Kartografické listy / Cartographic letters, 2025, 33 (2), 59-80

OLD MAPS AND SPATIAL PLANNING – POSSIBILITIES AND LIMITATIONS OF THEIR USE ON THE EXAMPLE OF THE ELBE RIVER NEAR LYSÁ NAD LABEM (CENTRAL BOHEMIA)

Eliška COUBALOVÁ

Old maps and spatial planning – possibilities and limitations of their use on the example of the Elbe River near Lysá nad Labem (Central Bohemia)

Abstract: Until the 1930s, the Elbe River near Lysá nad Labem meandered, creating side arms that eventually became blind. The surrounding landscape was therefore threatened by flooding, partly due to the shallow depth and shape of the riverbed. However, during the period in question, the river was made navigable, i.e., straightened and deepened, and the danger of high water was thus eliminated to a certain extent due to the faster drainage of water caused by the modification of the shape and depth of the riverbed. The aim of this paper is to clarify how the landscape around the Elbe and the shape of the riverbed itself changed from the 18th to the first third of the 20th century, and to identify the extent to which the flood areas of selected episodes of high water extend into parts of the former riverbed and how an spatial plan reflects these potentially endangered areas. An author also attempts to answer the question of the extent to which old maps and illustrations depicting Lysá nad Labem and its surroundings are usable for the creation of the current spatial plan. The text also reflects on the methodology of working with these old maps in the ArcGIS Pro environment. Furthermore, the author attempts to determine the extent to which the spatial plan works with information they provide and what possibilities there are for their use in current spatial planning.

Keywords: Lysá nad Labem, spatial plan, landscape transformation, Elbe floodplain, Military Survey, flood maps, 18th century

Introduction

The Elbe River meandered in its middle course until the first third of the last century, then its bed was navigable by anthropogenic intervention, or rather straightened and deepened to its present form. This intervention reduced the risk of flooding, but also significantly affected the character of the original landscape, in which side and later blind branches formed naturally before this intervention. The area between Lysá nad Labem, approximately 12 km long, which was delimited in the north-south direction by the river floodplain, approximately two kilometres wide, was selected for the study.

In the area thus selected, there are areas that are potentially threatened by waves of n-year waters. The aim of the work is to use the example of the cadastre of the town of Lysá nad Labem to determine what form these potentially risky areas had in the High Modern Age, how the current spatial plan views them, and to what extent information from old maps was reflected or taken into account when creating it.

Iconographic and cartographic sources were used to elaborate the topic. The approach to their elaboration varied depending on their nature. They were described in terms of content, critically evaluated, and their limits for elaboration were also commented on.

Mgr. Eliška COUBALOVÁ, Katedra historie, Filozofická fakulta Univerzity Jana Evangelisty Purkyně v Ústí nad Labem, Pasteurova 13, 400 96 Ústí and Labem, e-mail: coubalovae@gmail.com

Apart from that, they were also processed in the environment of geographic information systems (GIS). For the purposes of reconstructing the shape of the riverbed and the surrounding landscape and subsequent comparison with the spatial plan, individual cartographic and some iconographic sources were compared with the current base map (and later the spatial plan) using the georeferencing method using the so-called identical points and were thus assigned geographical coordinates (Tuček, 1998). Subsequently, the selected elements were processed (vectorized) using layer editing, or outlined and analysed in the form of reconstruction maps, i.e., using the method of gradual interpretation (Skokanová, 2008).

The issue of using old maps for spatial planning is also addressed in numerous professional literatures. In general, this literature considers old maps to be a useful source of information for spatial planning. On their basis, it is possible to understand the development of the landscape of a given area, identify important landscape elements and also plan the treatment of a certain area and its protection and restoration. Authors are aware not only of the potential of these sources, but also of the limits of their use. According to some opinions, Military Survey maps can serve as a suitable basis for assessing the development of macrostructures of a given landscape (Skaloš, 2011).

Military Survey maps are particularly suitable for this purpose, as they allow monitoring changes in the morphostructure of the landscape and trends in its development. They can also serve as a source of information about the nature of land use in the past (Forejt, Dolejš and Raška, 2018), and they can also provide evidence of the existence of individual ecosystems in the landscape and their possible transformation due to human activity (Forejt et al., 2020). These can also include water areas (O'Hara et al.,2024), e.g., wetlands, rivers, ponds or blind river branches, and their emergence or disappearance can also be identified using old maps.

Comparing old maps with current ones in a GIS environment allows us to monitor landscape development over longer time horizons. Their use brings with it a number of advantages, but it also has several limits. Some of them do not have a geographic network and their processing in a GIS environment is very complicated and can yield distorted results.

It can therefore also be used to understand how changes in land use shaped the dynamics of floodplains and affected flood risk. In order to capture these facts, these old maps were analysed, for example, over orthophotos and satellite images, and changes in land cover were subsequently determined (Skaloš et al., 2011; Mäyrä et al., 2023). In the Czech Republic, this issue of land use is addressed, among others, by Ivan Bičík (Bičík, Jeleček and Štěpánek, 2001; Bičík et al., 2015).

Land cover as such has an impact on the infiltration capacity of the landscape, the speed of flow and water runoff, and also on the potential siltation of the riverbed (Sugianto et al., 2022). According to some authors, urbanization, the expansion of agricultural areas and the loss of natural vegetation increase the risk of floods, further causing faster water runoff from the landscape and changes in the form of riverbeds. The risk of floods also increases when there is an effort to isolate the watercourse in connection with urbanization or town development (Apollonio et al., 2016). According to some opinions, afforestation and soil protection can help reduce the intensity of floods (Labat, Rattayová and Hlavčová, 2018).

1. Data and methods

Iconographic and cartographic sources were used for the elaboration. Of the iconographic sources, the so-called topographic-panoramic copper engravings from 1712 (Vogt, 1712), 1717 (Rentz, 1717) and 1720 (Rentz, 1720) (Fig. 1a, b, c) were used, which depict Lysá and its immediate surroundings, including the Elbe River and to a certain extent also take into account the landscape cover. However, the area depicted by them does not coincide with the defined area, or rather, they do not capture the area of Čelákovice and Mydlovarský luh.

These images are more or less schematic in nature. They can only be processed to a certain extent in the ArcGIS Pro environment. They depict the Lysá manor from the south and southeast, distorting the distance of some landscape elements, and thus complicating or, to a certain extent, making processing in the aforementioned software impossible.

A specific source for the 18th century is the map of the Lysá manor from 1752 (Mapa panství Lysá nad Labem, 1752; Fig. 2). It shows the entire studied area, the river as such, and also shows much more detailed information about the landscape cover in its surroundings (which is, in addition to the previous engravings, coloured and provided with a detailed legend).

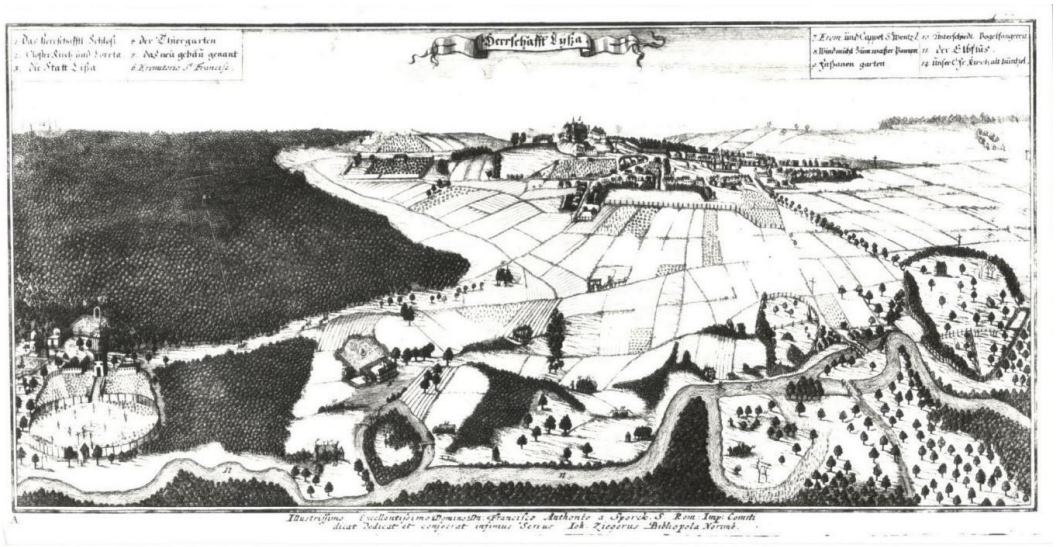


Fig. 1a The observed riverbed in topographic – panoramic copperplates engraving and depictions from the 18th century: copperplate engraving from 1712 (Vogt, 1712)

