Czech University of Life Sciences
Faculty of Environmental Sciences
Department of Land Use and Improvement

THE POSSIBILITY FOR USING GREENWAY FOR ECOTOURISM IN THE TRADITIONAL CZECH PLUZINA LANDSCAPE

Master Thesis

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DIPLOMA THESIS ASSIGNMENT

Drncová Zuzana

Thesis title

The possibility for using greenway for ecotourism in the traditional Czech pluzina landscape

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Objectives of thesis

This thesis is dedicated to identify the prototype of greenway suitable for the traditional Pluzina landscapes in certain parts of the Czech Republic, where they are preserved. The visual impact assessment of the landscape character of the particular area should be performed in case study to investigate the potential impacts of a greenway on this type of landscape.

Methodology

Set a list of criteria for Pluzina landscape assessment methods. Develop a list of methodologies for assessment and development of greenways in the Pluzina landscape. Try applying a variety of different design and placement principles in a real Pluzina landscape. Do visual impact assessment on different sites, ie case study applications and draw conclusions from the literature and theory.

Schedule for processing

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The proposed extent of the thesis

50

Keywords

pluzina, pluzina landscape, greenways, ecotourism, landscape character, landscape character assessment

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Recommended information sources

Ahern, J. 1995. Greenways as a planning strategy. Landscape and Urban Planning 33: 131-155.

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The Diploma Thesis Supervisor

Kumble Petr, Ph.D.

Declaration

I hereby that work presented in this thesis is to the best of my knowledge and belief, original, except as acknowledged in the text, and that the material has not been submitted, either in whole or in part, for degree at this or any other university.

Prague, 22th of April 2013 Zuzana Drncová

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Abstract

This thesis is dedicated to the topic of possibilities of the greenway planning in the traditional Czech pluzina landscape. The historical structure of pluzina, the remnant of agricultural management from the Middle Ages. There are attempts to find a way how to protect these structures, because pluzinas are threatened by, among others, self-seeding, or development. A huge area of pluzina hedgerows disappeared in the second half of the 20th century. The cause of it was the collectivization in agriculture, therefore there are only several areas, where pluzina remained till present days. The greenway planning is proposed as a tool for preserving the pluzina landscape and also for interpreting this structure to a wider range of public. Design principles for the greenway planning in the pluzina landscape are proposed in the thesis and are tested out in the case study. A great advantage for the greenway planning in the Czech Republic is the fact that anybody has a right of access to the open landscape. This makes the whole procedure easier.

The landscape character is protected by the law in the Czech Republic. This is a reason for the assessment of the potential impact of the proposed greenway trail. The result of this assessment is very positive, the greenway planned in accordance with the design principles proposed in this thesis has very low, or even no impact on the landscape character.

Keywords

pluzina, pluzina landscape, greenways, ecotourism, landscape character

Abstrakt

Práce je vĎnována moģnostem využití greenways pro ekoturistiku v krajinĎ tradiļních ļeských pluģin. Tyto struktury pluģiny jsou dnes dochovány jiģ jen v limitovaném rozsahu, mnoho jich totiģ bylo rozoráno v dobĎ kolektivizace. PozĽstatky pluģin jsou ale také ohroģeny mimo jiné náletovými dŚevinami a moģným rozģiŚováním zástavby obcí. Je tedy tŚeba najít nĎjaký zpĽsob, jak pluģiny pŚed tĎmito jevy ochránit. VytvoŚení greenways se zdá být jako Śeģení, jelikoģ zvýšení potenciálu pro cestovní ruch, mĽģe zpĽsobit zvýšení zájmu místních obyvatel na zachování tĎchto krajinných struktur. V této práci byly navrģeny základní principy pro návrh greenway a byly vyzkouģeny v pŚípadové studii. NáslednĎ byl zhodnocen

potenciální vliv takto navržené greenway na krajinný ráz. Jelikož je krajinný ráz v České republice chráněn zákonem, je třeba si ověřit, že takový záměr by krajinný ráz nenarušil. A skutečně, zhodnocení záměru z hlediska krajinného rázu ukazuje, že případný vliv záměru na krajinný ráz by byl velice nízký.

Klíčová slova

pluginy, greenways, ekoturistika, krajinný ráz

Content

1 Introduction

Looking through the landscape we can see many diferent shapes and structures and all of them have their particular origin and can give some evidence about the history; how they were established and developed, what was the purpose of their establishment, etc. One of these shapes in the landscape of the Czech Repuplic are pluzinas. Pluzinas have been developed in medievel times and some of them we still can find in particular areas of the country.

People typically go to the landscape to enjoy nature and a sense of being outdoors, but they often do not know what surrounds them. They perceive trees, branches, meadows and so on, but they might not understand why everything is formed as it is and the purpose that it serves. Greenways are an excellent tool for interpreting historic or cultural landscapes; can be used as means for protecting or preserving scenic, cultural and environmentally significant landscapes; and greenways are an excellent technique for providing access to these landscapes for the public to enjoy. Greenways would also help to preserve this historical pluzina landscape form. The question is, are greenways suitable for this purpose in this kind of landscape?

2 Goals

This thesis is dedicated to identify the prototype of greenway suitable for the traditional Pluzina landscapes in certain parts of the Czech Republic, where they are preserved. Specifically, what is the most suitable technique for placement of a greenway in a pluzina landscape? A methodological visual impact assessment of landscape character of a particular area will be performed as a case study to investigate the potential impacts of a greenway on this type of landscape.

3 Literature Review

3.1 Hedgerows

3.1.1 Hedgerow Description

One of the definitions of a hedgerow says that hedgerow is a row of shrubs or trees, or shrubs and trees together managed in various ways. In most of cases hedgerows are managed by people in order to have a control over the hedgerow and eventually prevent the possible undesirable expansion of the hedgerow vegetation onto the immediate surroundings. A hedgerow is not considered a hedgerow unless it is managed by people (Baudry et al., 2000).

The landscapes, whose basic structure the hedgerow networks create, are an example of a rural management. A great example from the historical-cultural point of view for the specific regions, because theese hedgerow based landscapes eveloved over a period of centuries and are spread throughout western Europe. In different regions hedgerows were established in different times for a variety of purposes, those are among others wood production, drainage, or production of fodder (Burel and Baudry, 1995).

Hedgerows create boundaries or borders, this is their primary function. They serve as boundaries in physical, but also in a symbolic way. An example of a symbolic boundary is a hedgerow used as a garden encloser with an open gate. On the other hand we can think of a cattle management. If there is a cattle mixing unwanted, then hedgrow will be a useful physycal boundary. Cattle management is one of the reasons for hawthorn being a planting material for hedgerows for it is a non-palatable species. There is a different species planted in Ecuador for this purposes, but the objective is still the same (Baudry et al., 2000).

Hedgerows used to be a primary and mostly aslo the only source of wood for the rural societies (Baudry et al., 2000). Hedgerows can provide different types of timber, e.g. for fence construction or for firewood which was often the only source of energy for rural communities because forests were traditionally owned by large landowners (Baudry et al., 2000). However Baudry and Jouin (unpublished data) found out that farmers of northeastern Brittany France even nowadays use wood or as fenceposts Under a nine-year harvesting cycle the timber yield of a hedgerow is three-eight tons of dry weight per 100 m of hedgerow for coppiced and pollarded trees (Burel and Baudry, 1994). See below the Figure 1, which shows the basic

ways of hedgerow management in terms of harvesting methods, however the case study done by Burel and Baudry 1995 in Brittany prooves the sustainability only for the coppice kind of management, because coppices may live hundrets of years. The hedgerow vegetation is not used for house heating only. At higher altitude the elm (Ulmus Glabra) leaves and ash (Fraxinus sp.) are collected to be a winter fodder for animals. Berries were picked e.g. balckberries (Rubus fruticosa) and willow (Salix sp.), branches were used for basket-making , etc. (Baudry et al., 2000).

