DATA LAYER FOR PROTECTION OF CULTURAL HERITAGE – DESIGNED LANDSCAPES

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ABSTRACT
Designed landscapes are a specific type of cultural landscapes, with a particular idea in their design. As the part of cultural, historical and urbanistic values shall be protected in processes of spatial planning and development according to Czech Republic's Building Act (183/2006). Because not all the designed landscapes in the Czech Republic are known we aim to create a data layer of potentially designed landscapes (identified in available old map works) to be used in Planning Analytical Materials. ArcGIS is used to analyze the maps and create the data layer. To verify the composition structure indicated in historical maps we use digital terrain model with depicted hillshade. In GIS environment the schematic representations of particular design landscapes are made (vectorization of composition points, lines and areas) with a basic description in attribute table (type and character of composition).

Keywords: *designed landscape, military survey, composition, planning analytical materials*

INTRODUCTION

Designed landscapes have been officially described by the Committee for World Cultural and Natural Heritage UNESCO [1] as proposed and created intentionally by human means. This subcategory of cultural landscapes contains gardens, parks and large landscape compositions. The paper is focused on large landscape compositions and uses the term designed landscapes in this meaning. The values and characteristics of designed landscapes are based on other than utilitarian needs, they bear a particular idea behind the design and are mirroring aesthetical criteria of their period and also sociocultural environment and religious culture, as stated by Kubeša a Kulišťáková [2]. Hendrych [3] speaks about preserved monuments of intentional and elaborate organizing and cultivation of rural spaces and landscapes, or landscapes containing features and clusters of features that are significant in terms of cultural and historic heritage.

Large landscape compositions used to be throughout history a part of fashion in garden art in the whole Europe, as described by Hunt [4]. Possibly the most famous are works of André LeNôtre, described for example by Mariage [5], or English landscape parks, again referred by Hunt [6]. Czech Republic is generally rich in historical traces in landscape, also designed landscapes or their remnants. In the Czech Republic the most common are baroque designed landscapes (e.g. Jičín and surroundings), but many of them origins in earlier or later periods, or were created during longer time (for example Lednice - Valtice Area), as described by Kulišťáková [7]. Each development phase of intentional creation of landscape organized the space in a different way. Usually they take part in creation of atmosphere of the place, landscape character and the attractiveness of the place until nowadays. Nevertheless, when the design principles are not known, it may lead to disappearance of values, which used to be in our landscape for centuries (Flekalová, Kulišťáková [8]).

So the precondition of any protection is the primary identification of a designed landscape and elements of composition and links between them, which is often difficult because the historic traces could have been destroyed by later use of the land. This identification is crucial also for the process of spatial planning, during which the preserved traces of a composition can be considered valuable from the cultural, historic, and town-planning point of view and should be conserved as such, as written in Act No 183/2006 Coll., on town and country planning and building code (Building Act) [9] and their description and graphic map representation included in spatial analytic documentation

(Public Notice No 500/2006 Coll., Decree, on planning analytic materials, planning documentation, and planning activity filing [10].

The complication is that the designed landscapes in Czech Republic are not systematically examined. Also there does not exist the database, which could turn the attention of municipalities and spatial planners to potentially designed landscape in the developed area, with the need to check the remnants and verify the cultural heritage and set up the principles of protection.

The paper introduces a project aiming to map the potential designed landscapes in Czech Republic and create a GIS layer with database of such landscapes. The mapping is based on publicly available old maps and the result shall be used as one of the base materials for heritage protection in spatial planning and development. The project is still running, so the article focuses more on the method used, the presented results are just partial.

MATERIAL AND METHODS

The project is a part of long-lasting research done by Department of Landscape Planning, Mendel University in Brno (CZ), where both the academics and doctoral students are focused on research of designed landscape. One of the former results was for example the Methodology of Identifying Designed Landscapes (Kulišťáková et al. [11]), showing the procedure to verify compositional principles in previously determined potential designed landscape. Also the analyze has been done of Müllers maps and 1st Military Survey for potential designed landscapes in previous projects, which we are following with slightly updated method by analyzing 2nd and 3rd Military Survey.

The base data used were old maps, publicly available for the whole Czech Republic and easily accessible in various web applications, which the above mentioned maps fulfil. In Czech Republic all the used historical maps are available online on the map server of Geoinformation Laboratory, Faculty of Environment, Jan Evangelista Purkyně University - http://oldmaps.geolab.cz/. However the maps of Military Survey have been done for the whole Austrian – Hungarian Empire and are available on server http://mapire.eu.