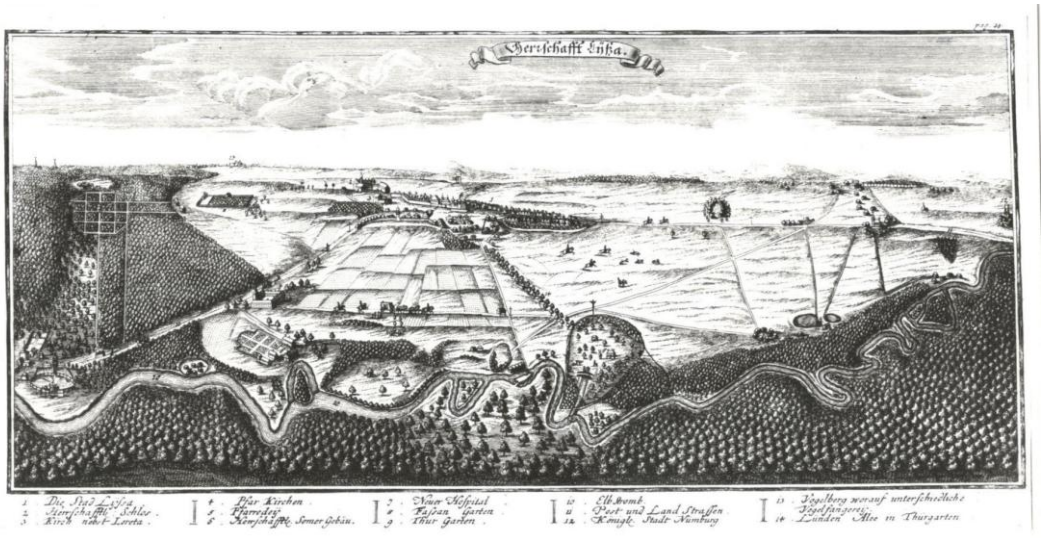


Fig. 1b The observed riverbed in topographic – panoramic copperplates engraving and depictions from the 18th century: copperplate engraving from 1717 (Rentz, 1717)

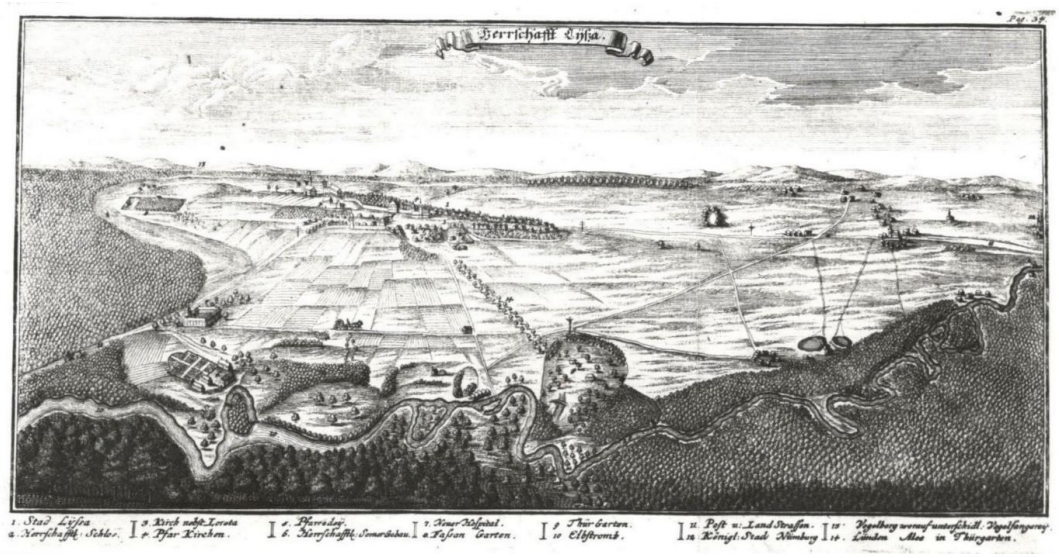


Fig. 1c The observed riverbed in topographic – panoramic copperplates engraving and depictions from the 18th century: copperplate engraving from 1720 (Rentz, 1720)

Fig. 2 Landuse in the Elbe floodplain on the map of the Lysá estate from 1752
(Mapa panství Lysá nad Labem, 1752)

The author also used cartographic sources. The 1st Military Survey (Charte antiquae, 2025a) was not very accurate, military officers carried it out "a la vue", i.e., "by eye", or without using a network of goniometric and trigonometric points. The maps pay attention to the river, but also, for example, buildings, mills, churches and agricultural crops, for which she distinguishes arable land, meadows or pastures. She also distinguishes, for example, types of forest. Except for the map part, this work also contains a so-called topographic description, which states, for example, the depth and width of the given watercourse, etc.

Working with the above-mentioned sources entails several inaccuracies. Engravings from the beginning of the 18th century provide a schematic view of the landscape of the Lysá manor. They show the types of landscape cover (forest, cultivated land or tree stands) in an approximate manner, and also capture the shape of the riverbed. Due to the absence of a mathematical basis, it is impossible to determine, for example, the area of these areas, the length of the river, and generally process these images statistically. Although the above-mentioned map of the manor is approximately 35 years younger than the analysed engraving, it provides more detailed information about the use of the local landscape. It reflects both natural areas and areas cultivated by man, and when processed in GIS, it is possible to determine their area, due to the existence of a map scale.

Some areas are drawn less accurately, but these are partial inaccuracies. Maps of the 1st Military Survey show the local landscape less accurately, in terms of its use, than the map of the manor. The categories of landscape cover are generalized. For example: cultivated areas are not distinguished into lordly and serf-owned, or in the case of meadows, dry and wet meadows are not distinguished. Due to the absence of a mathematical basis for this mapping, it is not possible to determine their exact area (or in the case of a riverbed, its length, width, etc.). The maps of this mapping also, due to the nature of their creation, distort the shape and location of some of these landscape elements. These inaccuracies can also distort any statistical evaluation.

These inaccuracies must be taken into account, for example, when comparing the shape of a riverbed or other surfaces. In the case of springs without a mathematical basis, there may be shifts in position or distortions in the shape of their individual parts, which can complicate the identification of, for example, partial river branches. Therefore, the results of the reconstruction of the course of the historical riverbed are interpreted cautiously and are supplemented with more accurate cartographic sources, such as the 2nd Military Survey (Charte antiquae, 2025a) or maps of imperial imprints of the Stable Cadastre (Archiválie ÚAZK, 2025).

Maps of the Stable Cadastre were published for Bohemia in 1826–1843 and for Moravia and Silesia in 1824–1836. The Habsburg state carried out mapping based on cadastral maps in order to find other potential sources of taxes. (Švejda, 2016). The 2nd Military Survey (also František's from 1836–1852) was created at a scale of 1: 28,800. In contrast to the 1st Military Survey, a triangulation network was already used here, and the mapping was more accurate. It was based on the maps of the Stable Cadastre, which were created at a scale of 1: 2880. In terms of content, the maps of the 2nd Military Survey were the same as those of the first military mapping, with the difference that height information were added. General maps on a scale of 1:288,000 and special maps, which were created on a scale of 1:144,000, were also derived from this mapping (Švejda, 2016).

The Elbe flood maps date from 1885–1901 (Záplavové mapy, 1885–1901) show the shape of the Elbe riverbed, the surrounding landscape, but also anthropogenic interventions in the course of the river (canals) or the surrounding infrastructure (bridges). What is interesting about these maps is that they are oriented to the south. They are available in the Elbe River Basin archive in Hradec Králové.

Floodplains were delineated based on pedological (Czech Geological Survey, 2025b) and geological maps (Czech Geological Survey, 2025a), as well as maps of biotope formation groups (AOPK ČR, 2025). Another source for delineation was the Digital Water Management Data Base project (VÚV TGM, 2025). It contains polygons depicting areas of five-year, twenty-year and hundred-year waters, as well as the floodplains of the largest recorded natural floods. These documents were processed in the environment of geographic information systems. In order to reconstruct the appearance of the riverbed and the surrounding landscape and subsequently compare them with the spatial plan, individual cartographic and some iconographic sources were compared with the current base map (and later the spatial plan) using the georeferencing method using the so-called identical points and were thus assigned geographical coordinates (Tuček, 1998). Using the method of gradual interpretation (Skokanová, 2008), the selected elements were vectorized and analysed as reconstruction maps. The data obtained in this way (e.g., on the area of individual areas) were then statistically evaluated (e.g., using the change index and compared between individual periods). The maps were processed in the S-JTSK Krovak EastNorth coordinate system. The S-JTSK Krovak to WGS 1984 transformation was used. The transformation and vectorization were performed by the author.

2. Study area

The study area is the Elbe floodplain extending from the town of Čelákovice to the Mydlovarský luh nature reserve. The boundary of the floodplain (Fig. 3) was defined on the basis of pedological, hydrological, and biotope formation group maps, not, for example, flood barriers.

