venta river has been used as a transport corridor and thus has had an impact on the formation of the city's buildings not only in the oldest period of the city's development in the 13th-19th centuries, but also in the 20th century Soviet years. During the active operation of the veneer factory “Vulkāns”, its employees or employees of industries related to the operation of the factory (for example, timber floating) built private houses - in the vicinity of the river Venta left bank – area called Putnudārzs. The housing stock was also built for factory workers. According to the demand, the supply of accommodation for tree floats developed.

Impact of historical use of the river on landscape formation and change

The most important aspects of landscape formation:

- in the Middle Ages, agricultural land was located outside the city fortifications. Residential buildings were located on the left bank of the river, slowly expanding along the river bank in a northerly direction;
- in order to improve navigability, the construction of a canal around the Venta fall began in the 17th century. The construction works did not result in a navigable canal, but had an impact on the landscape by introducing a landscape element that is not typical of the Venta valley;
- during the times of manors (17th-18th centuries) the river banks were managed - mowed, grazed up to the river water or fields;
- the beginning period of 18th-19th and the 20th century is characterized by the use of the Venta riverbanks, using traditional agricultural methods for the management of the territory - grazing, mowing, cleaning of fields and vegetable gardens;
- in the interwar period, agriculture was not intensive. Due to the shortage of people and horses, 30-45% of the fields were uncultivated and unsown;

- In Soviet times (mid-20th century), agriculture was centralized, creating extensive pastures and agricultural land outside the city. The need for agricultural products increased, so various solutions to increase the yield were searched and used;
- after the restoration of the independence of the state, the property rights were restored or they were transferred to the management of the municipality. The study concludes that in some places during this time there has been overgrowing of open areas - grasslands and river riverbank - with trees and bushes;
- the aesthetic quality of the modern Venta river has decreased because the river is not used intensively (economic need has disappeared) and therefore the area of the water surface, which is an important element of the landscape, has decreased.

Impact on ecology

The historical use of the Venta has affected the ecological status of the river, as the river and its bed have been regularly cleared of aquatic plants and their roots during the maintenance of the water transport route and the floating of timber, thus limiting the spread of aquatic plants and coverage of aquatic plants. This, in turn, prevented the development of eutrophication processes, as less nutrients from dead aquatic plants accumulated in the river.

Today, the ecological status of rivers is more significantly affected by other factors (climatic conditions, nutrient inputs from catchment areas), so the positive impact of restoring potential historical uses will be relatively small.

Assessment to renewal of historical uses

The oldest use of the river can be restored as a demonstration of historical uses, demonstrating certain activities related to the earlier use of the river for educational and cultural purposes.

As **renewable uses** are offered:

- renewal of water tourism competitions - in order for the competitions to be successful, they would need a municipal initiative, taking part as the organizers of the competitions. The competition is held in the spring, during the high-water level season in Venta river. Suitable place - downstream of the Venta fall to the brick bridge.

- barge route - downstream of the castle mound. Offer for summer time. The barge route is possible from the berth at Virka manor and below, assessing the depth of the river. In total ~ 40 min long trip (round trip).
- routing of boats, rafts, SUPs and other floating craft (mainly during the summer season) from the new bridge up to the Venta fall. Recommended as an opportunity to return to the Ventas fall for those who walk along the Venta river left bank path to the new bridge.
- restoration of Duke Jacob's canal - by clearing the coverage of aquatic plants and giving it an educational and entertainment function. Possibilities to demonstrate geomorphology throughout the exhibition site.
- installation of fish baskets on the Venta fall to demonstrate the ways in which fish were caught in baskets in the past.
- crossing the Venta river by horse. The offer can be created in cooperation with private businesses. There are shallow places in Venta river suitable for river crossing. Crossing the Venta by horse can be both an alternative to a pontoon bridge and a parallel offer.

The study concludes that there are also historical uses that **are not renewable** directly from their previous use. Those are:

- timber rafting in Venta;
- “Driver Festival”.

3 Landscape and ecological assessment of the river Venta and it’s riverbanks

3.1 Geological and geomorphological structure, assessment of nowadays geological processes

The city Kuldīga, like all of Latvia, is part of the NW part of the Eastern European platform. Its geological structure is characterized by two radically different structural elements of rock composition, age and development history: crystalline basement and sedimentary blanket.