The oldest analyzed map sources are the Müller's Map of Bohemia of 1720 and Müllers Map of Moravia of 1716 (in version of print of 1790), rendered in 1:132 000 scale (Semotanová [12]). First Military mapping took place between 1764 and 1768 in Czech countries, in the scale of 1:28800, with rectification in 1780 - 1783. Although these maps lack accuracy, the value of their evidence is very high because they capture many significant features in the landscape. Second Military mapping took place between 1836 and 1852 on the basis of an already established trigonometric network and after surveying of cadasters – land registers. These maps are much more accurate and capture the landscape in great detail, also in the scale of 1:28800 – they allow for identification of many different features. Third Military mapping took place between 1877 and 1880, in the scale of 1:25000, elevation is already represented by contour lines and ground elevation points (Boguszak and Císař [13]).

Each list of the old maps was examined in digital form and it was looked for any presence of physical structure of composition. The composition consists of basic compositional elements and links which are captured in maps. So the specific elements (the significant features of composition), which usually announce and mean the presence of composition, are looked for in the old maps. They can be divided to points (e.g. castles, lusthouses, gamekeepers lodges, farmyards, small sacral objects, monasteries, churches, statues,…), lines (e.g. tree rows, alleys, paths, water channels, forest clearings,…) and areas (castle gardens, pheasantries, game parks, ponds and pond systems,…).

The significant features of composition were redrawn to the new ArcGIS layer, together with supposed compositional links (e.g. connection of two compositional points with line feature). Thus

the basic scheme of structure of composition was got and described and divided according to its complexity (see more in Results).

Due to the character of significant features the compositions were divided (accordingly to Salašová [14]) to three basic types: sacral – connected with religious object, profane – connected with the seat of aristocracy or utilitarian objects and places of rest and recreation, combined – where both sacral and profane elements built the composition.

When the scheme of the composition was found out, the main composition point (determining for the compositional scheme or connected to most compositional links) has been set up, typologically sorted (e.g. castle, church, gamekeepers lodge,…) and its GPS coordinates have been marked down for further easier localization. All data for the main compositional point have been marked in attribute table. However due to the spatial extent and volume of data processed it was not possible to describe in this way each composition feature discovered.

Three of potential designed landscape discovered according to above described method were verified by field research and further analyzed in GIS. To verify the composition structure indicated in historical maps we used digital terrain model with depicted hillshade. The description of GIS tools used is shown in model area Chroustovice (Fig. 1) in chapter Results and Discussion. The designed landscape in Chroustovice is baroque, connected to noble family of Kinský and the central compositional point is a large baroque castle.