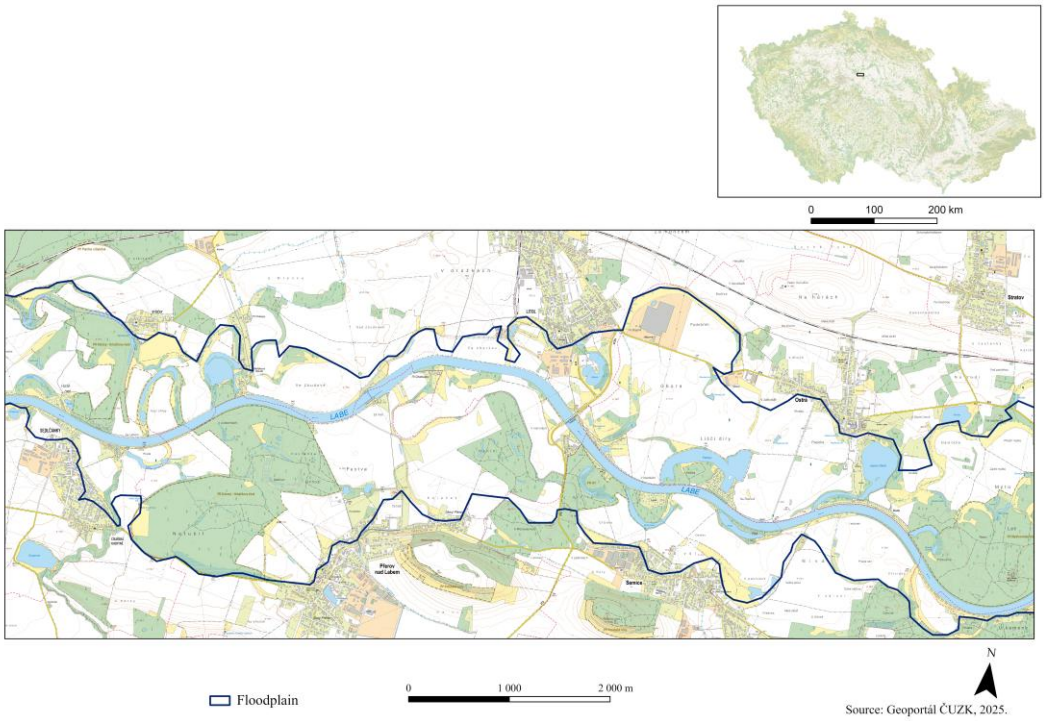


Fig. 3 Study area (authors' own processing)

A Soil map (Česká geologická služba, 2025b), Geological map (Česká geologická služba, 2025a) and a Map of Biotope Formation Groups (AOPK ČR, 2025) were used to define it. In them, the floodplain fill was monitored and its boundary was determined as the interface between this fill and the surrounding different conditions. The course of the floodplain boundary is identical on all three maps, except for some details.

Geologically, the floodplain is mostly made up of fluvial clayey sands and sandy gravels. In the peripheral areas, loess and loess clays can also be found, as well as humus deposits and organic sediments in areas of former river meanders.

From a pedological point of view, the floodplain is mainly made up of alluvial soils and also alluvial gley and gley soils. Gley soils lie at the edges of the floodplain and alluvial gleys form a mosaic with the alluvial ones. From a vegetation point of view, the floodplain is made up of floodplain forests, oak-hornbeam forests, wetlands and meadows. However, its territory is largely affected by anthropogenic activities, or rather transformed into agricultural areas (Fig. 4).

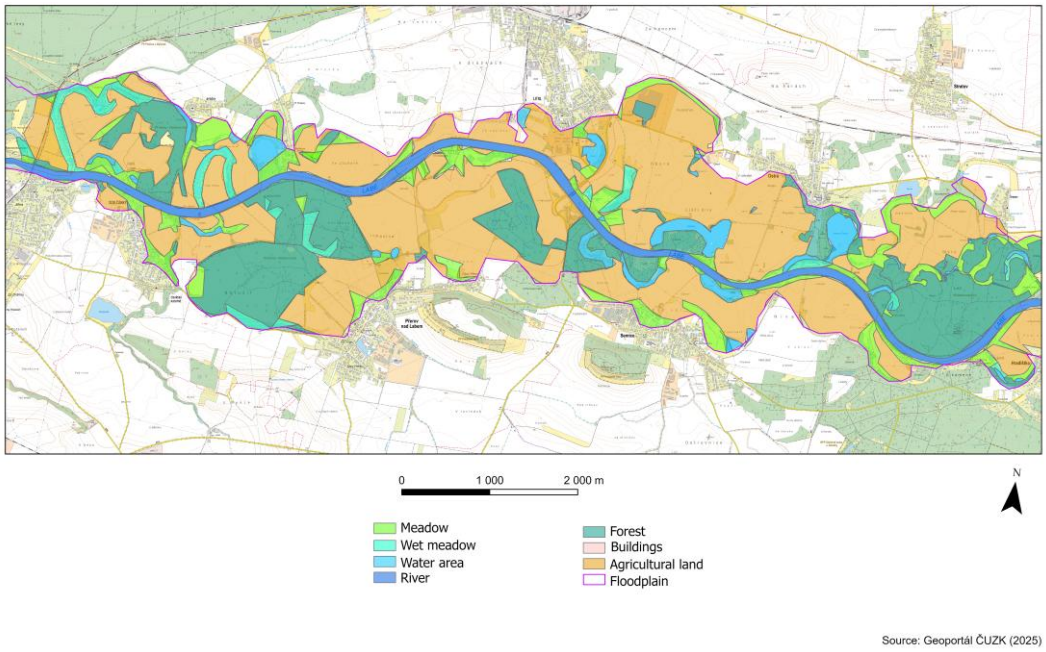


Fig. 4 Landuse in the Elbe floodplain today (authors' own processing)

This is the middle reaches of the Elbe River. It is an area with variable energy, where erosion and sedimentation processes take place, as well as the transport of small material. The river also slows down, the riverbed widens, and in the past it meandered.

The Elbe floodplain also features a number of meanders that may be older than the riverbed shown in the illustration. Dating them based on a digital terrain model and fieldwork would be a matter for further research. The author has already done this in part in her thesis on the Mydlovarský luh site (Coubalová, 2022).

The long-term average flow rate at the station in Brandýs nad Labem is 102.9 m^3/s (PLA, 2025b). The three largest floods since measurements began at this station were on March 11, 2000, with a flow rate of 1020 m^3/s, January 30, 2002, with a flow rate of 840 m^3/s, and April 3, 2006, with a flow rate of 1030 m^3/s (PLA, 2025a).

The river was modified to its current form in the 1920s and 1930s. The river between Litol and Ostrá was regulated between 1919 and 1923 (Bauer, 2005). The regulation of the middle Labe took place irregularly and in several stages. For example, in the third phase, the locks at Lysá nad Labem were completed in 1933, those at Brandýs nad Labem in 1936, and those at Čelákovice in 1937 (Čelákovice, 2025).

3. Results

3.1 Transformation of the river landscape around Lysá nad Labem from the 18th to the first third of the 20th century

From the first quarter of the 18th century there are topographic-panoramic copper engravings (Vogt, 1712), depicting the appearance of the Elbe River and its surroundings, but not the entire area. The flow near Čelákovice is not depicted, the copper engravings end at the hermitage near St. Wenceslas (3 km west of the present town centre of Lysá nad Labem). In addition, the copper engraving from 1712 depicts the area from the hermitage to Obora near Ostrá.

In the western part of the area, from the hermitage to Obora in Ostrá, the compared engravings show a similar course of the river. The river flowed around the hermitage, i.e., significantly further north than today. From it to the east there are bends and meanders, e.g., in the area of Řehákova tůně, Tři Chaloupky and the Hanín meadow, where a meander apparently formed. It could have been later stopped by a direct flow. The engravings show both the meander and the direct flow, as active parts of the flow. Southeast of Litol Mršník, an alluvial island is visible and east of it the Litol meander (Fig. 1a).

The eastern part of the Obora in Ostrá is depicted in engravings from 1717 and 1720 (Rentz, 1717; Rentz, 1720). From Obora to Mydlovarský luh we observe further bends and at Mydlovar Castle there is a distinct S-shaped meander. The river is probably bordered from the south by floodplain forests and from the north by a mosaic of agricultural and forest areas (Fig. 1b).

On the map of the Lysá estate from 1752 (Mapa panství Lysá nad Labem, 1752), the river situated similarly to the previous period, albeit with some changes. These are most noticeable between the Řehačka meander and the Litol – Mršník. The Řehačka meander was closed, a large arcuate meander in the southern part of the Litol disappeared, an alluvial island near Litol and a branch split off north of the Litol meander, which led towards Obora, one of its branches split off south of Litol and flowed towards the south. The flow continues to twist towards the east and in Mydlovar an S-shaped meander is again visible. This image also shows the Elbe tributary Vlkava and the Farský stream, flowing into the Elbe at Mydlovarský luh.

The map also shows the surrounding landscape in great detail. Apart from this, the ownership of individual plots is also distinguished. The largest area is occupied by agricultural areas (about 58% of the estate area). They extend north of the river and are interwoven with roads that pass to the south. Most of them are serf lands, which occupy approximately 10 times the area of the manor lands.

The southern part is filled with forests, meadows and pastures. Floodplain forests are located in the southeast of today's cadastre (Mapa panství Lysá nad Labem, 1752). At first glance, pastures are the dominant component of the river's surroundings. In total, these permanent grasslands make up 21% of the area, or meadows less than 6%, i.e., they occupy less than a third of the pasture area, which represents around 16% of the total area of the area. It is located, for example, south of Řehačka, further south of Tři Chaloupky or in Litol, while in the place where it is separated from the main riverbed by a branched branch, the landscape is created by meadows and floodplain forests.

The area around Ostrá is similar to that of Litol. A strip of forest areas crosses here from the west, south of them were the manorial and serf agricultural areas, and immediately next to the river there are pastures covered with trees. The landscape around Byšičky is also similar, consisting of manorial and serf fields, meadows and pastures.

The maps of the 1st Military Survey show both similarities and differences in the shape of the riverbed. Although they cover the entire area, they are much less accurate than the 10-year-old estate map. From Čelákovice the river makes bends. Between Byšičky and Čelákovice we see parallel branches that diverge from east to west. As in the previous stage, it is possible that the northern branch is probably older in terms of development, while the southern one may have arisen as a result of the natural straightening of the riverbed.