In order to analyze the structure of the Quaternary sediments of the Ventas Valley at a level to assess the compatibility of the planned management measures with the geological and

hydrogeological conditions of the site, it is possible to use only the geological mapping materials of the level 1:200 000, which is not sufficiently detailed.

The characteristics of hydrogeological conditions have insufficient information on the spread of individual aquifers, water resources and quality, and their treatment (i.e. seasonal and long-term changes in water levels).

The exogenous processes in the majority of river Venta valley are weak, with the exception of certain active erosion sites, the most important of which is the landfall of Venta's left bank downstream of Kuldīga, where erosion is promoted as river activity (leaching of the base of the floor, particularly during the floods), geological conditions (the landfall is largely loose, mainly fine grained sand sediments) as well as hydrogeological conditions (leakage of ground waters causing suffusion occurs at the base of the slope).

The slopes of Venta valley are stirring ravines, mostly stable at the moment, and there is virtually no development, but some areas of seabed leaching. In order to avoid the risk of formation of new ravines, a significant assessment of any ground works or water drainage measures taken upstream of the slope shall be carried out. Artificial removal of ravines (backfilling) can lead to the formation of new ravines in adjacent areas. It is recommended to reinforce the base of the ravine (e.g., with a splinter, pebbles riverbank), which prevents the ravine from deepening while not interfering with the leakage of water.

In order to obtain more precise information and to ensure purposeful management, protection and use of the Venta valley, its engineering geological mapping (geological structure, paying special attention to Quaternary sediments, hydrogeological conditions, exogenous geological processes and other information) have to be performed in the study area.

The outcrops of dolomite have both scientific and aesthetic value. They are the habitat of European Union importance for 8210 *Calcareous rocky slopes with chasmophytic vegetation*.

3.2 Hydrological characteristics of the river

Evaluating the data of long-term hydrological observations at the station Venta-Kuldīga in 1961-2018, it can be concluded that:

- the water level in Venta is stable, except for some years, and there is no significant upward or downward trend;
- the flow of the river does not show an upward or downward trend. The average flow rate is 69,4 m³/s;
- there has been a significant change in the seasonal distribution of runoff. Between 1980 and 2018, compared to the period from 1961 to 1987, runoff in winter has increased by about 14%, while in spring and autumn there is a downward trend in run-off of 9% and 4% respectively;
- significant changes have also been observed in the ice regime of the Venta river. From the end of the 1980s, the ice period in the Venta river decreases and becomes thinner. By 1986, the ice cover had formed in the winter for an average of 50 days, but after 1987 - for an average of only 15 days. Spring ice congestion is also decreasing in Venta river. The thickness of the ice cover is characterized by a slight, statistically insignificant decreasing trend.

Changes in runoff and ice regime are mainly affected by climate change.

Venta river in Kuldīga forms a valley with steep slopes, which serves as a natural flood protection. Therefore, the study areas of the Venta river section are not characterized by large flood areas.

There is a declining trend in maximum water levels. Maximum water levels are generally well below the floodplain.

3.3 Ecological status of the Venta river

Venta waters correspond to the moderate ecological quality class. The total phosphorus concentration in water does not correspond to the good ecological quality class.

According to the information of the Health Inspectorate of Latvia, the long-term water quality of the city bathing place “Mārtiņšala” in 2008-2018 is excellent. Since 2010, the bathing area has been awarded the international Blue Flag certificate.

In the study area of Venta in Kuldīga (downstream of the Kuldīga-Rīga highway bridge), priority salmonid fish waters have been identified as priority waters. For certain salmonid water quality indicators in 2009-2014. (e.g. oxygen concentration in 2013) have been found exceeds of limit values set for them.

3.4 Ecosystems, natural values and their management

Ecosystems, ecosystem services

The study area consists of freshwater-river, grassland and forest ecosystems.

River habitats shall ensure the self-cleaning of surface waters. Freshwater ecosystems provide a living environment and feeding areas for many species of invertebrates, fish, amphibians, birds and mammals. The recreative function of freshwater ecosystems is important.