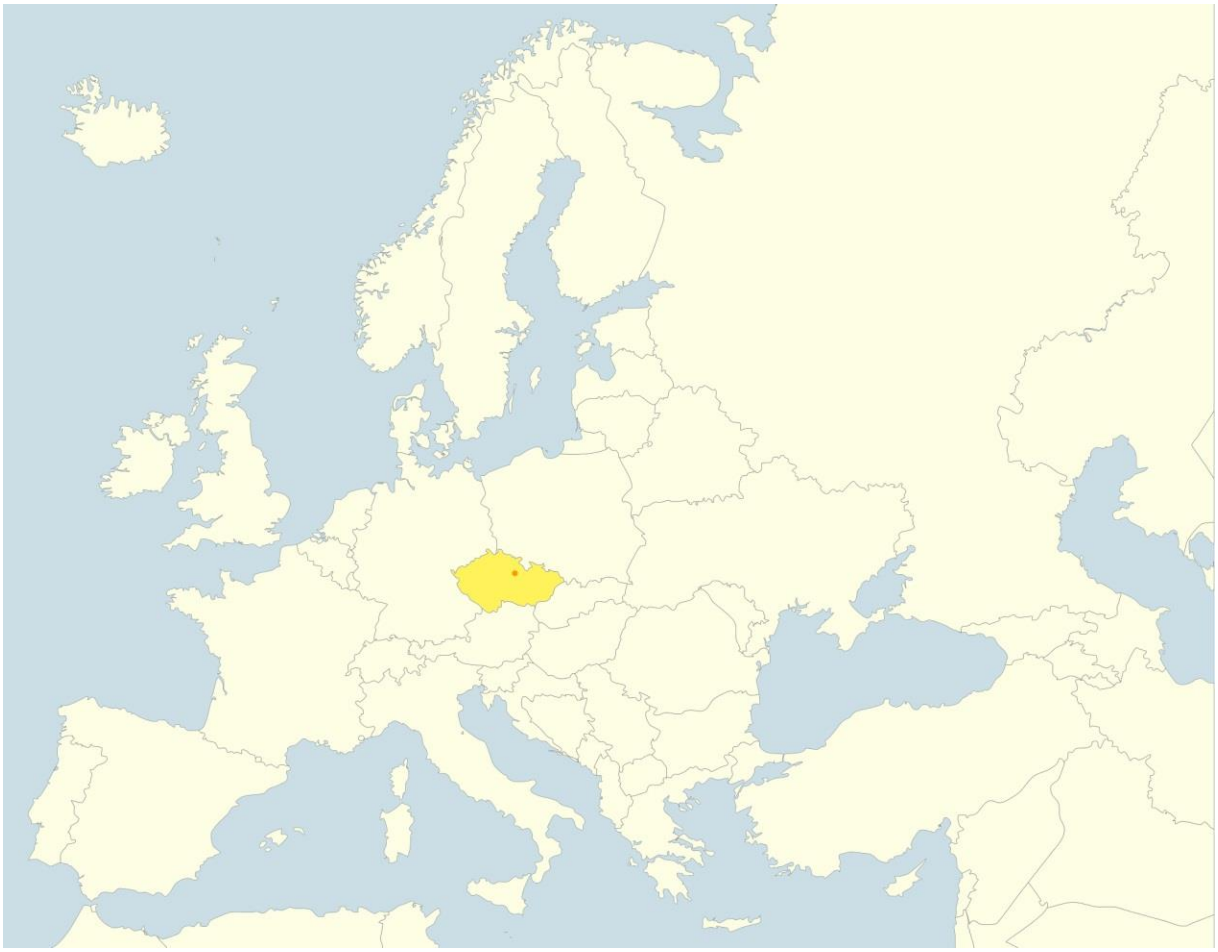


Fig. 1. Localization of Chroustovice in Czech Republic and Europe. Source of base map: http://www.publikacevymolova.cz/publikace/vlastiveda-neni-veda/mapa-cr/mapa/

RESULTS AND DISCUSSION

The ArcGIS environment was used to standard vectorization of data for the whole Czech Republic. The basic step was to create data layers with exact position of individual significant features of composition and compositional links, as were determined from analyses of maps of 2nd and 3rd Military Survey, current maps, ortophotomaps and lidar data in ArcMap 10.2 version.

The vectorization of potential composition is shown in the model area, Chroustovice and its surroundings (Fig. 2). The basic editing tools in the GIS environment were used. The first vector data layer consists of composition points (point). The second vector data layer represents composition areas (polygons).

Lines (poly-lines) were drawn over the layer of selected points and areas of composition using the editing tools in order to connect the individual point or areal features, accordingly to historical physical or visual links. These lines compose the third data layer.