At the meander on the Řehačka, where its slight retreat compared to the 1950s is visible. In the area around Litol, as in 1752, the original southern semi-circular meander, which was still part of the active river flow in the 1820s, no longer exists. Its disappearance therefore probably occurred within a 30-year period.

In the vicinity of Mršník, the branch flowing towards the Ostrá game reserve also disappeared from the 1850s, from which there is no longer a branch flowing to the south and southeast. The western branch therefore remained, but only waterlogged areas and partial water areas remained from its former eastern part. The alluvial island in the riverbed, south of Litol, is also visible on these maps.

Several bends and meanders are shown in the direction of Mydlovar, similar to the map of the Lysá estate. West of the Mydlovar floodplain, an abandoned elongated meander is visible, which was part of an active stream 10 years ago. An S-shaped meander still exists near Mydlovar Castle.

This mapping shows the surrounding landscape cover less accurately. Although it is similar to the state on the map of the Lysá estate, the maps of this mapping (Server Laboratoř geoinformatiky, 2022a) generalize this information and do not provide as much detail about the use of the landscape around the river (see Fig. 11 and 12). In the 18th century, the river had a system of bends and meanders, some of its parts are similar, while others have changed significantly.

Maps from the 19th century were processed both descriptively and statistically, by evaluating selected parameters, such as river length, changes in the area of individual land cover categories, etc. These maps already have a mathematical basis, and therefore the measured lengths or areas can be credible.

On the maps of the 2nd Military Survey (Charte antiquae, 2025b) and imperial prints of the stable cadastre in the western part near Byšičky, the southern part of the arm disappeared, while the northern part remained. Towards the east, the retreat of the meander near Řehačka is visible, which roughly corresponds to the state on the maps of the 1st Military Survey. The area that the meander occupied in the 1820s is already shown on these maps as a waterlogged area surrounded by meadows and internal forests.

The surroundings of Litol have been preserved in a more or less similar form as on the 1st Military Survey, albeit with some differences. The original alluvial island remained in the riverbed, the partial arm of the Elbe no longer leads to Obora near Ostrá, and there are now waterlogged areas and residual water areas, which have decreased in size compared to the maps of the 1st Military Survey.

The eastern part of the studied area also looks similar to the 1st Military Survey. From Litol towards Mydlovar, both meanders have been preserved. However, changes have taken place on the Mydlovar floodplain. The s-shaped meander near the water castle has already been abandoned. The round and rounded shapes of partial areas of forests, meadows and waterlogged areas in this area evoke the existence of partial older meanders and bends. These are therefore probably several generations older, judging by the fact that they are dry and higher up.

At the turn of the 19th and 20th centuries, the riverbed changed slightly compared to the maps of the imperial prints of the stable cadastre and the 2nd Military Survey. Its shape remained similar, but the northern arm in the western part behind the meander at Řehačka is marked as dry. The section from Řehačka to Litol – Mršník remains similar to the maps of the 1st Military Survey, but 3 km west of the present-day Litol settlement, the meanders were probably accentuated.

The alluvial islands around Litol and the branch to the northeast of it are no longer shown on the maps. In the eastern section, the flow does not change much – both meanders exist around the village of Ostrá and in Mydlovar the S-shaped meander is still marked as closed, as is the elongated meander southwest of it. The riverbed is therefore, as in the 1960s and at the end of the 18th century, only some branches have dried up or been closed.

This situation was maintained until approximately the turn of the 1920s and 1930s, when the river was navigable by the river company. The flow was straightened (its length was shortened by about 8 km), the meanders were artificially stopped, thereby accelerating the outflow of water from the landscape and reducing the risk of floods. The change was accompanied by a decrease in meadows and marshes in its surroundings. Due to the influence of melioration, the area of agricultural land increased (Fig. 5).

3.2 Flooding in the floodplain through the eyes of old maps and current models (Povodí Labe, státní podnik)

These maps show the Elbe floodplain area, which in its shape and size (Fig. 6) corresponds to the extent of the flood of a 100-year flood. The maps also show, as mentioned above, that during the 19th century the river straightened and meanders gradually disappeared, especially in the Byšičky, Mydlovarský luh and Ostrá areas. Flood maps also confirm that floods most often spill into places where the river flowed in the past (Fig. 7).

Data from the DIBAVOD project (Digital Water Management Database) was also used for floodplain definition. The examined section of the floodplain is also largely filled by a 100-year flood, a slightly lesser extent the floodplain of a 20-year flood, and also the floodplain of the model of the largest natural flood (VÚV TGM, 2025).

Specifically, these were polygons showing areas affected by five-year, twenty-year, and hundred-year floods and a model of the largest recorded flood.

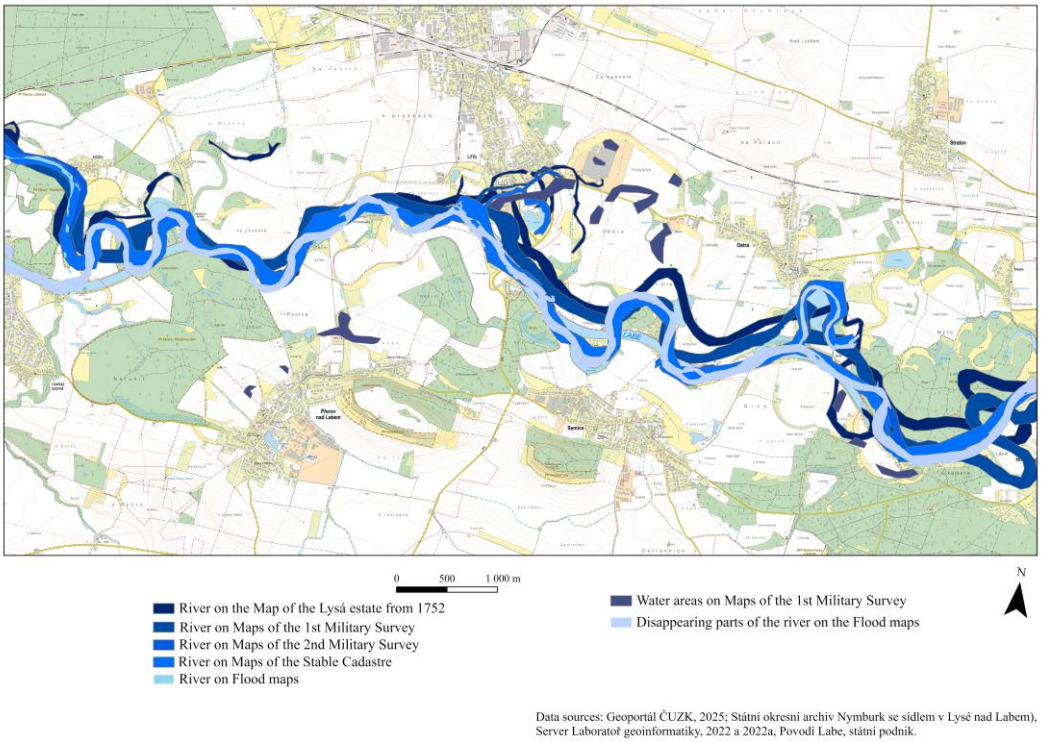


Fig. 5 The development of the riverbed shape and individual meanders (authors' own processing)

Fig. 6 The investigated section of the Elbe River floodplain on the Flood Maps from 1885–1901 (Povodí Labe, státní podnik)

In the case of the polygons mentioned for n-year floods, its boundary is understood as the design flood line for design floods with a periodicity of 5, 20, and 100 years. This is derived from the highest water level in individual watercourse profiles during a design flood, with its elevations determined by hydraulic calculation (according to the Ministry of the Environment decree pursuant to Section 66(3) of Act No. 254/2001 Coll.; VÚV TGM, 2025).

In the case of the floodplain of the largest recorded natural flood, the flood line corresponds to the highest level in individual profiles of the Elbe River during the largest recorded natural flood. The Elbe floodplain is then filled by the five-year flood area from 16%, the twenty-year flood area from 76.5%, the hundred-year flood area from 93.8%, and the largest known flood from 51.8%. The values were calculated as the ratio of the area of individual n-year flood areas to the area of the floodplain. It can therefore be seen that during floods, water can spill into places where the river flowed in the past, or rather floods former parts of its course (Fig. 8).