Grasslands and forests provide different types of ecosystem services, mainly related to the extraction of materials (grass, hay), the provision of biodiversity, as well as recreation, site information and scientific function.

Habitats of European Union importance

A total of 6 types of protected grassland habitats have been identified in the area: 6120* *Xeric sand calcareous grasslands*, 6210 *Semi-natural dry grasslands and scrubland facies on calcareous substrates (Festuco-Brometalia)* (*important orchid sites), 6410 *Molinia meadows on calcareous, peaty or clayey-silt-laden soils (Molinion caeruleae)*, 6430 *Hydrophilous tall herb fringe communities of plain and of the montane to alpine levels*, 6450 *Northern boreal alluvial meadows* un 6510 *Lowland hay meadows (Alopecurus pratensis, Sanguisorba officinalis)*. When assessing the inventory data for grasslands, it has to be concluded that the previous grassland management measures have not been sufficiently effective. Grassland quality has largely remained medium to low, with extensive crop species still accounting for a high proportion, and invasive plant species in many areas. Some grasslands are not managed, grow with trees and shrubs.

In order to increase the quality of grassland habitats and species diversity, ecological restoration of grasslands is necessary, ensuring the application of appropriate management for each type of grassland habitat.

A total of 4 types of forest habitats of European Union significance have been identified in the area: 9010* *Western taiga*, 9180* *Tilio-Acerion forests of slopes, screes and ravines*, 91E0* *Alluvial forests with Alnus glutinosa and Fraxinus excelsior (Alno-Padion, Alnion incanae, Salicion albae)*, 91E0* *Riparian mixed forests of Quercus robur, Ulmus laevis and Ulmus minor, Fraxinus excelsior or Fraxinus angustifolia, along the great rivers (Ulmenion minoris)*. Their

quality is mostly medium. In the future, the areas of forest habitats to be protected must be maintained at their current level, ensuring their natural development.

The river corresponds to the protected freshwater habitat 3260 *Water courses of plain to montane levels with the Ranunculion fluitantis and Callitriche – Batrachion vegetation* variation 1 and 2. To the variation 2 of this habitat, corresponds to the section downstream from the new bridge to the Venta fall, but to variation 1 the section downstream from the Venta fall. In both phases, the quality of the habitat has been assessed as being medium.

Reinforced enrichment of rapids habitats occurs as a result of eutrophication. The reduction of nutrient runoff is considered to be a priority measure for the protection of species and habitats.

Localities of specially protected species

There are 16 specially protected or rare plant species, including 8 specially protected species, 4 species for which micro-reserves are to be formed. They are all included in the Latvian Red Data Book. In addition, the area is important for the protection of fish and for the conservation of biodiversity. It contains 3 restricted fish species specially protected in Latvia. 3 specially protected species of invertebrates have also been identified in the area of the study.

For the precise determination of the boundary of species localities, which would allow for the setting of suitable management methods, it is necessary to carry out a re-inventory during the vegetation season.

Invasive species occur in the area, mostly outside specially protected habitats (ruderal areas). Their presence has a negative impact on the nature and landscape values of the study area. Invasive species reduce biodiversity, cause economic damage, harm to human health and impair the quality of recreational resources. In the further phase of the development of the study, a set of measures should be prepared to limit (management) the spread of invasive species in both protected habitat areas and outside.

The situation of specially protected fish and invertebrate species in the area of the study is considered as good and stable. The state of these species should not be further deteriorated.

3.5 Stormwater drainage system in Kuldīga

In Kuldīga, the stormwater drainage system consists of open moats and rivers and of underground pipeline systems. Urban drainage of surface water is provided by the River Alekšupīte (Water drainage of national importance CODE 3638:01), rain sewer systems installed in part of the city. According to the information published by the State Limited Company “Ministry of Agriculture, Real Estate” (MARE) in digital a melioration cadaster information system www.melioracija.lv, the city of Kuldīga is divided into five catchment areas of State importance – No. 36373, No. 36381, No. 36382, No. 36383 and No. 363839.