Hedgerow is a significant landscape feature in terms of water management and wind protection. The hedgerow network decreases the speed of water runoff and controls aganst erosion, especially the wind erosion, etc. (Baudry et al., 2000). Hedgerows have an overriding ecological function. They support biodiversity and offer a habitat for species that otherwise could not exist and act as corridors in the fragmented ladscape (Burel, 1996).

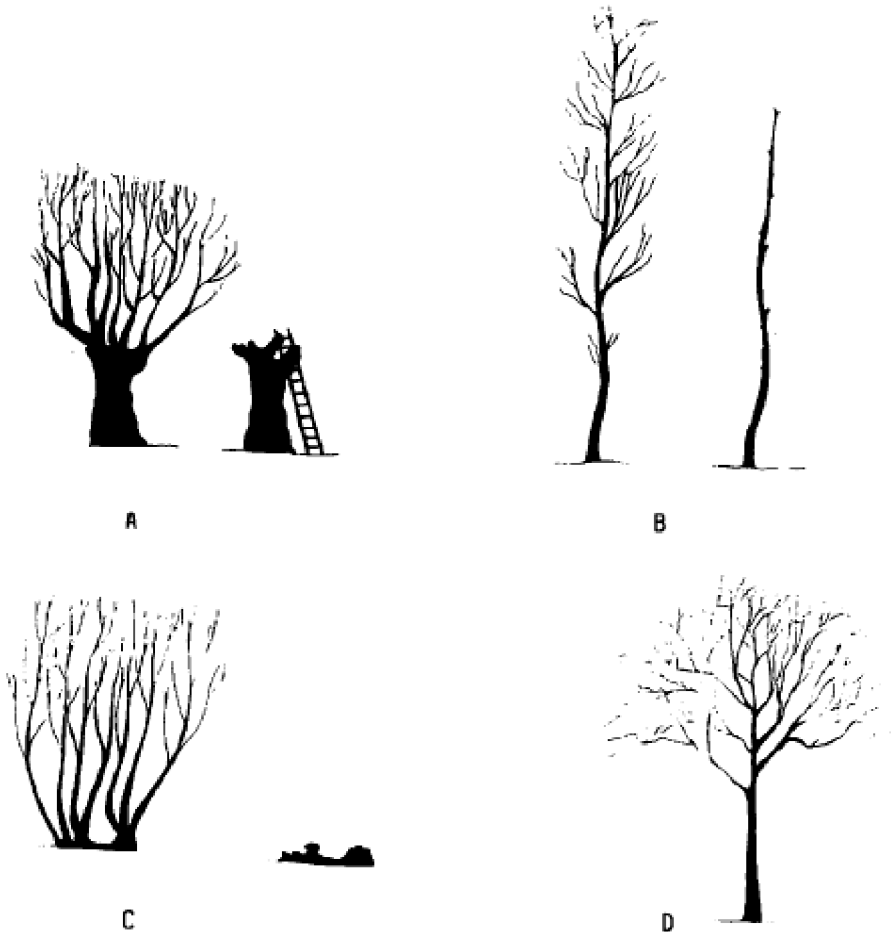


Figure 1 Four types of tree management. (A) Pollard; (B) shreddet; (C) coppice; (D) timber tree. For (A)-(C), views are given before and after pruning. Adopted from Burel and Baudry, 1995.

3.1.2 Hedgerows Nowadays

The hedgerow cover in the landscape declines because ofthe lack of demand for firewood. Another reason behind a hedgerow cover decrease is that the boundaries between the fields of small farmers are no longer needed. Other functions of this type of a landscape element are, however, worth of protection. The ecological function of biodiversity conservation is one of the most important reasons for us to be concerned with the fact that hedgerowes disappear from the landscapes. Landscape corridors prove to be a useful tool in designing a landscape, because of they connect different landscape structures. We can achieve this connectivity by planting or preserving the hedgerows (Baudry et al., 2000). On the other hand, not every hedgerow always makes a great contribution to biodiversity. The hedgerow contribution to biodiversity conservation always depends on a particular groups of fauna species. Diptera, for example, shows a much smaller species number in an open landscape than in a dense landscape. For carabides this is not much of a difference (Burel et al., 1998). However in some cases the landscape planning aims to provide against the soil erosion or to improve the water management; and in many cases hedgerows also have a high cultural and historical value (Baudry et al., 2000).

3.1.3 Hedgerow Based Landscapes

The hedgerow networks in England come from the eighteenth century, from the time of division of common land into private lots. Hedgerows were planted around a particular lot to serve as boundaries (Burel and Baudry, 1995). In some studies it appears that hedgerow landscape dates back even further before the eighteenth century to Roman times. In Britain, i the beginning of the eighteenth century most hedgerows were created by planting hawthorn (Cratageus monogyna) (Baudry et al., 2000). According to Hoskins, 1955 the hawthorn even gets its name from the old word haga, what used to mean a hedge.

In France it was obligatory to divide the property among all heirs, which led to the formation of hedgerows planted as boundaries of a field belonging to a new owner. In this case certain regions developed a matrix with very fine fields, because of the lot division among several people (Burel and Baudry, 1995). There is also a term bocage, which is used for hedgerow-defined landscape in Western Europe. In Western Europe the effort is put to preserve the bocage landscapes for the sake of hedgerow connectivity, land use heterogeneity and grain size (Deckers, et al., 2005).

One more country that can boast of hedgerow landscapes is the Czech Republic. A specific Czech term used to denote a hedgerow-based landscape is pluzina. The next chapter will give an overview on the issue including some historical landscape development data.

3.2 Pluzina

The term pluzina has evolved over the centuries. At the time when the word pluzina was established, it referred to the belongings of a single village, particulary meadows, pastures and a system of field roads that connected them. Today the term pluzina is used only to refer to the remnant structures of pluzinas in the landscape (Gojda, 2000).

3.2.1 History of Pluzinas

In the later Middle Ages an increase of the area of farmed land was significant (Sádlo et. al, 2005). After the year 1300 a regular network of settlements was established due to colonization process. Feudal land owners hired a specialist, a so-called locator to choose a site, design a layout of a village and then offered this site for collonization and settlement. Of course, not every area was suitable for a new village. The locator had to consider if there was enough space, water and good soil for the future needs of potential inhabitants and only after that he would make a decision. Locators got money, or an in-kind award, e.g. a mill for their job. They could also be granted a status of the head of a village. The entire new village with all its surroundings, such as meadows, pastures, etc. got the name pluzina (Löw and Míchal, 2003). At that time the farming methods changed to a three-field system and hence the yield of the pluzina increased significantly (Sádlo et. al., 2005). Since that time bigger various changes happened in relation to pluzinas, till the Industrial Revolution (1814-1914), when the four-field system was introduced and due to this the yields grew up by 50% least (Löw and Míchal, 2003), but it also brought the general negative change in the attitude of people to landscape in terms of promoting the values of natural conditions (Ţeliğ, 1997).

The most dramatic changes happened during the first (after February 1948) and the second (1970s) waves of collectivization, when private farmers were forced to join big ñcollectiveò farms. This led to ploughing of the scattered greenery and combining of separate lots into a big field. It obviously had a negative imapct on pluzinas, which started to disappear from the landscape (Löw and Míchal, 2003). Nevertheless the remaining pluzinas could also be threatened by modern trends.