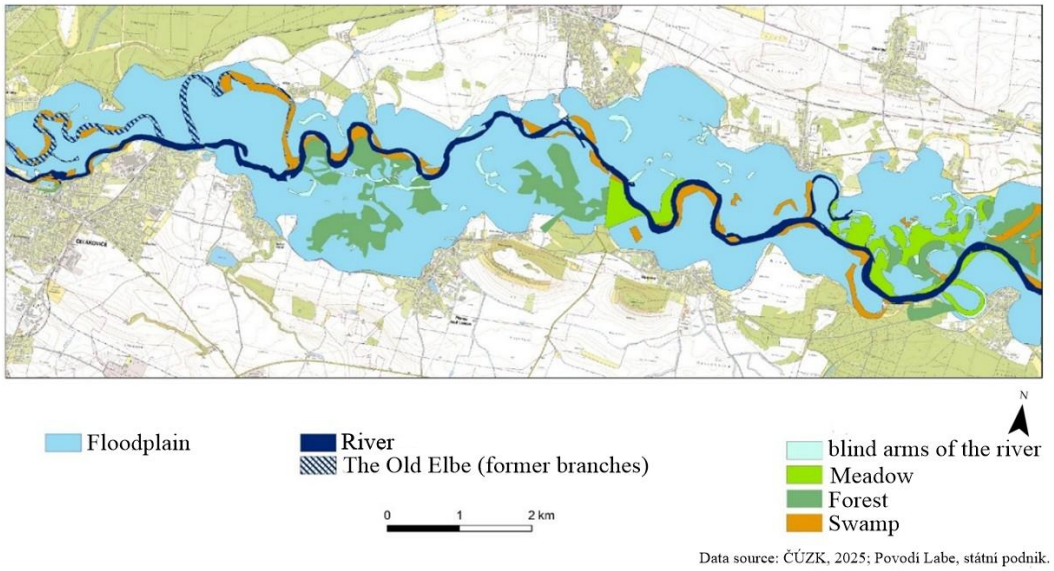


Fig. 7 Landuse in the Elbe floodplain on Flood maps (authors' own processing)

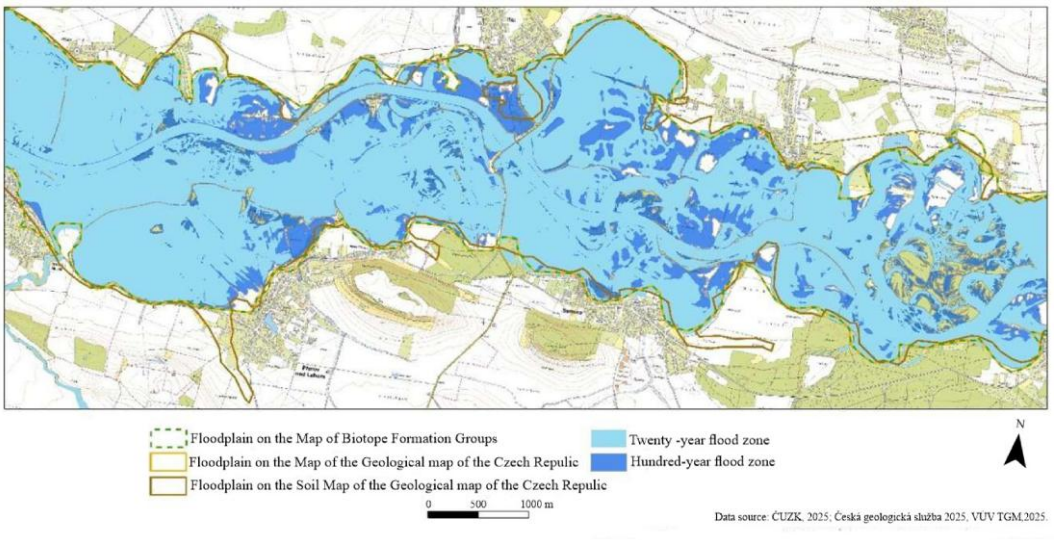


Fig. 8 Delimitation of floodplain areas using flood waves of n-year waters (authors' own processing)

3.3 The Elbe floodplain on old maps and the spatial plan of Lysá nad Labem

3.3.1 The Elbe floodplain in the spatial plan of Lysá nad Labem and Ostrá

From a geographical point of view, a floodplain refers to the floodplain of a given watercourse. According to the spatial plan of the town of Lysá nad Labem (Územně plánovací dokumentace ve Středočeském kraji, 2025a), this floodplain is located around the Elbe and is sometimes referred to as a "floodplain" plus the appropriate name of the locality. Taken from the west, it is the area of "Elbe near Čelákovice and Přerov", which extends from the westernmost border of the cadastre to the village of Byšičky and then continues around the remains of the riverbed to the old road from Karlov to Litol and then curves back to Byšičky. Another part of it is the area near the cadastre border called "Elbe floodplain near Semice and Ostrá", which is again tied to the former meanders of the Elbe. Furthermore, the floodplain includes areas located north of the riverbed and are intended, among other things, for water management.

The former Elbe meanders (Kozí Chlup, Řehačka or Mršník) are registered as water areas in the plan (Fig. 9). The western area around the Kozí Chlup area is listed as an undeveloped area, or rather a natural area. The central part, which stretches along the northern and southern banks of the Elbe towards Mršník, is then understood as an undeveloped zone, the significance of which varies locally. It plays the role of a protective area for water resources, generally a water management area, an area with nature protection and also an agricultural role (Územně plánovací dokumentace ve Středočeském kraji, 2025c). The shape of both of these areas is significantly asymmetrical and when compared with the maps of the imperial imprints of the Stable Cadastre and the 2nd Military Survey (see Fig. 13), it is clear that this is an area that was shaped by the river.

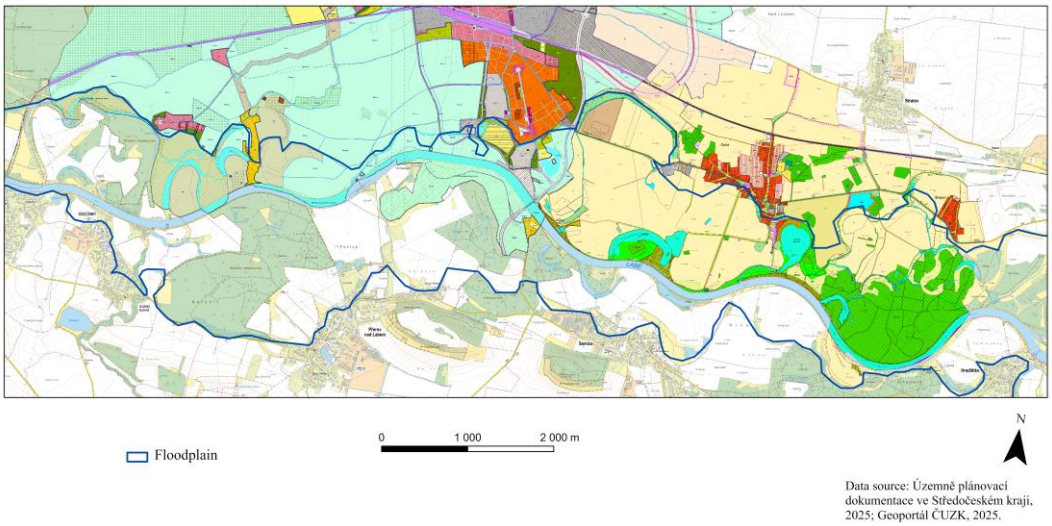


Fig. 9 Elbe floodplain within the spatial plans of the municipalities of Lysá nad Labem and Ostrá (authors' own processing)

The character of the floodplain areas in the cadastral territory of the municipality of Ostrá is different. Most of them are agricultural areas. In the south, similar to the cadastral territory of Lysá nad Labem, we find water areas that resemble the former meanders and bends of the Elbe River, namely Doubka, Ostrá Lake, Budské rameno, Bezednice, Králíček and Žitina. The last four mentioned are located in the Mydlovarský luh nature reserve in the eastern part of Ostrá. The nature reserve area is a natural area, similar to the eastern surroundings of the lake in Ostrá or the promontory of the former Doubka meander. The northern part of the floodplain is then additionally formed by built-up and recreational areas (Územně plánovací dokumentace ve Středočeském kraji, 2025b).

3.3.2 Analysis of three locations in the Elbe floodplain: comparison of old maps with the spatial plan and assessment of their usability

Three locations were included in the analysis: Homolka and Byšická tůň (marked with the letter A), Kozí Chlup and Řehačka (marked with the letter B), and the area from Tři Chalupy to Mršník (part C on the maps). They were selected because they are part of both the Lysá land registry and the Elbe floodplain, and in addition, they contain former meanders, i.e. areas potentially at risk of flooding (Fig. 10).

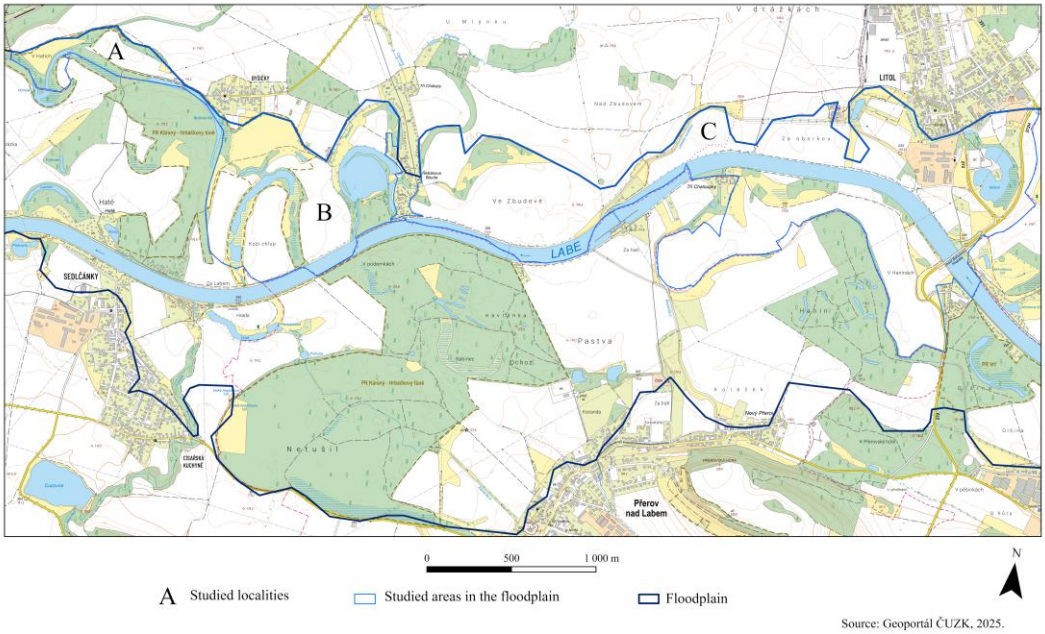


Fig. 10 Natural and undeveloped areas on the Lysá cadastre (potentially threatened by floods) (authors' own processing)

Homolka and Byšická tůň have retained the character of natural areas throughout the research period. The current spatial plan describes this area as also a natural area, with economic and agricultural potential. The surroundings of Kozí Chlup and Řehačka again show constancy in appearance and use. Old maps and the spatial plan reflect it as a mosaic of water and natural areas (Tab. 1).