The challenge in Kuldīga as well as in Latvia – how to transform stormwater from the (urban) problem to the (urban) resource into the urban environment, minimizing the risks of flooding areas during intense rainfall.

According to the data of the Latvian Environment, Geology and Meteorology Centre, more frequent and intense stormfall is expected in the future throughout Latvia, including Kuldīga. Permanent observation data show ongoing climate change - overall average air temperature in Latvia has increased by 1 degree in the 20th century, while annual stormfall in the last 100 years has seen fluctuations with a tendency to rise from the second half of the 20th century. The existing rain sewer system in Kuldīga does not have sufficient capacity⁴ to accommodate more stormwater and protect areas from flooding in the event of extreme rainfall. For the identification of specific risk areas, hydrological modelling should be carried out, for example by using the *Storm Water Management Model (SWMM)* programme in short-term scenarios, identifying the necessary maintenance measures and the necessary activities for network development.

Assessing the experience of other countries in dealing with the consequences of floods, it has been concluded that floods cause great economic losses to both the city and its inhabitants, as well as hinder movement, disrupt road traffic and flooded property. The main risk areas include areas with a high proportion of water-tight coverings, where the main emphasis in stormwater management is placed on conventional (underground pipelines) networks, the exact risk areas in Kuldīga can be identified using hydrological modelling, with particular attention being paid to areas where flooding problems are already experiencing during intense rainfall.

⁴Assumption based on the experience of other cities with similar-age stormwater sewer systems

When developing new areas, it is desirable to limit the runoff, for example by setting the permitted amount of discharge in conventional networks 5 l/s (so as not to load stormwater systems), with the view that the amount of other rain waters should be able to be kept on its own by integrating green solutions. In case of filling ditches, you should create, for example, rain gardens on your property, which compensates for the lost volume.

The situation in which the existing ditches are not maintained and the systems are arbitrarily modified, thus the system is interrupted, and it is not able to function fully, it is necessary to explain the role of the ditch systems in the urban environment.

In order to prevent possible entry of pollution into the Venta, measures should be taken in the areas adjacent to the study area to prevent river pollution from the stormwater drainage system.

3.6 The landscape of the river Venta and the riverbanks

The landscape of the study area reflects history in the form of natural and cultural heritage, it can be read in spatial structures and creates preconditions for further development of the landscape. Historical research shows that landscaping has taken place since ancient times, but the process has not been smooth. The last major landscape transformation throughout Latvia, including Kuldīga, took place after the restoration of Latvia's independence. During this time, the landscape of the banks of the Venta river stabilized in a new form, based on the preservation, integrated management and use of cultural and natural heritage for tourism and recreation purposes.

Approach to landscape formation

In 2000, the Council of Europe adopted the European Landscape Convention, which aims to promote the protection, management and planning of landscape areas and to organize cooperation on landscape issues in Europe. In 2007, with the adoption of the Law on the European Landscape Convention, this Convention was ratified by the Saeima of the Republic of Latvia. In joining the Convention, Latvia committed to establish landscape policy and promote the implementation of the measures set out in the Convention. The Convention emphasizes that landscapes are in any territory, it looks at all landscapes in their diversity of origin (natural or man-made) and by assessment (unique or common). A landscape is considered to be a special product of the

interaction between nature and humans, in which cultural and natural heritage are organically linked.

In the context of landscape policy, “landscape management” is defined in the European Landscape Convention as follows: “Landscape management - action, from a perspective of sustainable development, to ensure the regular upkeep of a landscape, so as to guide and harmonize changes which are brought about by social, economic and environmental processes”. It outlines the general principles of governance.

When looking at the landscapes in the study area, the site conditions, the territory, the interaction of different processes (natural and human), their scales and spatial manifestations are taken into account. The most important preconditions for the development of the characteristic landscape of the Venta valley are the cultural and natural heritage, which forms the landscape of the territory.

Major landscape forming elements

The nature of the landscape space of the Venta valley is determined by the river valley with steep or terraced slopes, therefore wide panoramic views open from the main bank of the valley. Landscape assessment and summary of elements is performed taking into account the basic principles for determining landscape values from the aesthetic point of view, based on three criteria: landscape quality, its visibility and accessibility.