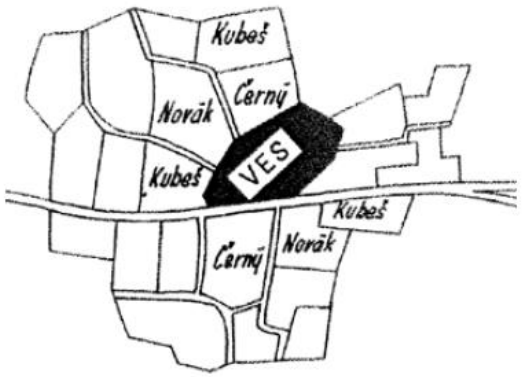
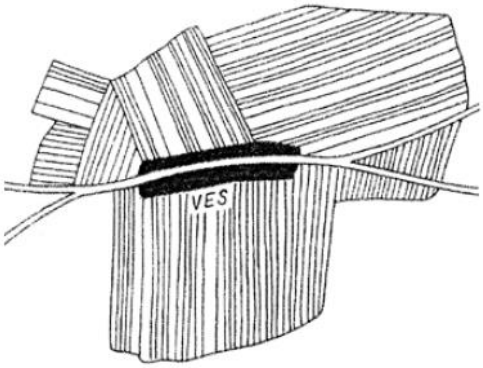
Privatization, consolidation or restitution of land can also affect of the pluzina landscape a lot (Molnárová, 2008).

3.2.2 Typology

A village was divided into sections and each farmer had fields in each section and managed it within a three-field system. This is the origin for a type of pluzina with long, narrow fields, which however did not come down in the Czech landscape and its original field pattern can be seen in some parts of Polland (Gojda, 2000).

While the second type of pluzina was established a bit differently. Every farmer got a hide of land directly connected to his farm, what he could manage anyhow. The arisen structures are ñong fields or pastures, perpedicular to the axis of an elongated village and partially or entirelly enclosed by hedgerowsò (Gojda, 2000).

Molnárová, 2008 carried out a synthesis of different approaches to the finer pluzina landscape typology classification of different authors (eg. Ļerný, 1973, Löw and Míchal, 2003, etc.). This synthesis describes the typology of pluzina very well, therefore its brief summary is presented in this diploma thesis in the Figure 2.

	**SEGMENTAL PLUZINA**	▪ prevailing in early middle ages ▪ recent presence of this type is however of modern origin ▪ the owner belongings is several plots at different places within the pluzina ï unconsolidated land holding
	**PSEUDO-SECTIONAL PLUZINA**	▪ arose by adaptation of segmental pluzina to three-field system and heavy plaugh ▪ in each section of pluzina there are fileds belonging to a farmer

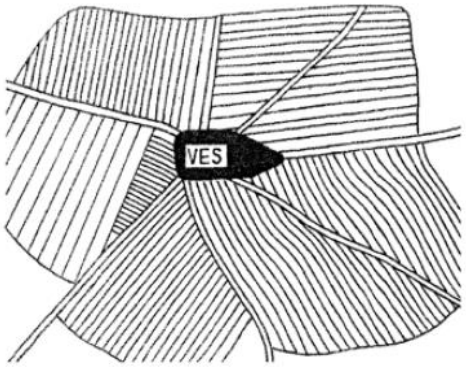
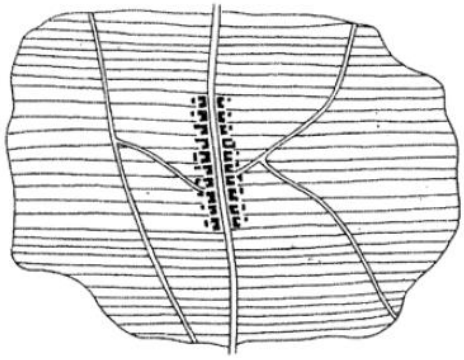
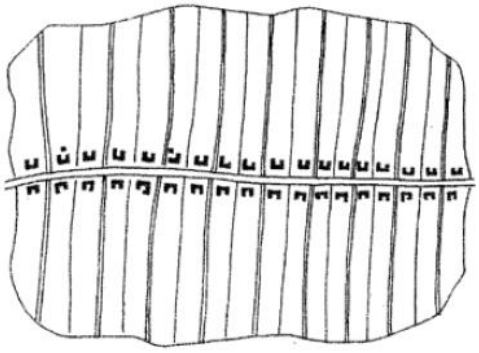
	**SECTIONAL PLUZINA**	▪ three-field system of farming ▪ divided into sections, where each farmer had some fields
	**LINEIC PLUZINA**	▪ transitional type between sectional and croft and also between unconsolidated and consolidated land holding ▪ in areas with still suitable conditions for agriculture, however not in the places of the best agriculture conditions ▪ strip fields tend to concentrate behind the farms ▪ not always three-field farming (Löw and Míchal, 2003, Moravec, 2005)
	**CROFT PLUZINA**	▪ hilly areas colonization ▪ all farmers land in one hide ï consolidated land holding ▪ hides usually surrounded by hedgerows ▪ it can be seen in the current Czech landscape

Figure 2 The typlology of different pluzina types (Molnárová, 2008). Pictures adopted from Ļerný, (1973).

3.3 Greenways

3.3.1 Description

The definition of a greenway is not an easy one, there are many opinions and definitions offered. Generally greenways are linear objects that can create networks in the landscape, they are planned and managed to fulfill several purposes (Ahern,

1995; Flink and Searns, 1993). The problem of a clear definition is in the variability of greenways. They can vary from very narrow stripes along a river to very wide corridors. Greenways can exist along rivers, around cities, as a linkage of two or even more areas, etc. Their functions differ. In addition every greenway can offer natural and cultural experiences. It is important to point out that greenway planning is not focused only on the nature protection, but it should also meet the requirements of human uses. It can be a tool of sustainable landuse planning and recreation, obviously even of economic development (Ahern, 1995).

The forms of greenways can differ significantly depending on their functions, resource constraints, recreational needs, situation, etc. (Flink and Searns, 1993; Hellmund and Smith, 2006). Greenways are found in many kinds of landscape in different sizes, but they all have in common the linearity (Hellmund and Smith, 2006). Hellmund and Smith in Designing Greenways (2006) describe the greenway and greenway-like designation in a chart, some excerpts of which are given bellow in Table 1.

The popularity of greenways is increasing (Flink and Searns, 1993). They are designed in cities, in the countrysides in response to environmental problems (floods, degrading water quality), or in order to acomplish the vision of a particular community in terms of improving their surroundings and being more in touch with the nature (Hellmund and Smith, 2006).

Term	**Objective or condition**
Biological corridor (biocorridor)	Protect wildlife movement and accomplish other aspects of nature conservation
Bioswale	Filter pollutants from storm runoff (usually at the scale of a site).
Conservation corridor	Conserve biological resources, protect water quality, and/or mitigate the impacts of flooding.
Ecological corridors (eco-corridors)	Facilitate movement of plants, or other ecological processes.
Environmental corridor	Conserve environmental quality
Greenbelts	Protects natural or agricultural lands to restrict or direct metropolitan growth.
Green extensions	Put residents in contact with nature in their day-to-day lives through systém of residential public greenspace, shaded sidewalks, and riparian strips.

Green links	Connect separated greenspace
Green veins	Help protect biodiversity in agricultural landscapes through networks of small, mostly linear landscape elements.
Landscape linkages	Connect large ecosystems across broad linear bands, including undistributed rivers.
Recreational corridors	Provide Recreation.
River or other linear parks	Protect or at least follow river or other corridors, sometimes with scenic drives and trails.
Wildlife corridor	Proetct wildlife movement between areas of habitat.