A more or less permanent state of the landscape can also be observed in the central and eastern part of the analysed area (Tři Chalupy to Mršník), it consisted of agricultural areas, forests, meadows, characteristic of the river landscape. Flood maps say that this is an area potentially threatened by floods, the spatial plan designates it as a natural or undeveloped area. Therefore, certain similarities can be observed between the localities, which were probably related to the fact that they were all shaped by the river.

On the map of the Lysá manor from 1752 (Fig. 11), the river and forests predominate among natural areas, with the smallest areas occupied by woody plants. The serf fields reach a total area of approximately five times larger than the manor fields.

In comparison with the maps of the 1st Military Survey (Fig. 12), which are approximately 12 years younger than the estate map, there is a noticeable decrease in the area of the riverbed, by about one third. This is due to the disappearance of the side branch near Mršník. This disappearance explains the appearance of water bodies on the maps of the 1st Military Survey.

The representation of forests is approximately the same in both sources. Another significant change compared to the estate map is the almost twofold decrease in agricultural areas, which could be due either to their real disappearance or to inaccuracies in the drawing of the shape and areas of some areas. Meadow areas also decreased by approximately 20 percentage points (pp.). The maps of the 1st Military Survey distinguish between dry and wet meadows, and dry meadows are 2.25 times larger in area than wet ones. The appearance of wet meadows was probably also related to the disappearance of river branches.

Tab. 1 The appearance of natural and undeveloped areas potentially in the Lysá cadastre on maps of the second half of the 18th and 19th centuries

Localities	Map of the Lysá estate from 1752	Maps of the 1st Military Survey	Maps of the 2nd Military Survey	Maps of the Stable Cadastre	Flood maps	Current status (according to the Office of the Inspectorate)
A) Homolka, Byšická tůň	mosaic of meadows and water bodies; semicircular manor fields (old riverbed) near Byšičky; agricultural areas between forest belts	west of Byšičky: 1/3 wet meadows, 1/3 forests, 1/3 agricultural land	west of Byšičky: waterlogged areas and wet meadows	western edge near Byšičky: forests	from Byšičky to Mršník – floodplain; forests and blind branches; importance for defining the floodplain.	undeveloped area, area with natural potential; possibility of water management and agricultural use
B) Kozí Chlup, Řehačka	mosaic of meadows and water bodies	larger part of meadow, smaller part of wet meadow; the Elbe River flows through	south and east: forests, west: wet meadows; the meandering Elbe, the shapes of some meadow areas evoke the appearance of former Elbe riverbeds	mosaic of forests, meadows, fields	visible river's blind arms, swamps, forests.	mosaic of natural and water areas
C) Tři Chalupy to Mršník	Tři Chalupy: agricultural areas between forest belts; Litol – Mršník: mosaic of meadows, watercourses and trees	Tři Chalupy: wet meadows, forests, agricultural areas, Mršník: agricultural use, wet meadows, forests	undeveloped natural landscape, wet meadows, forests, river flow	natural character, but more detailed economic use	floodplain; emphasis on the course of the riverbed and blind branches.	Tři Chalupy: undeveloped natural area; Mršník: natural and recreational area, fishing, sports use

Source: authors' own processing

When comparing the maps of the 1st and 2nd Military Survey (Fig. 13), we can see that in approximately 72 years the area of the riverbed has increased by about 12 pp. This may be related to the expansion of the riverbed, for example, in the area southwest of Mršník. Compared to the 1st Military Survey, the area of forests has decreased by 28.5 pp. The share of meadow areas has decreased by about 27 pp., while only wet meadows are shown on the 2nd Military Survey. More than a quarter of the area of the analysed area on the maps of the 2nd Military Survey is occupied by waterlogged areas, which is again probably related to the disappearance of parts of the riverbed. This is probably also related to the occurrence of water bodies, the share of which has increased by about half compared to the 1st Military Survey.

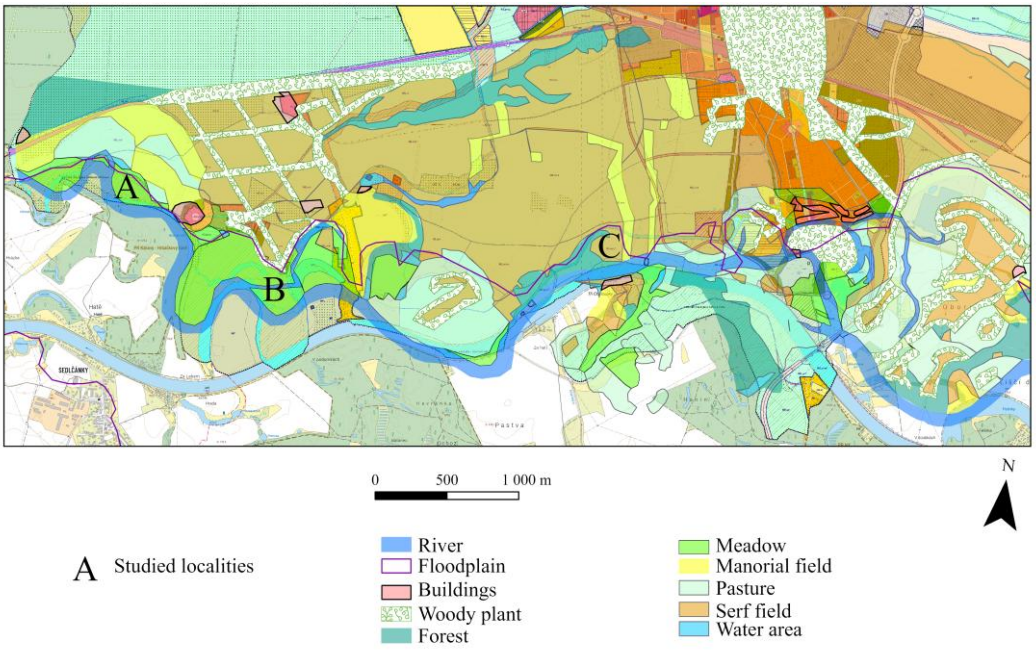


Fig. 11 Landscape around the Elbe River on the Map of the Lysá estate from 1752 (authors' own processing)

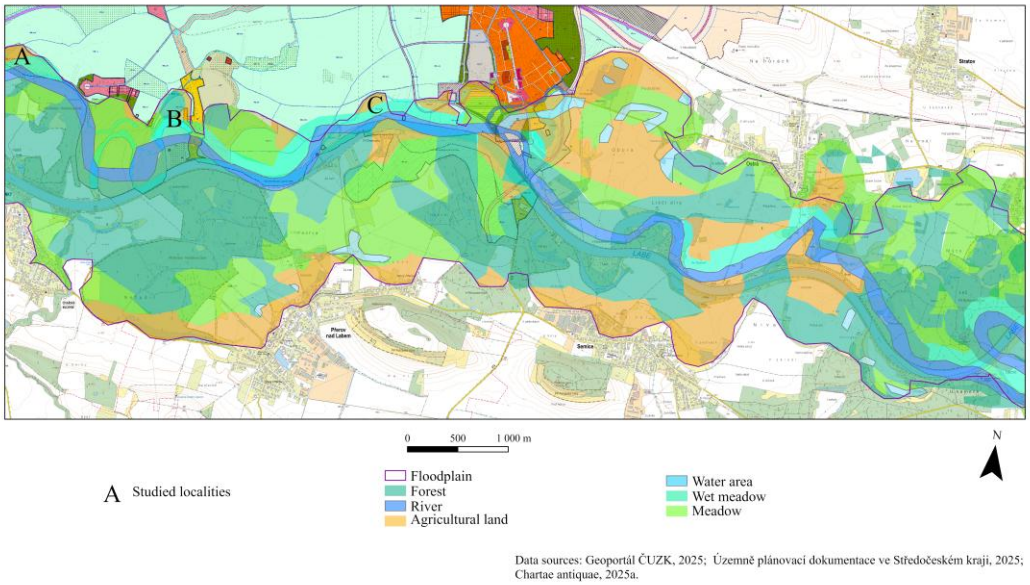


Fig. 12 Landscape around the Elbe River on maps of the 1st Military Survey (authors' own processing)