Major landscape forming elements:

- the most important features of the blue-green structure are: the river Venta and its tributaries: Alekšupīte and Krāčupīte, as well as Pārventa Park, Mārtiņšala, Mākslas dienu Park and the latest of the sites - the left-bank path of the river Venta;
- The area of the study is one of the richest and most interesting areas in Latvia in terms of natural and cultural heritage landscape elements. The most important objects:
 - geomorphologic natural monument “Ventas rumba” – the largest waterfall in Europe (width 240 m, height 1,8-2,2 m);
 - steep bank “Melnā Kolka”;
 - State protected cultural monuments:
 - urban building monument “Historical Centre of the city of Kuldīga” (date: 13th -19th century);

- archaeological Monument “The Old city of Kuldīga”;
- architectural monument “Red brick vault bridge” (date: 1874),
- archaeology Monument “Veckuldīga castle mound and the Old Town”;
- The territory, buildings and objects of the UNESCO World Heritage Latvia's national list of the “Kuldīga (Goldingen)”:
- architectural monument Red brick vault bridge (date: 1874);
- Venta Canal (date: 17th-19th century);
- Alekšupīte fall – the highest waterfall in Latvia, height 4,15 m;
- Venta fall – the largest waterfall in Europe (width 240 m, height 1,8-2,2 m);
- historic sites and objects:
- Duke Jacob's channel is also known as the Venta canal;
- former berth;
- former ferry;
- veneer factory “Vulkāns”;
- Accessibility of the site in the context of tourism and recreation infrastructure:
- walking path of Pārventa Park (0,8 km);
- Mārtiņšala nature walking path (1 km);
- the left bank path of the river Venta (2,4 km);
- cycling route (area crossed by the E11 European route);
- the Mārtiņšala bathing place with a Blue Flag certificate;
- “Vikingu placis” fire place.

The recognition of the city is also increased by the fact that the development in this area is oriented towards tourism, incl. the organization of beautiful and traditional and well-attended events, recreation based on natural and cultural heritage, the unifying framework of which is the landscape of the Venta river valley.

Changes in the landscape

The landscape is in continuous variability and development, its nature is based on natural conditions (the river Venta valley with slopes) and interaction between human activities (urban formation).

The initial objective of the establishment of a nature reserve was to ensure the protection of specially protected species and habitats, the preservation of landscapes typical of the territory, as well as the protection of natural and cultural monuments, while maintaining the area for visitor recreation, education and sustainable management. Therefore, the main directions of the territory development - protection of values and development of tourism and recreation are topical and dominate in the research territory also in today's situation.

The management of the open landscape on the banks of the Venta river from traditional agriculture, which was linked to economic objectives such as haymaking or grazing, has changed and is based on nature conservation objectives. The management of the site may be based on ensuring the transparency of the landscape, protecting, preserving or enhancing its aesthetic and landscape values in the context of tourism and recreational objectives, thus seeking new ideas and solutions to preserve and maintain the significant and distinctive features of the natural landscape and human activities.

The most significant changes in construction can be seen along the left bank of the Venta in the section from the old bridge to the new bridge, where the transformation of the agricultural landscape into urban land is observed. Initially, the city's buildings were located on the left bank of the river, slowly expanding along the river bank in a northerly direction. From the 19th century, on the other hand, with the development of industry, the city has expanded and buildings have been located in the city's pastures. Also in the post-war period, the cities boundaries have changed significantly - previously undeveloped agricultural land has been excluded from the city territory, but residential buildings on the right bank of the Venta have been included in the city territory.

Landscape changes have also affected the Venta river, as changing economic conditions (types of use and management of the Venta river and its banks in the pilot area and also outside it – upstream of river) have promoted vegetation formation in the river, promoting coverage of aquatic plants of the river. Thus, today the presence of a water element in the landscape is much less pronounced compared to the situation observed in the 20s - 30s in the 20th century. Coverage of aquatic plants with surface plants is characteristic for the river in the whole study area. The highest degree of coverage of aquatic plants - in the section upstream and downstream of the Venta fall. The high degree of coverage of aquatic plants of the river creates a visual effect that the meadow landscape seems to expand, but thus the water element in the landscape is lost.