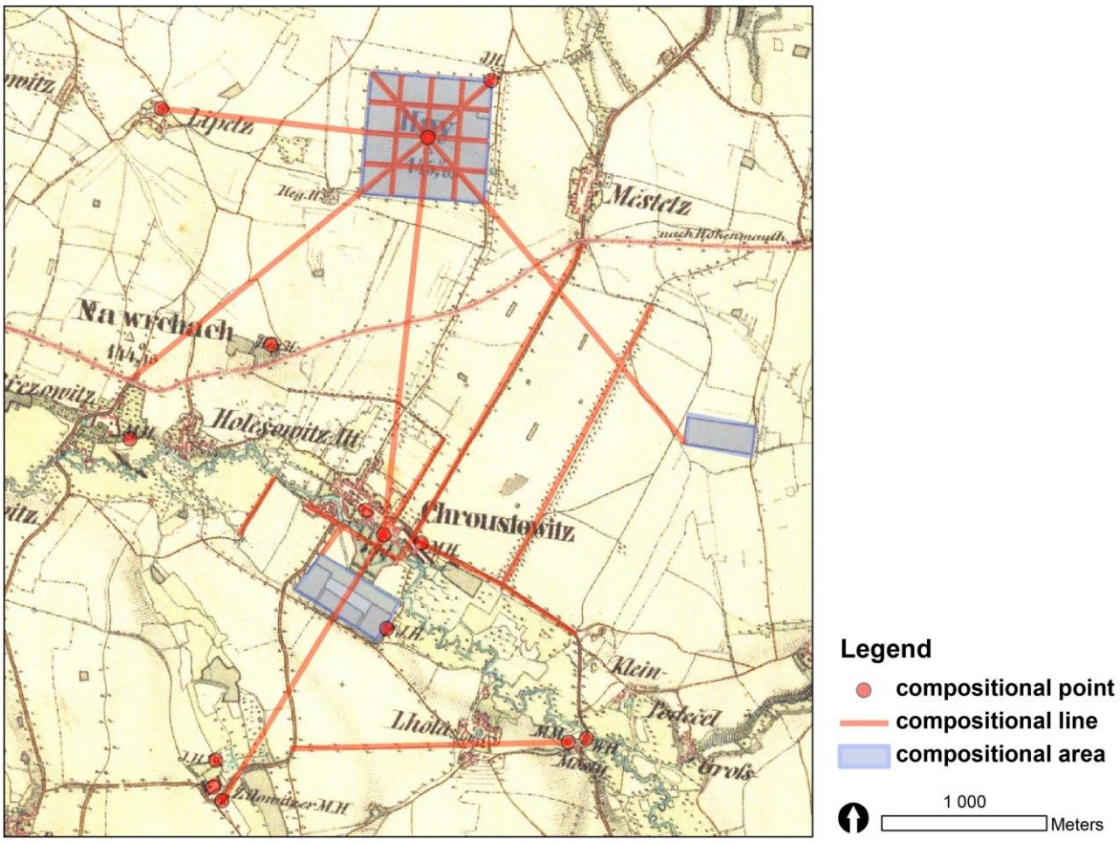


Fig. 2. Vectorization of supposed composition in Chroustovice surroundings. Based on – II. military mapping © Laboratoř geoinformatiky Univerzity J.E.Purkyně - www.geolab.cz, © Ministry of the Environment of the Czech Republic - www.env.cz, © Austrian State Archive/Military Archive, Vienna.

An Identification Point has been added to each determined potential landscape composition and it gives the basic information about the composition. This information was described in attribute table in layer Identification_point.shp (Fig. 3) and in later research will be the primary source information for further analyses.

The necessary basic information is serial number and GPS coordinates of Identification Point (which means the core of composition). Other information describe the own composition. The fourth column shows the character of the composition (based on main composition elements) – profane (P), sacral (S) and combined (K). It is followed by determination according to spatial distribution of composition elements: discontinuous points (0), linear (1) and spatial (2). The next typological criteria are the

number of composition elements, resp. complexity of composition, expressed with a letter, from the simplest (A) to the most complex (D, respectively C for linear compositions). The next column gives information about type of the core composition point. The last column contains further notes, if necessary, mostly additional information about location or other information of interest.

Shape *	serial number	GPS_N	GPS_E	concept	spatial type	frequency	compositional type	centre	note
Point	58	49°57'13.824N	15°59'36.815E	P	2	C	2C	castle	Chroustovice
Point	59	49°53'35.402N	16°1'42.002E	K	2	B	2B	castle	Luže
Point	60	49°49'53.947N	16°2'26.308E	P	2	B	2B	farmstead	
Point	61	49°40'46.846N	15°52'33.19E	P	1	A	1A	town	
Point	62	49°59'20.701N	16°7'55.412E	P	2	B	2B	castle	
Point	63	50°5'42.114N	16°5'26.511E	P	2	B	2B	castle	Borohrádek s lesy
Point	64	50°7'21.428N	16°11'57.697E	P	2	B	2B	castle	Častalovice
Point	65	50°15'54.099N	16°6'56.742E	P	2	B	2B	castle	Opočno
Point	66	50°2'4.862N	16°30'13.348E	P	2	B	2B	castle	Letohrad
Point	67	50°5'35.936N	16°25'8.31E	P	2	A	2A	gamekeeper's lodge	
Point	68	50°14'54.953N	16°27'1.35E	S	1	B	1B	chapel	
Point	69	49°54'10.673N	16°30'55.116E	P	2	A	2A	gamekeeper's lodge	lesní průseky
Point	70	50°4'28.831N	16°46'57.222E	S	1	A	1A	monastery	Králíky
Point	71	49°52'50.535N	16°16'23.427E	P	2	A	2A	farmstead	

Fig. 3. The print screen of Attribute table with description of several potentially designed landscapes in Eastern Bohemia, Chroustovice marked with blue color.