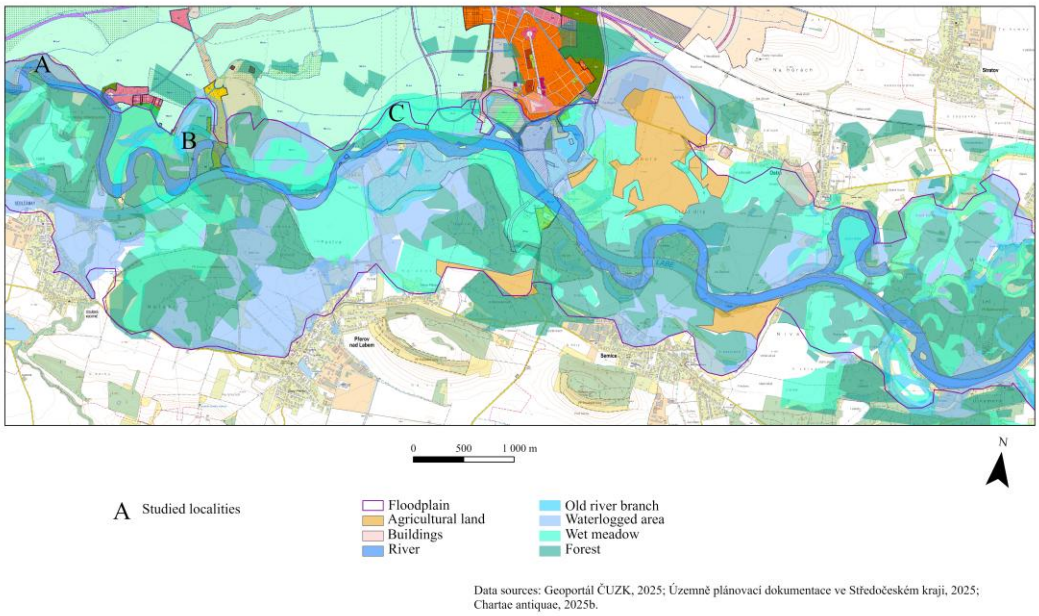


Fig. 13 Landscape around the Elbe River on maps of the 2nd Military Survey (authors' own processing)

The area of the riverbed on the Stable Cadastre (Fig. 14) maps is approximately 13% larger than in the 2nd Military Survey. The forests are also similar in area. The Stable Cadastre distinguishes landscape cover in more detail. In addition to wet and dry meadows, there are pastures. The share of meadow areas in total is apparently 55 pp. larger than in the 2nd Military Survey, which may be a distorted figure, since meadow areas could fall under waterlogged areas and the area of meadows would be equal. The Stable Cadastre maps capture large agricultural areas and small marshes. Small differences can be explained by the fact that both of these mappings were created at approximately the same time, and they can also be explained by the fact that the Stable maps were created for the purpose of tax collection, so there was an effort to map the land in more detail.

Over the last 150 years, significant changes have occurred. The area of the riverbed has decreased by about 61 pp., due to straightening and navigability. The area of agricultural land has increased 6.5 times at the expense of natural areas (the area of forests has decreased approximately 10 times and meadow areas almost twice), caused by land consolidation and land reclamation carried out in the middle of the 20th century. The largest areas are the river, forests and meadows (both dry, wet or pasture, depending on the informative value of the map), the smallest is the built-up area, due to the potential risk of floods (Graph 1).

The individual types of land use categories were determined based on the legends used on old maps. For each period, the composition of land types respects the information provided on the original map. The landscape change is also expressed by the change index, which is understood as the ratio of the area of areas where there was a change in use in the selected time period to the total area of all areas (Kilianová, Pechanec and Zapletalová, 2008). The change index for the entire area confirms that the studied area preserved its natural character in the 18th and 19th centuries. The most represented types of landscape cover in terms of area are rivers, forests and meadows. The least represented are built-up areas, partial water bodies and marshes. The use of the landscape then fundamentally changes in the 20th century in connection with the intervention in the riverbed. The character of the localities in the monitored period copies this trend and their landscape is stable in terms of the type of landscape use.

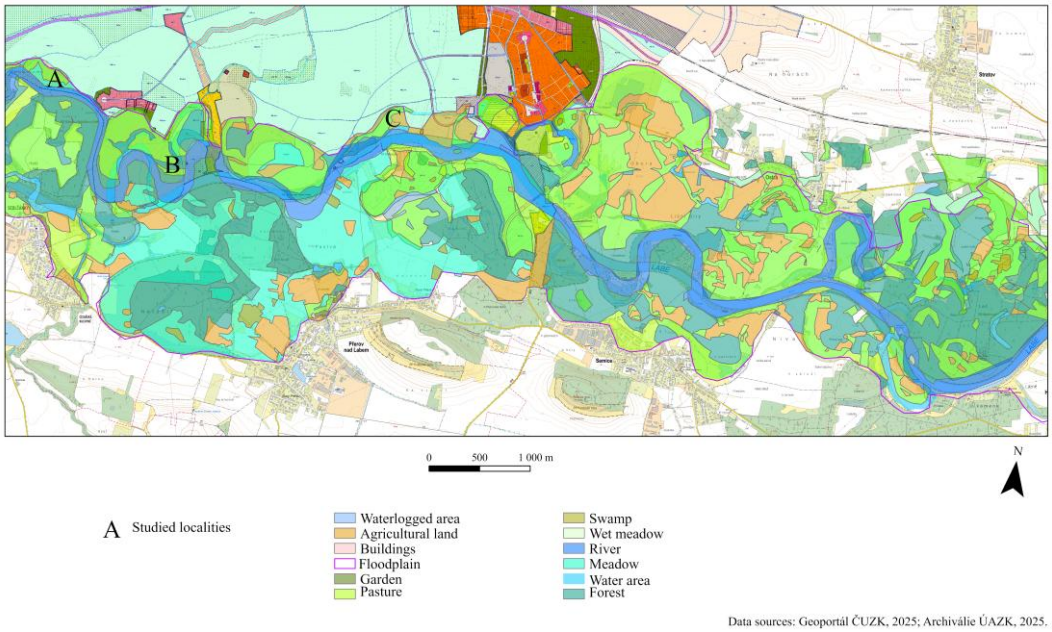
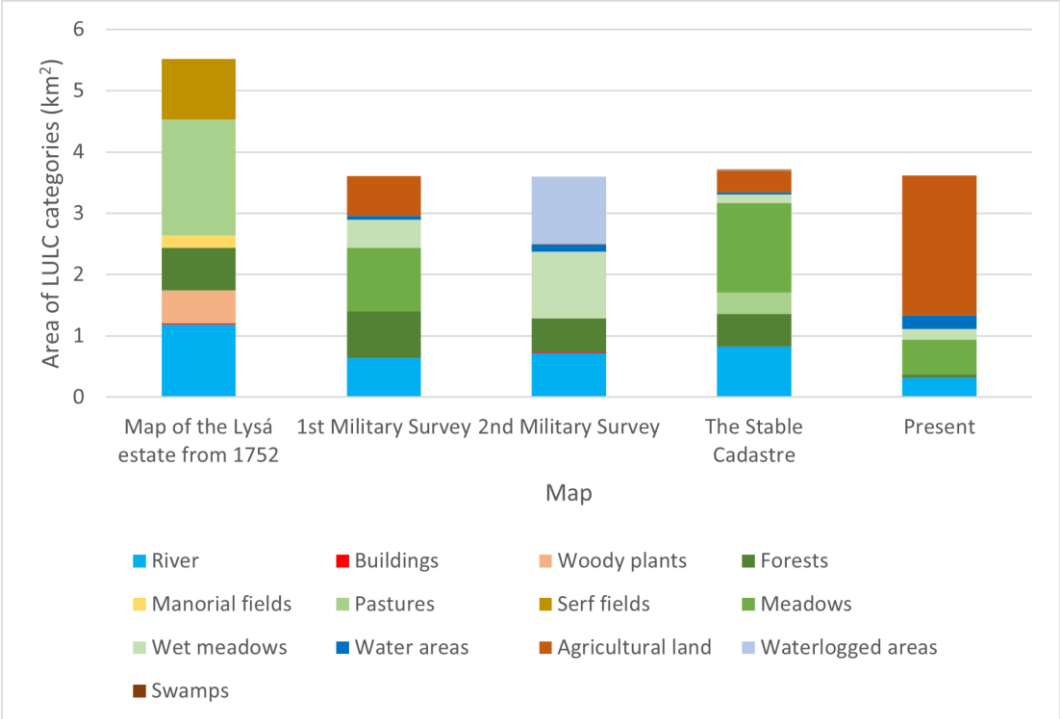


Fig. 14 Landuse in the cadastre of Lysá nad Labem during the Stable Cadastre (authors' own processing)



Graph 1 LULC categories in the river floodplain area in the cadastre of Lysá nad Labem from the 18th century to the present (authors' own processing)

The spatial plan is compiled on the basis of the cadastral map, but does not work with old maps. This plan tries to preserve in particular some historical paths. The Department of Nature and Landscape Conservation thus made an effort to include a country path towards Stratov in the spatial plan in the direction of Milovice or Nymburk or Kárané (Koubek et al., 2014). However, the historical landscape was not preserved, due to the construction and expansion of railways and also with regard to forest management (Lysá nad Labem City Hall, Ing. Markéta Kučerová, spatial planning officer, Department of Construction and Spatial Planning, e-mail communication: 7.10.2025).