The outline of the Venta fall has been influenced by both natural processes (flood streams, ice flow) and human activities (rafting, timber floating, systematic cleaning of the river to improve navigation conditions, etc.). Today, the outline of the Venta fall changes minimally, it is mainly influenced by geological processes. Depending on the amount of water in the river, the dolomite waterfall wall may be completely or partially covered with overflowing water. Dolomite outcrops (vertical walls) can also be seen along the riverbed downstream. Dolomite outcrops are a habitat of European Union importance, they have scientific and landscape (aesthetic) value.

Analysis of visual perception of spatial composition

The analysis of the visual perception of the spatial composition evaluates the view perspectives, the silhouette of Kuldīga Old Town and the most significant viewpoints and perception areas in the pilot area and its visual perception area, which includes Venta water area, riverbank and its panorama with exhibited objects (vertical dominants and urban design).

Silhouette and panorama

The panorama and silhouette of Kuldīga Old Town - the historical center of Kuldīga - are unique values that form the image of the city. The panorama and silhouette of the Old Town are well visible in the views from the right bank of the Venta. Venta riverbanks are terraced and undeveloped, therefore the variety of views and angles is diverse. The panorama and silhouette of the left bank of the Venta is dominated by the landscape of the Venta river valley with a water mirror and floodplain meadows, steep banks, the Venta fall and Alekšupīte with its waterfall and as well low-rise historical buildings. In the linear composition, some vertical accents - church towers - stand out. The elements and structures of nature are mainly exhibited in the panorama of the right bank. The most expressive and characteristic node is the surroundings of the old bridge with a bathing place “Mārtiņsala” and Pārventa park on the right bank, Venta fall and Alekšupīte waterfall, and the construction of Kuldīga Old Town on the left bank of the river.

The panoramic and urban skyline of the old and Venta river is a vivacious and culturally valuable area and forms the identity of the site, as well as a basis for the development of tourism and recreation.

The most important viewpoints, view perspectives and other elements of perception of urban composition

In order to preserve and increase the landscape values in the pilot area, the most significant viewpoints have been identified, from which the panorama of Kuldīga Old Town buildings and/or the panorama of the Venta riverbank opens.

The study identifies the most important existing viewpoints - places in public space or simply publicly accessible places for observing the landscape in the Venta valley, which are essential to capture the overall panorama and silhouette of the city. Viewpoints are an area of a few square meters that offers a wide, expressive and engaging view from above ground. The viewpoints are visited specially to enjoy this view and are a resource for recreation and tourism.

View perspectives (directions to important objects and territories) are also shown graphically. Most of these directions are from one river bank to the other. The unique place is the red brick vaulted bridge, which overlooks the river and both banks. In addition to viewpoints (the most important viewpoints) and directions, other elements important for the exhibition and visual perception of the urban composition have also been identified and highlighted in the analysis.

The elements of Kuldīga spatial composition and its perception detected in the analysis can be considered as values that should be preserved as important components of the landscape and should also be included in the perspective structure of the public space.

The diversity of the landscape, which includes a set of natural and cultural values, determines that the landscape of the Venta River Valley is one of the most unique and outstanding landscapes in Latvia in terms of visual aesthetics.

4 Proposals for the development of the Venta river and its riverbanks

Based on the research and analysis carried out in the study area, proposals have been prepared for the development of the Venta river and its banks in the urban environment, balancing the aspects of nature, cultural heritage and landscape, tourism and recreation.

Proposals are prepared in the following areas:

- freshwater, grassland and forest habitat management, including:
 - measures for the management of grasslands and forest habitats;
 - reduction of the degree of river coverage of aquatic plants, recultivation of streams, cleaning of the bed;
 - protection and management of specially protected and rare plant species;
 - measures to restrict invasive species;
- management of stormwater drainage systems;
- maintenance of the landscape and creation of the riverbank silhouette
- proposals for the further studies.

Management of the freshwater, grassland and forest habitats

Management measures of the habitats of the European Union importance in the study area are divided into two groups: restoration measures and maintenance measures.