In the model area of Chroustovice the data layers were correlated with current maps and the results verified in field research. The research helped to assess the actual state of composition, the condition of particular compositional elements and links and the validity of spatial relations and visual links. The field research also brought the necessity of further use of ArcGIS tools, to find out, if the compositional axe found in old maps as connecting Chroustovice castle (garden façade, Fig. 4) and Žilovice farmyard (Fig. 5) really existed and if yes it was visual or symbolic. As we learned in the field research that the farm was not visible from the ground, the possibility remained it was visible from the 1st or 2nd floor of the Chroustovice castle. As the castle is closed for public and there is a new forest near the farm, it cannot be verified by a simple look.

Fig. 4. Chroustovice castle. Flekalova, 2016.

Fig. 5. Žilovice farm. Flekalova, 2016.

Spatial analysis of visual relations from selected viewpoints was performed using the ArcGIS environment and its Viewshed tool. The principle of visibility is based on a calculation over a digital terrain model, which defines points (cells in a grid) that are linked by an uninterrupted line of view. Visibility analysis issues from landform and land cover, which are represented by a digital model of the surface. The result is a map showing visible and invisible areas from the selected standpoint – groundfloor, 1st floor and 2nd floor of the Chroustovice castle.

A basic map for visibility analyze was the map of 2nd Military Survey, showing the land cover of half of the 19th century. The map was used to vectorize areas of use and built objects that form spatial barriers and may therefore change the visibility (all built objects, woodlands, orchards, and pheasantry).

Calculation method:

1. Digital relief model (DMT); Input data: DMT 5G (with the Contour tool created the contours); Operation: Topo to Raster; Output data: Grid with pixel size of 2 x 2 m

2. Vectorization of 2nd Military Survey and transformation to grid representation; Input data: WMS 2nd Military Survey, Operation: Vectorization of the grid using editing tools; Output data: vectorized 2nd Military Survey (polygon layer with database – specification of use, height of spatial barrier)

3. Analysis of visibility from selected viewpoints; Input data: DMT; Output data: grid representation of areas, which do/do not appear in views from the viewpoint. Three viewpoints were selected: ground floor, 1st floor and 2nd floor of Chroustovice castle (garden façade), from where the visual link to Žilovice farmyard through the straight clearing in pheasantry was verified. The eye height of the viewer is defined in the offset database field. In the ground floor it was 2 m, in the 1st floor it was 7,2 m and in the 2nd floor it was 14,4 m. The height of 1st and 2nd floor has been found out with digital telemeter Nikon Forestry Laser Pro. The visibility of the whole height of Žilovice farmyard was the aim of verification, therefore there was no special height added to DMT.

The analyses proved that from the ground floor the Žilovice farm yard was not visible (Fig. 6), which agreed with the field research, when the high embankment on the edge of the pehasantry disables to see the farmyard, even if the straight clearing directing the link is still present. So the question was, if the farmyard was visible from the 1st or 2nd floor. As it can be seen in following pictures, from the 1st floor it was not yet possible (Fig. 7), but from the 2nd floor it already was (Fig. 8). Although the composition line is not in whole length visual in the ground floor and to see the farmyard it is necessary to climb the 2nd floor, the analyze verified the connection of the castle and farmyard.