4. Discussion

The aim of the study was to evaluate changes in the river floodplain landscape around Lysá nad Labem in the first quarter of the 18th to the first third of the 20th century. Within the framework of the study, several locations potentially threatened by floods were identified. Their appearance on old maps and the current spatial plan of the town were compared. Based on the comparison, the possibilities and limits of using these old maps for spatial planning were considered.

The river floodplain forms the southernmost part of the Lysá cadastre. It consists of undeveloped areas that are of additional importance for agriculture or water management, as well as natural areas, some of which resemble the course of one of the Elbe riverbeds in the past, as well as water areas that were previously part of the active flow of the river.

In the cadastral area of the town of Lysá nad Labem, certain similarities in the use of the landscape around the Elbe can be observed. Significant changes occurred in the 20th century, when the river was straightened and navigable in the 1930s and parcels were consolidated in the 1950s, which led to a reduction in natural areas. It is theoretically possible to use information from old maps when creating a spatial plan.

However, when working with them, it is necessary to take into account several limitations, especially when processing them in GIS. Maps of the First Military Survey and depictions of the Lysá estate from the 18th century are burdened with geodetic inaccuracies. Due to the absence of a mathematical basis and the circumstances of their creation[1], they cannot be accurately georeferenced and, for example, accurately determine changes in the area of individual areas.

Other factors that limit their use are scale, with medium-scale maps not necessarily suitable for, for example, the analysis of changes in the use of individual parcels (Skaloš et al., 2011), another obstacle to use may be, for example, the ambiguity of the definition of a given area (Forejt et al., 2020), or inconsistent methodology or semantics, where individual map creators could interpret mapping criteria in different ways, or if multiple authors evaluated the use of the same land in different ways (Forejt, Dolejš and Raška, 2018).

For the creation of a spatial plan, the most useful use of the 2nd Military Survey appears to be from younger sources, which are cartographically accurate and can be supplemented with information about individual parcels of the Stable Cadastre map operations. The use of the 1st Military Survey maps, which capture the macrostructure of the landscape at a given time, also appears to be relatively useful. However, cartographic inaccuracies and the absence of a legend must be taken into account.

The map of the Lysá estate from the mid-18th century has similar characteristics. It provides relatively detailed information about the use of the landscape of Lysá nad Labem and the surrounding area in the 18th century, but is burdened with distortion.

Topographical-panoramic copperplate engravings from the early 18th century provide an approximate idea of the landscape, because they depict the territory from multiple sides and lack a trigonometric network, they cannot be processed precisely in a GIS environment. However, they are used, for example, in the creation of nature trails. (Koubek et al., 2014).

Homolka and Byšická tůň, Kozí Chlup and Řehačka and the area from Tři Chalupy to Mršník were selected for the analysis, because they are part of the town's cadastre, the Elbe floodplains are

[1] In Topographic-panoramic copperplate engravings from the early 18th century, the view from the west, centre, and east is combined, which with the missing geographic grid, poses a problem for accurate processing in GIS.

former meanders, potentially threatened by floods. Their character does not change throughout the monitored period and is filled with natural areas, such as forests, wet or dry meadows, waterlogged areas and water bodies. This mosaic was probably created by the effect of the river on the local landscape. In places it is supplemented by agricultural areas. According to the Flood Maps, this is an area threatened by floods, but the spatial plan reflects it as an undeveloped area.

There are other studies dealing with the issue of land use changes on alluvial plains near cities. For example, the study Flood Risk Assessment for the Long-Term Strategic Planning Considering the Placement of Industrial Parks in Slovakia (Grežo et al., 2020) aims to show how data from old maps can be used to assess flood risks in peri-urban zones in alluvial areas, with an emphasis on the location of industrial parks near Žitava and Nitra. The authors of the study use these historical maps as a supplement to flood maps. Maps from the 1st and 2nd Military Survey (also used by the author of this paper) and orthophoto maps from the 1950s were used for the research. It was found that the parks were built on originally wet meadows and pastures, where there were once branched river arms. The conclusion proposes a methodology for using old maps to identify and prevent flood damage.

An example of the second study is the above-mentioned work using old military survey maps and orthophoto maps to analyse long-term land cover changes – Case study (Skaloš et al., 2011). The aim of the work was to further develop the method of detailed landscape cover analysis based on maps from the first to third military mapping and further. The study assessed the suitability of these maps for analysing landscape development trends. The maps were processed in a GIS environment, similar to the previously cited and presented study. The study confirms that military surveys are a suitable source for analysing landscape development trends. However, they are not suitable for detailed analysis of the microstructure of the landscape due to their scale and the unclear specification of some elements. In addition, inaccuracies in the maps of the 1st Military Survey prevent a more reliable statistical evaluation of the areas of individual plots and comparison with other time horizons.

Conclusion

The change index shows a 2.36-fold decrease in the riverbed area from the mid-18th to the early 20th century, mainly due to river regulation in the 1930s.This is probably due to the disappearance of the branch in Litol, the natural narrowing of some parts of the stream, but also to anthropogenic intervention in the shape of the riverbed in the 1930s. The forests at the monitored sources occupy approximately a comparable area, with a significant decrease in their area only occurring in the third of the last century. The permanent state is probably caused by the activity of the river and the decrease in area was apparently related to its straightening. In the old maps, partial increases and decreases in area can be observed in meadow areas, which were related to the dynamics of the Elbe River flow. In the 20th century, their area decreased more significantly, due to the straightening of the riverbed.

The least represented areas are agricultural, water and built-up areas. The least built-up areas are probably due to the possible risk of floods. The occurrence of smaller water areas is related to the disappearance of river branches and agricultural areas were probably built where the river landscape allowed it and their growth occurred in the 20th century due to drainage. The development of the landscape in the analysed localities follows these trends. Although the town is still aware of a certain risk of floods, it tries to actively use the floodplain areas, e.g., for economic or recreational purposes. Although old maps are not the primary basis for creating the spatial plan, they can, in the author's opinion, help in deciding how to deal with the local landscape further, given its historical development and its certain similarity to today's landscape.

The findings emphasize the importance of taking into account a historical river dynamic in spatial planning and flood risk management. By processing of historical data with modern planning tools can support sustainable land use and help minimize potential flood damage in threatened areas.

Acknowledgements

I would like to thank Mgr. Vilém Zábranský, Ph.D. and doc. PhDr. Václav Drška, Ph.D. for their valuable advices in editing the text.

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ZÁPLAVOVÉ MAPY 1885–1901. *Povodí Labe, státní podnik*.

R e s u m é

Staré mapy a územní plánování – možnosti a limity jejich využití na příkladu řeky Labe u Lysé nad Labem (střední Čechy)

Předkládaná studie si klade za cíl zhodnotit, do jaké míry jsou staré mapy z 18. až 20. století využitelné pro tvorbu územního plánu města Lysá nad Labem. Jeho jižní část je součástí nivy Labe a obsahuje části, které jsou potenciálně ohrožené povodněmi. Dále byly sledovány proměny krajiny v nivě Labe.

Do studie byly zahrnuty lokální mapy a vyobrazení Šporkova panství z období do první poloviny 18. století, dále mapy celozemské, tedy mapy 1. a 2. vojenského mapování a císařské otisky Stabilního katastru. Při zpracování textu byly také využity záplavové mapy z konce 19. a počátku 20. století, které mj. sloužily pro vymezení nivy Labe.

Prameny byly s výjimkou topograficko-panoramatických mědirytin ze začátku 18. století zpracovávány metodou tzv. postupné interpretace, tedy za použití georeference a následné vektorizace v prostředí GIS. Na základě takto vytvořených map byly pak kvalitativně (popisem) a kvantitativně (pomocí indexu změny) zhodnoceny změny v jižní části katastru města Lysé nad Labem.

Výsledky ukazují, že se až do 30. let 20. století na zkoumaném území vyskytovaly přírodní plochy, jako lesy, suché či mokré louky, močály, podmáčená území a meandrující řeka. I na dnešním územním plánu je jižní část katastru města zakreslena jako plocha přírodní s různým využitím. Zlom však nastal v první polovi-

ně 20. století, kdy přírodní plochy ubyly ve prospěch ploch zemědělských, v důsledku scelování pozemků a zmenšení rozlohy plochy koryta řeky, které bylo způsobeno jejím splavněním.

Územní plán sice respektuje trendy vývoje místní krajiny, avšak staré mapy nejsou primárním zdrojem pro tvorbu územního plánu. Ten je vytvářen na základě katastrální mapy. Tendence zachovávat prvky historické krajiny v některých případech ustupuje ve prospěch budování rozvojových prvků města.

Vymezení nivy Labe, včetně její polohy v rámci území České republiky, je zobrazeno na obr. 3. Obr. 4 pak zobrazuje současné využití půdy v nivě. Rekonstrukce historických koryt řek na základě starých map a vojenských průzkumů je znázorněna na obr. 5. Podoba pramenů z 18. století, použitých pro studii je pak zobrazena na obrázcích 1a–c a 2. Obrázky 6–8 věnují pozornost vymezení nivy a potenciálnímu nebezpečí výskytu n-letých vod. Způsoby využívání půdy v oblastech potenciálně ohrožených povodněmi a jejich proměny v raném novověku jsou pak shrnuty na obrázcích 9, 11–14. Sledované lokality jsou znázorněny na obr. 10.

Prijaté do redakcie: 31. november 2025

Zaradené do tlače: december 2025