Table 1 Greenway and greenwaylike designation. Selection from the table in a book Designing Greenways. Adopted from Hellmund and Smith, (2006).

3.3.2 Functions

Greenways serve to protect, preserve, interpret, restore and educate. Many landscapes where greenways can be planned contain critical ecological resources of varying conditions or integrity and greenways can improve and protect these resources. Many landscapes contain a variety of important cultural (historic) elements e.g. pluzina, which greenway can help to protect, restore, interpret and educate users. Greenways can also protect and call attention to the landscape aesthetics (Flink and Searns, 1993).

There are two basic functions of greenways in the landscape. It is recreation and preservation. The connectivity is one of the most important properties that a greenway introduces in a fragmented landscape. This goes for the recreational as well as for the conservation function. Whereas greenways may seem to serve one function, such as providing recreation, combining of these functions is common and welcomed and not only theese two functions, also others (Flink and Searns, 1993).

3.3.3 Ecological and Environmental Impacts

Biodiversity loss is one of the most spoken topics in terms of environmental threats. One of the causes of biodiversity loss is the landscape fragmentation fragmentation (Gontier et al., 2006). Greenways are a great tool for connecting the fragmented segments of the landscape. The lack of landscape connectivity results in the habitat isolation, which can lead to the species extiction (Forman and Godron, 1986). Another cause is the loss of habitats, because some species are dependent on linear structures and cannot otherwise survive (Linehan et al., 1995).

There are also some negative impacts of greenways, for example greenways can increase immigration, which can raise the spread of diseases and accelerate the spread of fires (Linehan et al., 1995). See below Table 3, which summarizes the pros and cons of greenways.

Potential Advantages	**Potential Disadvantages**
1 Increased imigration, which could A Increase or maintain species richness and diversity B Increase population sizes of particular species C Decrease probability of exinction D Permit species re-establishment E Prevent inbreeding depressionúmaintain genetic diversity 2 Increased foraging area for wide ranging species 3 Provide escape cover for movement between patches 4 Increase accsesibility to a mix of habitats 5 Provide alternative refuge from large disturbances 6 Provide greenbelts to A Limit urban growth B Abate pollution C Provide recreational opportunities D Enhence and protect scenery E Improve land values	1 Increase immigration, which can A Facilitate the spread of diseases, pests, etc. B Decrease the level of genetic variation between populations (outbreeding depression) 2 Facilitate the spread of fire and other contagious catastrophies 3 Increase exposure to hunters, poachers and predators 4 May not function for species not specially studied 5 Cost and conflicts with conventional conservation direction of preserving endangered species

Table 2 Pros and cons of wildlife corridors. Adopted from Noss, (1987).

Generally an indirect positive impact of greenways on ecology and environment is their placing in the landscape itself, because then they keep areas from the further development (Hellmund and Smith, 2006). Greenways provide planned linear connections linking multiple patches, which is their great ecological benefit (Forman and Godron, 1986). If they are planned in a big city in a sufficient extent, they can positively influence the urban heat island effect by shading and evapotranspiration, both of these cool the air. The dust is filtered out of the air by greenway vegetation in the city, which decreases the ratio of particular matter in it (Hellmund and Smith, 2006).

Greenways play a big role in water management. Flooding can bring huge damages, in that case the greenway corridors can soak up the. Water is filtered going through the greenway. The natural uptake of nutrients by the vegetation lowers the number of pollutants, which would otherwise flow to the river or some other reservoir. In addition the eroded material from fields or other areas is stopped by the greenway partially or fully and hence it does not sediment in the river beds or water reservoirs (Hellmund and Smith, 2006).

3.3.4 Social Impacts

The desire of people to experience nature is well known, however because of urbanization some of us cannot enjoy it every day, because the nature areas can be very distant, especially for those, who live in big cities. Greenways become very important, when speaking of urbanized areas and regular need for outdoor activities, or just for relaxation. This recreation function of greenways is the best known. Even the growing popularity of travel-oriented sports was recorded in relation with the increasing coverage of greenways. Joggers, walkers, bikers, or cross-country skiers enjoy the linearity of these corridors. The physio-geographic corridors, which are basicaly the core of almost each greenway, have also some historical and cultural significance. The aesthetic value of greenways is great. If we put these two attributes together, we can speak about the sense of place. They can provide us some information about the history. (Hellmund and Smith, 2006)

The connectivity arising from greenways presence in the landscape is important for ecological reasons that have already been mentiones. Greenways are important from a social point of view in that they connect different neighborhoods and in this way they can improve social interactions. Greenway planning and management can be a tool to bring togethere local communities and improve their interaction. This phenomenon has a positive impact on entire social group in terms of stronger social ties and collaboration (Hellmund and Smith, 2006).

The presence of greenways can increase property prices, which can make the costs of living unaffordable for some residents. This is a negative effect in terms of economics. Let´s speak about the positives. The rising property value can be considered both negative and positive. However the greenway networks areas can create jobs, attract new businesses, or expand local companies, decrease local government expenditures and increase local tax revenues (Hellmund and Smith, 2006).

3.4 Ecotourism

To define ecotourism the nature-based tourism is good to start with. As the name itself suggests, the nature-based tourism means visiting natural places. Ecotourism is a branch of nature-based tourism enriched with certain principles. These principles ensure the sustainability of ecotourism, that is the tourism has to ensure the economical welfare of the local residents and it has to be environmentaly friendly, that is it should provide benefits to the nature conservation in that area. Ecotourism is educational based, whereas nature-based tourism might not be. (Wunder, 2000; Ziffer et al., 1989). To be clearer Wunder, 2000 lists three criteria of ecotourism:

ña) minimal physical and social impacts on the visisted area

b) ecological education of the tourist at the natural site

c) notable economic participation as benefit to local residents.ò

Ecotourism is becoming an important source of income for developing countries, which covers one of the principles, the second principle is conservation. However conservation is a basic interest of the local managers, because if their area gets degradated, tourists will go to visit some other places (Wunder, 2000).

3.5 Landscape Character

Landscape character is protected by law in the Czech Republic. The §12 of the Nature and Landscape Preservation Act number 114/1992. An informative translation of this Act is cited below. Ministry of the Environment of the Czech Republic does not provide any official translations of acts (Ministerstvo ģivotního prostŚedí ĻR, 2013).

§12, 114/1992 Nature and Landscape Preservation Act (the Act)

1) The landscape character of a place or area is its natural, cultural and historical elements. It must also be protected from activities that reduce its aesthetic and natural values. Interference in the character of a landscape, particularly the approval and placing of buildings, may be carried out only with regard for the preservation of significant landscape components, particularly protected areas and cultural landscape high points and for harmonious standards and relations within the landscape.

2) The approval of the environmental protection authorities is required for approving and placing buildings which could impair or change the character of the landscape. Details for protecting the character of the landscape may be specified by the Ministry of Environment in a generally binding regulation.

3) For the purpose of protecting the character of a landscape with a significant concentration of aesthetic and natural values, and which is not particularly protected pursuant to part three of this Act, the environmental protection authorities may, with a generally binding regulation, establish a natural park, and limit such use of the area which could result in its destruction, damage or disturbance.

4) The landscape character is not assessed in built up areas and developable areas for which the local or regulation plan stipulates layout and space organization and landscape character protection conditions agreed upon with the environmental protection authority.

To summarize, the landscape character is defined by the characteristics of natural, cultural and historical attributes of a given area, or/and perceivable attributes and qualities of these characteristics. Any intention for a given landscape influences its landscape character. Therefor it is necessary to assess any such an intention (Vorel et al., 2006).