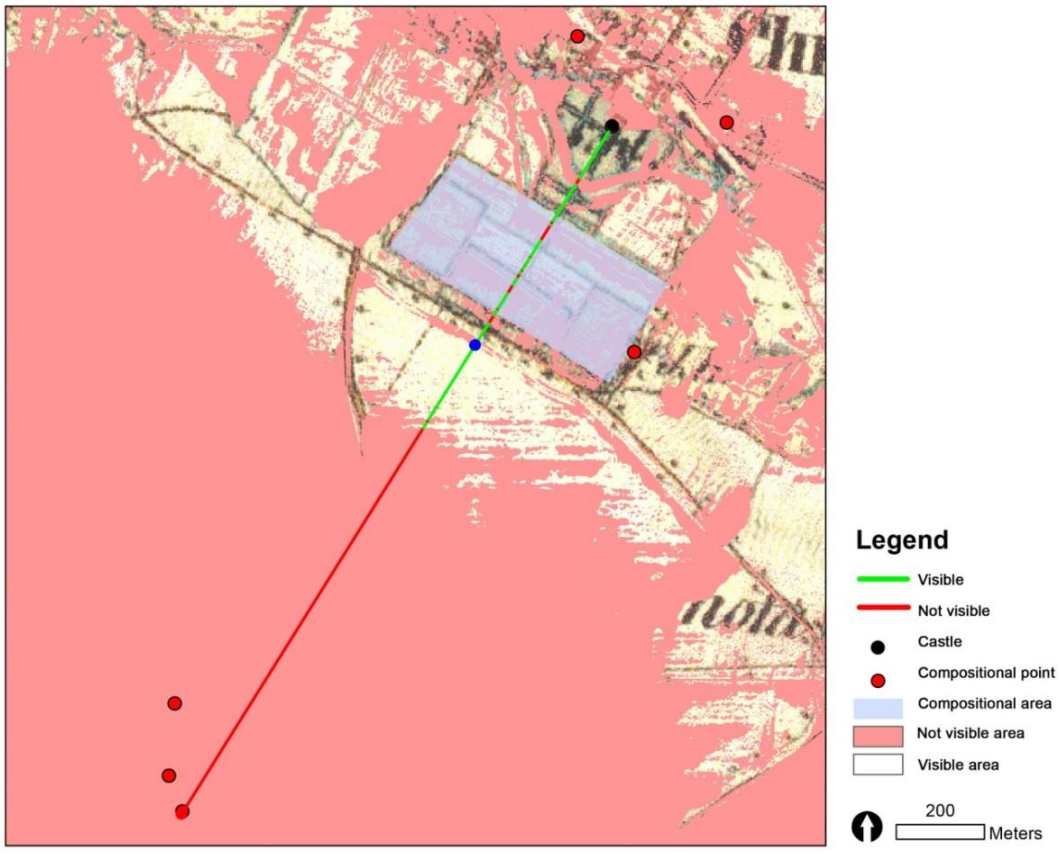


Fig. 6. Visibility from the ground floor of Chroustovice castle. Based on – II. military mapping © Laboratoř geoinformatiky Univerzity J.E.Purkyně - www.geolab.cz, © Ministry of the Environment of the Czech Republic - www.env.cz, © Austrian State Archive/Military Archive, Vienna.

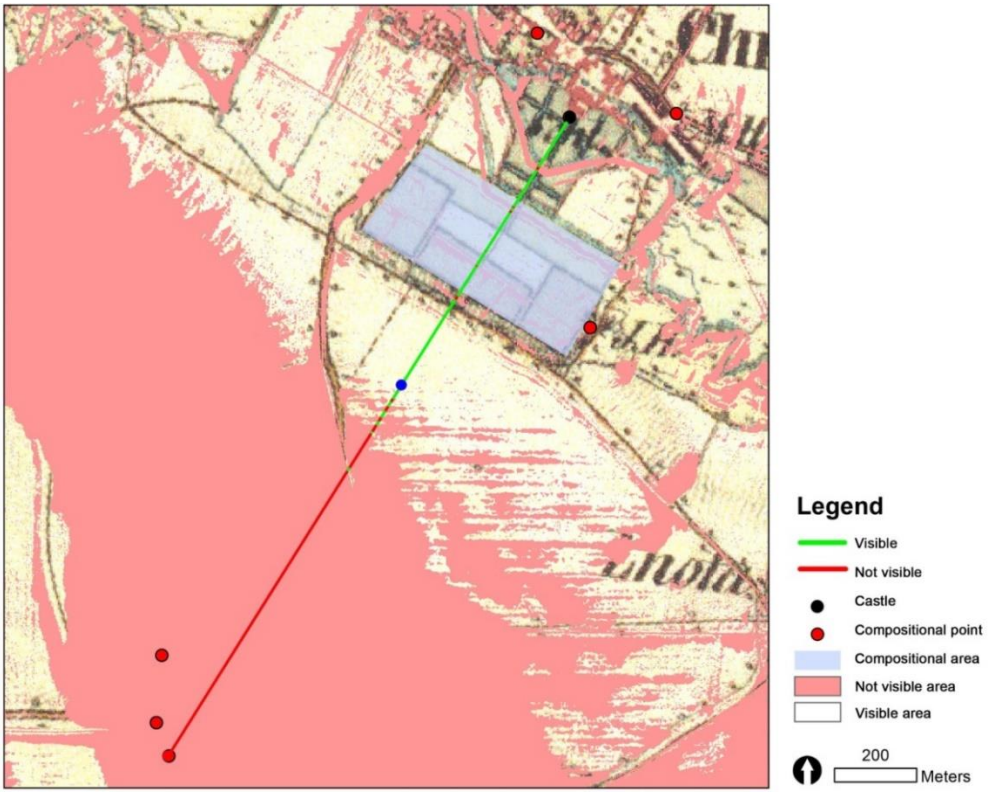


Fig. 7. Visibility from the first floor of Chroustovice castle. Based on – II. military mapping © Laboratoř geoinformatiky Univerzity J.E.Purkyně - www.geolab.cz, © Ministry of the Environment of the Czech Republic - www.env.cz, © Austrian State Archive/Military Archive, Vienna.