The following main measures are recommended for the restoration of protected grassland habitats: trees and shrubs cutting, limiting the spread of invasive species, reducing soil fertility, limiting the spread of expansive species, grazing or mowing, and for their maintenance - extensive grazing and mowing. The main measure for the maintenance of protected forest habitats is their non-management and natural development.

For maintenance of the freshwater habitat 3260 *Water courses of plain to montane levels with the Ranunculion fluitantis and Callitriche – Batrachion vegetation* it is recommended to do regular mowing of aquatic plants using manual or tractor equipment.

To reduce the anthropogenic impact to prevent the input of additional nutrients (mainly phosphorus and nitrogen compounds) or hazardous chemicals into the Venta, there are:

- 1) the inflow of domestic or other sewage (for example, containing oil products) into the river from drainage or rainwater collection system must be prevented;

- 2) research of potentially polluted sites in the territory of the former factory “Vulkāns” shall be prepared and, if necessary, in accordance with the requirements of regulatory enactments - monitoring or remediation;
- 3) shaving areas (former factory “Vulkāns”) on the riverbank should be recultivated, covering them with a substrate that would limit the spread of pollution.

In order to protect the localities of specially protected and rare plant species and to plan appropriate management, it is necessary to make an inventory of all localities and specify their actual boundaries.

In order to promote the conservation of biological diversity, the study area should be restricted to invasive tree plants (ashleaf maple *Acer negundo*) along the Venta left bank path and in the vicinity of Veckuldīga castle mound, as well as herbaceous plants (Indian Balsam, Canadian Goldenrod and other species) in grassland habitats, along the Venta left bank path and elsewhere.

Management of stormwater drainage systems

The integration of SUDS elements into the urban environment provides an opportunity to reduce the risk of flooding of areas during heavy rains, relieving conventional networks. The main goal of green solutions is to reduce surface water runoff from areas in a cost-effective way, bringing it closer to the natural situation when stormwater returns to the natural cycle (entering groundwater or surface watercourses and water bodies) and there is no constant need to discharge large amounts of stormwater from areas. This minimizes the risk of flooding associated with stormwater. In addition, these solutions also reduce stormwater pollution, ensuring that environmental quality objectives are met.

When developing projects that intend to integrate green solutions in specific areas, it is necessary to involve not only engineers who perform calculations to determine the necessary technical parameters (e.g. volume) of green solutions and their connection with existing conventional stormwater networks and their capacity at appropriate rainfall intensity, but also landscape architects to make these solutions as easy to manage as possible and to look attractive even in waterless periods. Taking into account the results of stormwater drainage system modeling, it would be possible to decide in which parts of Kuldīga city priority should be made improvements

to the stormwater drainage system to prepare for rainfall with a probability of at least once every 2, 5 or 10 years and preferably less frequent rainfall - even once a hundred years.

Cleaning of riverbank vegetation, exposing the landscape and creating riverbank silhouettes

Suggestions and recommendations for further action have been developed:

- 1) The existing most important viewpoints that are a recreational and tourism resource and are included as components of the nature trail or old town sightseeing tourism offer have been distinguished. In order to better display landscape values and emphasize that the path is placed along the riverbank and in order to maintain or increase the aesthetic value of the viewpoints, they should be managed. It is also desirable to improve the level of amenities and accessibility of these viewpoints, for example, to provide the opportunity to sit down by installing comfortable benches to enjoy the view, increase the level of comfort, install a waste bin and bicycle stand, etc.
- 2) It is recommended to expose the views with the gentlest methods possible, preserving the naturalness of the landscape. In these cases, the presence of a landscape architect or dendrologist is recommended (if necessary, a geologist as well) to evaluate the most suitable methods for forming trees and shrubs for each site to reveal the view. For a partially obscured view, it is recommended to use the technique of raising the height of the tree crown, or selecting individual branches to be cut.
- 3) In order to reduce or prevent the risk of erosion during and after trees cutting, it is recommended that operations be carried out gently and gradually over a number of years, cutting a small number of trees and shrubs each year and strengthening ground cover vegetation if necessary. It is desirable to preserve the largest trees, the root system of which helps to strengthen the river slope, preventing the formation of landslides. In this way, there would be no drastic change in environmental conditions, contributing to changes in ground cover vegetation.
- 4) In order to more fully exhibit the scientific and aesthetic value of dolomite outcrops, it is recommended to cut new trees in the dolomite outcrop wall below the Venta fall (on both sides).