Landscape character is defined by ñnatural, cultural or historical attributes, natural and aesthetic qualities, significant landscape elements (SLE), particularly protected areas (PLA), dominant cultural features, a harmonic scale and harmonic relationshipsò(Vorel et al., 2006)

4 A Recommended Approach for Greenway Planning and Design

When planning the greenway compromises have to be made often. One of the common problems is that recreational requirements can conflict with ecological aspects. When this happens a special management is required. In some cases one of the priorities is even eliminated, because the compatibility cannot be achieved (Ahern, 1995). Specifically accomodating people in some sensitive areas can have nehative impacts upon critical ecological elements such as animal habitat, etc. (Flink and Searns, 1993).

4.1 Designing Greenways

An important part of a greenway, which actually enables users to experience the given site is a trail (Flink and Searns, 1993). To design a sustainable interpretative trail several things have to be determined. According to Gebhard et al. (2007) the following should be done before the final decision is made: inventory, clarification of the legal framework for an intended project, selection of a locality, research of natural conditions of the site. It is also recommended to consult with the local people to gauge their interest and obtain their opinion on the proposed project and involve them into a decision-making. This should creatw a better collaboration and a sense of ownership. According to Flink and Searns, (1993) the very beginning of a planning process is the definition of a resource corridor which lays a foundation for the general vision, which can be further developed through an inventory and other subsequent planning steps.

4.1.1 Description of the Greenway Resource Corridor

At the beginning the designer, or planner of a new greenway has to realize the parameters of the resource corridor. This means, what is the linear structure that the entire idea is based on. It can be a river bed, some edges, a historic road, a wildlife corridor, etc. Is it in rural or urban area, or does it include both types of landscape? What should the corridor offer to users? Are there any landmarks, exceptional land forms, extraordinary fauna and flora to interpret or protect? Are there any sensitive areas? Are there any dangerous areas? From where to where should the corridor go? Who are the landowners in the project area, and is it located on a public or private land? Are we interested in a single greenway or in a network of them? (Flink and Searns, 1993; Gebhard et al., 2007)

4.1.2 Inventory

4.1.2.1 Topic

The inventory begins by establishing of the theme or topic of the trail (Gebhard et al., 2007). Since the recreation is assumed to bring benefits, it is desirable to design a trail that eill attract many visitors (Flink and Searns, 1993; Gebhard et al., 2007). To do so, Gebhard et al., (2007) suggest to design a trail that will be interesting for a wide range of people, not only adults, but also children. And that the information will be presented in such a way that visitors do not need any special background to understand what they are seeing. A good tool to draw attention is to emphasize the features, which are unusual, like a water fall for example, or even just to name the trail in a catchy way, e.g. ñLotrando Bandit Trailò The topic itself can range from a field of ecology, geology to history and others. Some examples: history of forest management, wetlands, wildflowers, swamps, cemeteries and so on (Gebhard et al., 2007).

4.1.2.2 Trail User Definition

According to Flink and Searns, (1993) there are two basic categories of trail users: motorized and non-motorized, which divide further into six subcategories. When designing a greenway it is crutial to decide what user group the greenway is meant for, because among some user groups there can be conflicts while using the trail. When this happens, the trail becomes dangerous to use. The six subcategories are following: motorized water trail user, motorized vehicular trail user, pack and saddle animal trail user, non-motorized water trail user, nonmotorized vehicular trail user such as mountain biker, pedestrian trail user. The functional requirements of a greenway have to be met to enable the movement of visitors according to the category or categories of users that the trail is palnned for. The decision influences the width and length of the trail, extent of vegetation clearing and also the radius of curves (Gebhard et al., 2007).

The trail design will also be strongly influenced by the physical fitness and interests of users. A trail for occasional hikers or skiers, etc. with lower level of skills or limited strenght will differ significantly from a trail for experts in this regard. Another point of view on the trail user definition are the key interests of the potential user. Is it a physical activity, or learning about nature, etc.? And at the end, one of the most important things that makes people to tke a trail is its aesthetic value. It is the main attraction for many people (Gebhard et al., 2007).

The number of visitors, their expectations and the distribution of visitors at different locations throughout the year are the aspects that also need to be taken into account. They are related to the carrying capacity of the trail and the level of its maintenance. Such information can be obtained through observations or by surveying. For example taking a visitor count on the parking lots (Gebhard et al., 2007).

4.1.2.3 Legal Framework and Involvement of the Local People

There is a §63 in the Czech Nature and Landscape Preservation Act number 114/1992 that disccusses the right of acces to the landscape.

§63, 114/1992 Nature and Landscape Preservation Act (the Act)

1) It is not permitted to establish or disestablish publicly accessible roads, trails and paths outside the built-up area of a community without the approval of the respective nature conservation authority. The community authorities keep records of publicly accessible roads, trails and paths within their territorial province.

2) Everybody is entitled to free passage over lands in the possession or tenancy of the state, a community, or other legal persons, provided he does not cause damage to the property or the health of another person, and does not transgress the rights to protection of another person's public personality or neighbourhood rights. In so doing everybody must respect the legitimate rights of the owner or tenant or the land and the appropriate generally binding regulations.

3) The rights pursuant to paragraph 2 do not apply to built-on land or building sites, courtyards, gardens, orchards, vineyards, hop-gardens and lands destined for animal farming. Arable soil, meadows and grazing lands are exempted from the rights, pursuant to paragraph 2, at a time when damage may be caused to the growth or soil, or during the grazing of cattle. Separate regulations may restrict or change the right pursuant to paragraph 2.

4) When enclosing or fencing in land which is not exempted from the right of free passage pursuant to paragraph 3, the owner or tenant of the land must ensure free passage over the land by technical or other means, and in a suitable place.

Involvement of the Local People

Several authors agree on the statement that local people should be involved in the planning or that is even neccessary for the project success. It is based on the fact that local people get much more interested and supportive, when they feel they

are a part of the decision-making process. Their feedback can also provide a different perspective for a designer (Flink and Searns, 1993; Gebhard et al., 2007; Hellmund and Smith, 2006).

4.1.2.4 Other Factors Influencing the Trail Design

When designing a trail it is fundamental to think about the technical solutions, as well as the aesthetic and interpretative aspects, so the question of money arises. The costs are strongly influenced by the materials used, the lenght of the trail and other factors, so it is important to be aware of the available fundings for the design (Gebhard et al., 2007).

Ecological conditions of a site also have a big influence on the design. The main rule is to avoid the trail placement in themost sensitive areas (Gebhard et al., 2007).

In the inventory it is critical to cover the information about the existing trails in the area, the required level of environmental protection and the natural features of the area. For this purposes the aerial photographs and topographic maps serve as a great source of information (Gebhard et al., 2007).

4.1.2.5 The Layout Configuration

There are six commonly used trail layouts all described on Figure 3. For a single greenway is most typical the liear type of layout, the other types from the Figure 3 are more typical for networks of greenways. Each layout type provides a little different experience for the user. Wheter it is the linkage from the origin point to the destinantion, or a serie of interlinked trails offering a number of alternatives to reach the point of destination (Flink and Searns, 1993; Gebhard et al., 2007).

Trail layout	Type	Basic characteristic
	LINEAR	A commonly used trail type, considered as a safe one. It is well suited for trails, where alternative transportation, or linkage are the main purpose. Because of its linearity, it enables easy distribution of information boards.