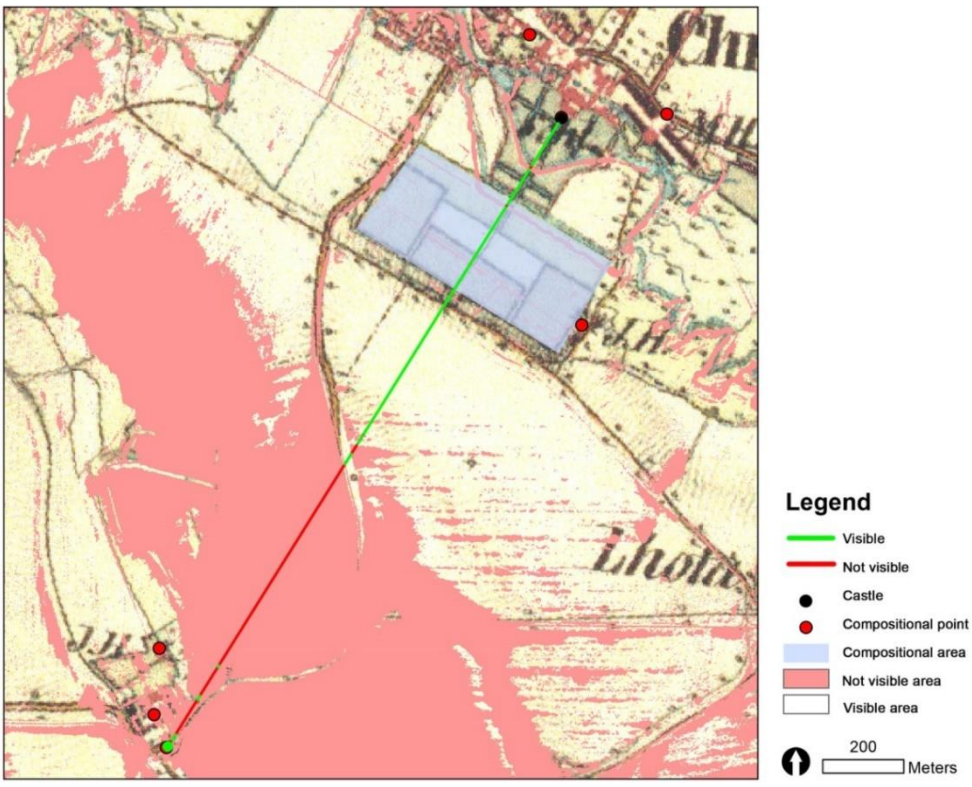
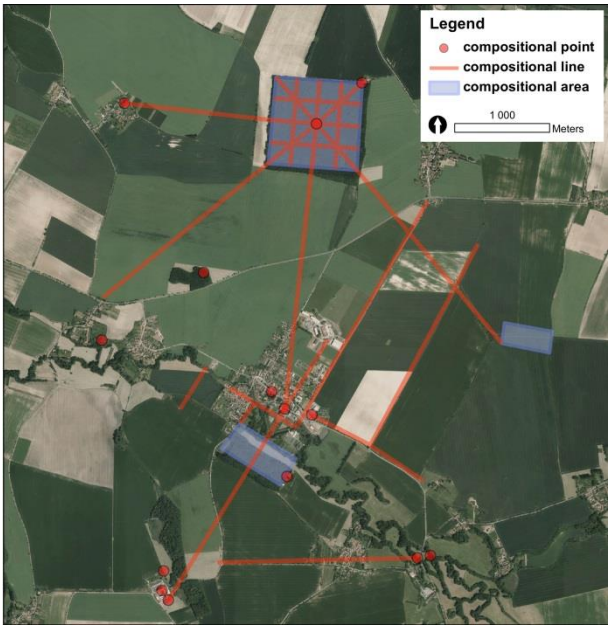


Fig. 8. Visibility from the second floor of Chroustovice castle. Based on – II. military mapping © Laboratoř geoinformatiky Univerzity J.E.Purkyně - www.geolab.cz, © Ministry of the Environment of the Czech Republic - www.env.cz, © Austrian State Archive/Military Archive, Vienna.