Further research

Based on the information and conclusions of the study, this section provides suggestions for further research:

- 1) Research in the field of engineering geology, mapping - research content, scope, cooperation opportunities
- 2) Study for the assessment of fishery resources
- 3) Modeling of stormwater drainage system

5 Recommendations for study on the development of rivers and riverbanks in the urban environment

Recommendations for similar research for the development of rivers and riverbanks in the urban environment have been developed based on the research carried out in the pilot area and the experience gained.

A similar study using the research method of this research is possible in other cities with similar urban planning situation:

- small or medium-sized town;
- historic urban environment;
- the city is crossed or adjoined by watercourses.

The study covers the following topics:

- review and evaluation of different researches and studies conducted so far;
- review of the historical situation (period to be defined);
- changes in the landscape over time (definable period of time);
- geological, geomorphological, hydrogeological, engineering geological characteristics, exogenous geological processes;
- hydrological characteristics of the river;
- flood risk analysis (if applicable) or stormwater system characterization and problem definition;

- description of the ecological status of the river;
- characterization of ecosystems and natural values, ecosystem services;
- landscape characteristics (the area to be considered).

Study development stages

Preparatory phase. In order to carry out a similar study in terms of content, it is necessary to define the existing problems in the urban environment, which are related to the use of rivers and riverbanks or to the study area. Define the aim of the research and set tasks, indicating the results to be achieved.

Initial phase of study. At this stage, it is necessary to identify the areas in which the study requires the involvement of experts, as well as the main sources of information and data holders. When planning the involvement of experts, it is necessary to develop the terms of reference of the expert, the content of the deliverables - the expected result of the work. Before starting work for a successful work organization, it is advisable to provide a joint meeting of the experts involved to prepare a timetable that clearly indicates the stages of the study and their interrelationships, indicating each expert's involvement, specific tasks and expected results at each stage. At the start-up stage, the content of the required information, the way to obtain it, the formats and the division of responsibilities for collecting, analyzing and processing the information have to also be agreed with the experts.

Carrying out the research - summarizing the current situation consists from elaboration of the united graphic design platform/database, such as ArcGis, which is accessible to all experts involved and to the client and serves to gather and analyze information. Depending on the structure and volume of the input data available to the researchers, sufficient time for data collection, analysis and processing should be planned. Data and information sources in each country can differ. In the case of Latvia, they are at least: data and information of information systems and archives managed by state institutions, information on research carried out in the territory and relevant graphic materials, data obtained within the state water monitoring program: hydrological, physico-chemical and biological quality data, information on natural values, specially protected nature territories and cultural monuments, reviews of previous projects or studies, reports or reports, as well as other information.

Carrying out research - developing solutions. Based on the prepared conclusions, a section of solutions and proposals is developed.

Research results and next steps

Research results and next steps. At the end of the study, a large amount of data is collected and processed. In order to maintain the continuity of the research and continue the updating of the collected data, it is necessary to develop and maintain a data management system. The database should contain layers of information, including: geology, geomorphology, hydrogeology, nature values, ecosystem services, landscape layers, polluted and potentially polluted sites, degraded areas and sites, effluent discharges, pollution sources, etc.

The main groups of measures to ensure management are:

- determination of responsible local government authority for the implementation of the study;
- attraction of financial resources for the implementation of specific projects;
- further planning, such as the development of a thematic landscape plan, the development or renewal of a nature protection plan;
- development of construction (improvement) plans;
- coordination and organization of the implementation of the planned measures: in revealing views, habitat management, attraction of specialists, creation and maintenance of facilities;
- cooperation with stakeholders, incl. coordination with state institutions (in the case of Latvia - the Nature Conservation Agency, The State Environmental Service of the Republic of Latvia, the National Cultural Heritage Administration), non-governmental organizations, landowners;
- regular accounting of the measures taken, compilation of results, evaluation of results - monitoring. If necessary, adjust the content of future measures.

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