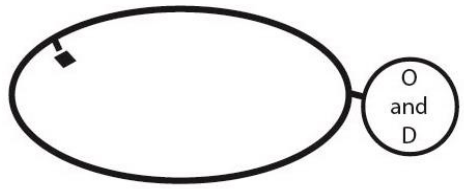
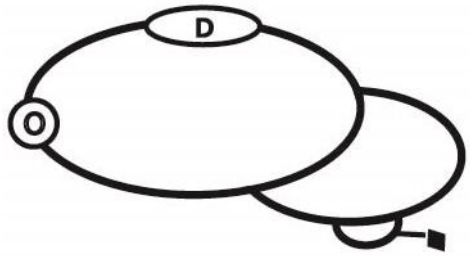
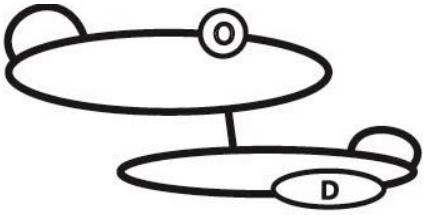
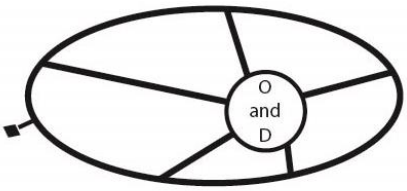
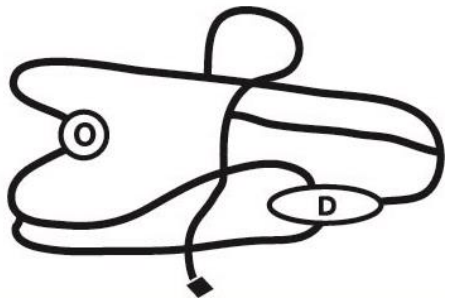
	**LOOP**	The major disadvantage of this type of trail can be a lack of variations it provides. On the other hand users do not have to retrace their steps, when returning back to the point of origin, therefore the impact on the trail state and its environment might be lower.
	**STACKED LOOP**	In this case two or more smaller loops are stacked onto a single bigger loop. It provides a great variety of possibilities in lengths and elevation differences, when the natural conditions are positive in this regard. So this type of trail can satisfy users at very different ability levels.
	**SATELLITE LOOP**	The central loop serves as a collector and it is surrounded by linear and looped trails, which radiates from the collector, therefore each part of the trail can offer different topic, terrains, etc. It increases the variability and also the likelihood that visitors will come again.
	**SPOKED LOOP**	This trail design offers also variability, plus the user is never that far from the place of destination. Visitor can easily choose the length of his trip and whenever is tired, he or she just take next ñspokeòto get back.
	**MAZE**	This arrangement provides the maximum of alternatives. However it require a large area, because the dispersal of visitors is great within this layout and overuse could lead to degradation of the natural resources. It is important to mark such a trail very properly, that users cannot get lost.

Figure 3 Types of a trail layout. O - point of origin, D - destination point. (Flink and Searns, 1993; Gebhard et al., 2007)

4.1.2.6 Trail Measurements

The trail length should reflect the case-specific assumptions of the whole project in terms of intended activities, terrain, topic and abilities of users. For example hiking through the rough terrain is much more tiring than walking in a flat

area e.g. around a lake, so it should be shorter. If there is a one-day visit trail, the length will definitelly differ if it is meant for pedestrian use and for bycycling. It is important to present the trail length and the time needed to cover the trail on signs, or boards (Gebhard et al., 2007).

The slope of a trail has a big impact on its difficulty level, therefore its length and also the drainage and level of needed maintenance. Generally the trail should be planned more parallel than perpendicular to the contours line. If the trail is oriented perpendicular to the contours, water concentrates in the middle of it and causes erosion while running downslope. It is desirable to ensure that the water is directed from the trail as soon as possible. If the trail is planned more parrallel to the contours, less erosion occurs. Well thought sloping sections are also more enjoyable for the users. The desirable range of grades is from 0 to 5 percent, maximum sustained grade is 12 percent and the maximum grade for short pitches is 20 percent up to a maximum distance 30 meters (Gebhard et al., 2007).

Another trail measurement is the **tread width**. The trail should be at least 0,5 to 1,5 m wide. The multiple-use trail should be design as two-way paths and therefor wider. The reconmended paved tread width for cycling should be 3 meters. It is more interesting and even more economical to design trail, which does not have the same tread width in the whole length. More open areas can accommodate wider trail, whereas in forest, or raugh terrain, or other natural environment it is preffered trail as narrow as possible. It enhances the natural feeling of the place (Gebhard et al., 2007). To summarize; Gebhard et. all (2007) states 0.5 meter the minimum tread width for a trail in general, Kumble et. all (2010) suggests 1.5 meters as the maximum width for greenway trail in pluzina landscape.

Clearing of vegetation. ñClearing should follow the rule: as much as necessary but as little as possible.ò (Gebhard et al., 2007) It should be at least 1 meter along the trail, or 0,5 meter on each side of the trail. The height of clearing should enable comfortable room for movement. For walking trails the height is 2,5 meters and for bicycle trails 3,5 meters. An expert is good to invite for the clearing performance, who says which plants would grow across the trail, where the height clearing should be reduced, because the sunlight would encourage the plant growth at the trail edges, etc. (Gebhard et al., 2007).

Material of Surface. Surfacing is a complex topic. It is assumed that there will be no need for very detailed information on this topic for this thesis. However, the very basic general rules are introduced: If same harden surface is required, the

material for this purpose should be of local origin. Natural materials would be used e.g. wood, in order not to destroy the natural character of a site. In case there are some bridges, stairways, or other hardened sections, all these features should be done in the same style along the trail (Gebhard et al., 2007).

4.1.2.7 Communication Methods

The main goal of the interpretative trails is to enhance the visitorsóexperience. The enhancement can be achieved by presenting educational information, or by making certain trail elements very visible and easy to notice. Different communication methods help to accomplish this task. There are three methods recommended by Gebhard et al., (2007). These are descriptive, interactive and sensory methods. A combination of these three methods is also possible. A big advantage of a combined method is that the experience of the nature is obtained at various levels, which leads to a better understanding and sensitivity towards the environment. The trails where sensory perception, interactive comminication of knowledge and images are employed are called the experience trails (Gebhard et al., 2007).

Descriptive Method

Descriptive communication is a method that conveys information via text, tables, pictures, etc. Decriptive method uses two tools ï the trail information panels and numbered pegs. The panels, or information boards provide information directly on the trail; they are not so costly. The second posibility are the numbered pegs, which can be distributed along the trail. These numbers or symbols on the pegs can be found in a map or information leaflet, which would be provided for the particular trail.

Several user groups can be a target group of a given trail and leaflets can be designed to provide a variety of information to different groups. For example, when it is assumed that the trail will be visited by families with children: one leaflet can be designed to contain detailed information about the place and the second one contain puzzles and questions to make the tour enjoyable also for children. It is important to make sure that potential visitors know where they can get the information leaflets. A combination of leaflets and permanent boards is useful. Basic information is always presented on the trail, while leaflets provide specific information for different user group (Gebhard et al., 2007).

Interactive Method

This method simulates the activity of visitors to obtain knowledge. The information is not simply written or showed in a different way, but a visitor is stimulated to think about the given topic. A good example is a board with flaps. There is a visible question or some task and the correct answer is hidden behind a flap. A user should find out the solution on one's own on the basis of some other given information, or via one's experience of the trail environment. One more way of interactive information transfer is providing it on a step-by-step basis. It keeps the interest of a reader and does not overwhelmed one with a lot of data (Gebhard et al., 2007).

Sensory Method

This method increases the experience dramatically. It promotes the incorporation of all senses: hearing, touching, tasting, seeing and feeling. Using this method leads to a deeper understanding and experience of nature. The awareness of different sounds in the woods can be raised by pointing them out and then a visitor would listen more attentively to the surrounding nature, which surrounds him or her. This was an audial example, but other senses can aldo be engaged (Gebhard et al., 2007).