The found landscape compositions are even nowadays roughly recognizable and if the observer got himself familiar with basic composition principles and historical maps, he can discover in present landscape the net of complicated relation between composition features. However the time gap of 180 years from the mapping (not from creating the designed landscape) has made many visual barriers in landscape (not to speak about barriers in different philosophical and social creative principles). For any designed landscape are both the visual and physical connections between compositional points and objects crucial, of course together with the symbolical meanings and motivations from creating the landscape, but that is due to the summarizing character of this research beyond its reach.

This research is unique in its extent – it covers the area of the whole state (in present borders) in two, respectively four time periods (the actual research deals with 2nd and 3rd Military Survey, but it follows the already done research of Müllers mapping and 1st Military Survey). Even if it may be called just the inventorying of old map works leading to the summary of only potentially designed landscapes and we are aware of the necessity of more detailed survey when planning the development of any landscape discovered. However – these cultural-historical values are not generally known and just now it is the best time to preserve them, if they successfully survived the industrialization and later on the socialization of landscape, it would be a pity if they are nowadays destroyed by unrestrained development and growth.

The general principles are more or less valid also for the designed landscape around Chroustovice. The secondary composition elements still exist, but are mostly damaged or changed. The links between the elements are disturbed, some of the compositional axes disappeared and some of the physical or visual axes therefore became only symbolic (Fig. 9, Fig 10).



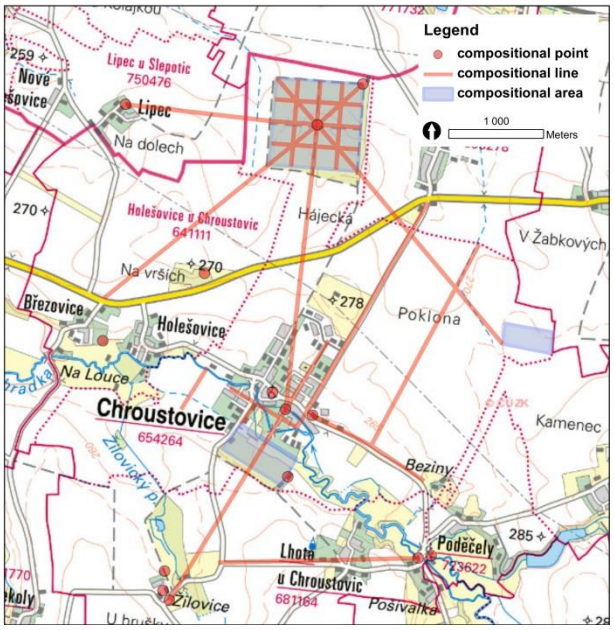


Fig. 9. Potential composition on Ortho-photo map. Source of base map: WMS, Czech Republic Ortho-photo (ČR) Copyright © 2010 ČÚZK.

Fig. 10. Potential composition on Basic map of Czech Republic. Source: WMS, ZABAGED, Copyright © ČÚZK.

It is necessary to realize that most of the designed landscapes is a geometric demonstration of private motives of investors of that time, and so the interpretation is difficult, subjective and may be superficial (not meant pejoratively, but as inevitable consequence), which is described for example by Gottlieb [15]. Especially analyzing just the maps may lead to misinterpretation; the results should

be verified in archive documents and terrain mapping to understand the real meaning. However the texts about the real intentions of founders and continuity of building particular designed landscape hardly exist. It shows how difficult it is to point out the crucial parts of design and assess the actual state and function of the composition. Anyway – it is necessary to try and to draw attention of municipalities to these pieces of heritage and the need of their protection.

CONCLUSIONS

GIS becomes an essential tool both in identification and analyses of potential designed landscapes and in their recording. Even quite simple tools, like analyses of visibility, have significant meaning in verification of supposed compositional links in moments, when it is not possible to verify them in real landscape (e.g. because of inaccessible objects or changes of land cover).

To create a data layer containing potential designed landscapes in GIS has an advantage in compatibility with other map sources. Therefore it can be used as base data for other map compositions, for example in spatial planning or in cultural heritage conservation. The identified composition elements are comparable with actual state, thanks to the exact placement in the map layer they can be easily physically identified in landscape (terrain) and therefore effectively protected.

Designed landscapes are a unique reminder of history, creative spirit of our ancestors, and are creating a specific landscape character. Czech Republic is rich in designed landscapes - The so far results discovered 12 potential designed landscapes in Müller's maps (1716-1720) and 255 potential designed landscapes in maps of 1st Military Survey (1764-1768). We expect the analyses of 2nd and 3rd Military Survey to reveal even more potentially designed landscapes. These analyses should be finished in September 2016.

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