5 Current State of the Topic

The idea of this thesis is based on a paper with the title: ñThe Potential For Developement of an Integrated Network of Greenway Trails on Medieval Hedgerows Landscapes in the Czech Republicñ presented by Dr. Peter Kumble at the Fábos Conference on Greenway and Landscape Planning in 2010. It is a result of a work of a group of cooperating authors from University of Massachusetts and Czech University of Life Sciences (namely Kumble, P., Molnárová, K., Skleniļka, P., Brabec, E., Kottová, B., Pixova, K., Ġálek, M.).

In general the authors of the paper see a great potential in the use of greenaway for the ecotourism in the historical Czech pluzina landscape. However the topic is not discussed in a great detail in terms of design standards, the funding possibilities, marketing, signage, wayfinding, or the way of interpreting the facts to educate potential users. The objective of this thesis is to propose the design standards for the greenway planning in pluzina landscape.

6 General Greenway Design Proposal for the Pluzina Landscape in Present Day Czech Republic

Following chapeter is based on information gleaned from the literature review and is dedicated to the description of the proposed greenway design for the remnant pluzina landscape. But why place such a greenway is the pluzina ladscape? The pluzina (a network of hedgerows which divided differnt agricultural land parcels) has its roots in history dating back to a pattern of agricultural land use common the the medieval period in the former Bohemian landscape. This is a key reason for interpretation of this historic and iconic landscape for the public with an integrated network of greenway trails.

Trail user definition. The idea is to attract mainly pedestrian trail users, off-road cyclist, and in specific areas where the conditions allow it, cross-country skiers. Greenways by their definition are not intended for use by motorized vehicles (motorcycles, cars, etc.). As such, the design is to plan the trail(s) for non-motorized users.

Another point is the main interest of the potential user. The idea in this case is to design a trail that would be interesting for different user groups, among others family with children going for a recreational after lunch walk, group of users such as a treking club who might want to conect learning about the culturla history of the landcape coupled with physical activity, or simply users whose main interest is physical activity typical to hiking or cycling.

The trail measurements. Since the group of potential users is envisioned heterogenous, the trail measurements have to allow for a variety of user needs. This could be accomplished by planning two or even more sections within the greenway trail with different lenghts and across different topographic slope characteristics. Then both, pedestrian and cyclist could find the trail enjoyable, not too long or too short. On a site where the terrain conditions are variable enough, the sections could also offer different slope graident challenges. The recomended values for the design of a trail slope are discussed in the litertature review. For example, the optimum slope is from zero to five percent and the maximum is twelve percent. The optimumal values are planned to be followed. The exception would be done in cases where it is not possible to place the trail within this range withoun any interuption, or

in some sections of the trail that would lead to a viewpoint or some other interesting feature that might be present.

Another trail measurement is the tread width, which is envisioned to be in a range between 0.5 and 1.5 meters. The width 0.5 meters is the minimum value and 1.5 meters is recommended maximum for the greenway in a pluzina landscape; both numbers are discussed in greater detail in the literature review.

Material surface of the trail. The idea is to avoid any significant surfacing (asphalt pavement or brick) of the trail in the pluzina landscape. Existing farm trails or roads are typically dirt paths or lanes, so a greenway trail must preserve the original character of this type of landscape. However if some surfacing is needed to prevent erosion (including narrow bridges, stairways, single steps and others), only local found material should be used for this purpose.

The communication methods. In the literature review the combination of the three communication method (descriptive, interactive, sensory) are described as the most effective way of transfering information to the visitor for their education or just entertainment. The combination of both educational and locational is a complex solution. In this diploma thesis, the descriptive method is recommended as the basic method for the purposes of greenway planning in pluzina ladscape. The combination with the other two methods is welcome and benefitial.

Trail accessibility. The target area should be accessible by public transportation too. When it is not reachable by bus, train, etc., safe and adequate parking for cars should be designated.

Linkage to trail already existing in the area. An analysis must be accomplished to to determine the presence of trails within the particular area. If there are some other trails in the area, the proposed pluzina-greenway should attempt to provide a linkage in order to expland the network of non-motorized trail opportunites. The presence of the trail can also indicate some other interesting features, which might be present in the area. It is good to analyse it as well to be aware of what else can be offered to the visitor. Other landmarks or interesting natural places not only among the existing trail, but within the area of interest, should be analysed for this purposes too. These might include historic landmarks such as castle remants, old religious markers, churches, burial grounds, battle fields, etc. If some are found, they can be used as an additionary target for the greenway user.

The pluzina landscape presentation. Since the greenway in this case is planned for the pluzina landscape, it is desirable to offer different perspectives on it. For example, the trail should be placed within the pluzina landscape in areas where the old medieval hedgerows are preserved. In areas where they have partially disappeared, educational information should be provided to explain why this occured. Historical maps are a great tool to analyse this because such maps also show the old roads, forested areas, settlement pattern, etc., all desirable for use as the basis for the new planned trail.

The hedgerow patterning and distribution within the pluzina should be also shown from different perspectives to make the trail more interesting and educational for users. This means locating the trail close to adjacent to the hedgerow. Other perspecitves is the observation of the spatial distriubution of the pluzina from greater distance such as the center of the village where the pluzina was once associated with, or from higher topographic hilltops or side slopes. A very simple scheme of the principle of placing the trail folows.

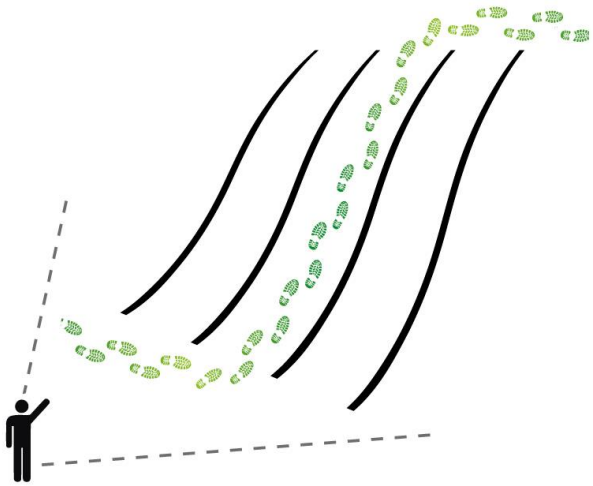


Figure 4: A scheme showing the idea to offer more perspectives to the user

Greenway idea application. Everything in the proposal what was stated as far could be aplicable to some random trail For greenway planning is neccessary to follow the main idea of it ï greenway is based on some linear structure (ridge line, stream, pluzina, etc.) In this case the structure are the hedgerows in pluzina. However the greenway can be planned in different lengths and also in areas with different level of preservation of the pluzina structure. It means that the lienar structure can happen not be continuous. Then other linear structure should be find to design the greenway trail

7 Methodology

7.1 Greenway Trail Design Methodology

The final proposal of a greenway trail is based on several analyses. Those analyses are carried out with a help of different data and also software. In general one should try to find digital data sources of information available online and for free with no charge for downloading. On-line data can be rapidly accessed and used. There are certainly such sources; these have been used in this thesis and are described below. However it is not possible to obtain free data for all of the analyses. For example, the slope analysis data set could not be obtained as a complete data set and the author had to generate original calculations.

7.1.1 Slope Analysis

There were defined the values of optimum and maximum slopes for the greenway trail planning (optimum 0-5 %, maximum 12%). This information can be obtained by performing a Slope Analysis using ArcGIS. The data source for it is the layer of topographic contours. The contours layer is available on Geoportal ČÚZK, the Czech Internet interface of the Czech Office for Surveying, Mapping and Cadastre (ČÚZK) organization, which provides the spatial data. The elevation data called ñZABAGED ï altimetry ï contoursò are not available for free for commercial use. The data would need to be ordered in accordance with the Terms Of Trade of the Geoportal ČÚZK E-shop and purchased in advance. The data are available for free for students for purposes of academic semester research; bachelor or master thesis. However students can order the data only in limited range (Geoportal ČÚZK, 2013). Once the data has been obtained, the analysis can be started.

The base map for the analysis used an aerial orthographic map of the study area, which can be added to ArcGIS using the WMS service, available on http://geoportal.cuzk.cz/WMS_ORTOFOTO_PUB/WMService.aspx. For creation of a digital elevation model (DEM), the author used a single ArcGIS tool known as ñTopo To Rasterò DEM is an input raster for the tool ñSlopeò, which creates a grid representing the slope values. The tool Slope offers two units settings; degree and percent. It is obvious that in this slope analysis the unit percent is chosen. The output raster of the Slope tool is further used for the delineation of areas with values in the range 0-5 % and 5-12 %. This is performed using the tool ñLess Thanò, which is actually used twice, first for 0-5 % and second for 5-12 %. In general the output of

the tool ñLess Thanò is a raster with values zero and one, where the pixels containing the value one are these, which meet a given condition. To make the results easily readable, the resulting rasters are converted to polygon features. First the raster 0-5 % is converted. To accomplish this, the tool ñRaster to Polygonò from Conversion Tool is used. The conversion creates a polygon layer with grid codes zero and one. In the obtained vector layer the polygons with grid code one are the polygons representing the required information. A separate layer is created for the polygons with grid code one. Open ñAttribute Tableò, then ñSelect by Attributesò, ñGridcode = 1ò. When the selection is done, a single new layer is created. The same procedure is repeated with the raster 5-12 %. At the end the appearance of the layers is set (transparency), which can significantly improve the clarity (ArcGIS Resources, 2013).

The slope distribution pictured on the aerial photograph of the area helps to avoid excessively steep sections.

7.1.2 Analysis of Historical and Current Maps

The comparison of maps from different time periods is a good method and helpful way for finding the areas where pluzinas were formerly located. It also provides a good means for locating the old routes or pathways. An overview of these maps is presented below.

IInd Military Survey

The IInd Military Survey map was created during the period 1836-1852. The scale of the map is 1:28800. This Survey had much higher level o accuracy than the previous Ist Military Survey, because it was based on the triangular net which arose in the period between the two military surveys. This map shows among other landscape elements, the fields and their divisions into separate plots (LaboratoŚ geoinformatiky, 2013). This map is available to be looked to on www.mapy.cz, or it can be also be viewed by using the ArcGIS server connection; link http://geoportal.gov.cz/arcgis/services, folder CENIA.

IIIrd Military Survey

The IInd Military Survey map was created during the period 1876-1880. The scale of the map is 1:25000. The triangular net was denser and the leveling net was established, resulting in an increase of the map precision. This map shows among other landscape elements the fields and their divisions into separate plots. It also

depicts the road network quite nicely (LaboratoŚgeoinformatiky, 2013). This map can be viewed using the ArcGIS server connection; link http://geoportal.gov.cz/arcgis/services, folder CENIA.

Aerial Maps

This map illustrates the land cover from the specified period in time. With this type of map, the pluzina landscape can be easily recognized. When these maps are compared with the Military Survey maps, the areas where pluzina is preserved, partialy preserved or disappeared can be identified. There are more sources where these types of maps can be view, however the general source is basically ĘUZK and most of the sources listed below are simply sources. On the server www.mapy.cz, the aerial maps from the years 2003 and 2006 are available. Aerial maps are also available on http://geoportal.cuzk.cz/geoprohlizec/ and on http://maps.google.cz. Another possibility is WMS connection in ArcGIS; link http://geoportal.cuzk.cz/WMS_ORTOFOTO_PUB/WMService.aspx.

7.1.3 Presence of Specially Protected Areas

The specially protected area on one hand indicates an interesting mostly natural feature, on the other hand it can also be the reason for redirecting of the trail. It is highly dependend on the specific rules of the specific protected area. The specially protected areas are collected in a database - the Central List of the Nature Protection on the webpage of the Nature Conservation Agency of the Czech Republic available on http://drusop.nature.cz. In this database are provided information about all specially protected areas in the Czech Republic. There is also a map service for searching. For every specially protected area there are described the objectives and goals of protection in this database. There are also the care plans and also other materials can be provided.

7.1.4 Analysis of the Existing Trail Network And Public Transportation Accesibility

The Touristic Map as viewed on Mapy.cz can be also a great source of information for planning, because mostly they present the most interesting landscape features in the given area. These include existing trails, points of view, historical buildings, etc. There is a touristic map available online on www.mapy.cz. Another source is the touristic web page, where directly a touristic map for Jeseníky region can be found; link www.treking.cz/regiony/jeseniky-mapa.htm.

The issue of public transport accesibility was discussed in Chapter 6 and the analysis of the options in a study area should be performed. An easy item to find, for example, is the starting point of the trail available by public transportation. The complete bus and train timetable available on http://jizdnirady.idnes.cz.

7.2 Landscape Assesment Methodology

Performing a landscape character assesment can be a problematic task in terms of objectivity, because the qualities of a particular landscape are difficult to quantify. Therefore a method was developed in 2006 by Vorel et al. to ñunify the procedures of case-specific landscape character impact assesment, and to create a single procedure that is as standardized as possibleò (Vorel et al., 2006). This method is described in the document called ñA method for assessing the visual impact on landscape character of proposed construction, activities or changes in landuseò (the Method).

The document itself describes the procedure of assesment in a detail. It includes also the important terms definitions. Since a great part of the document is necessary for the assessment and this Method will by used as a tool for the assessment in this diploma thesis, the whole document is atteched in the apendix of this work and on this pages only the basics of the procedure are described.

Landscape character protection must focused on all features forming the landcape character which are stated in the chapter ñLandscape characterò of this thesis in accordance with the §12 of the Nature and Landscape Preservation Act 114/1992 (Vorel et al., 2006). The method for assesing the impact of an intended project described by Vorel et al., 2006 consists of three separate stages. First of all the landscape area affected by the intended project has to be delineated. In the second step the landscape character of the affected area is evaluated. The last step is the assessment of the extent, to which the intended project can influence the landscape character (Vorel et al., 2006).

Delineation of the affected landscape area (ALA) is necessary particularly because any intented project can influence directly only a limited area. The delineation of ALA consits of two steps. At first a detailed description of the intended project has to be performed. The decription gives the basis for analysis of potential effect of the intended project, physical or visual, on the landscape character. The actual delineation of the ALA is accomplished by engaging the visibility analysis. Two rings of potential visibility are established, one for strong visibility of the

intended project, second for the clear visibility of it. Within these rings visual barriers are analysed, mostly by using the barrier method; a barrier can be the morfology of the terrain, forest stand, built up area. When the data for ALA delineation are combined, the potentially affected area is obtained (Vorel et al., 2006).

The evaluation of landscape character of the area includes several steps. There are established Landscape character zones (LCZ) and Landscape character unit spaces (LCUS). The LCZ is the charachteristic of the landscape character in general context. LCUS are landscape parts homogenous in character delineated within ALA. When LCZ and LCUS are established the evaluation and classification of identified attributes of the landscape character comes. Attributes ï natural, cultural and historical ï are identified only within ALA for each LCUS. The chapter B.2.4. of the Method describes the landscape character attributes and therefor it is very helpful for the identification of the attributes of LCUS. The classification of the attributes is done with regard to their significance, rareness and impression they give. The significance is differentiated in three levels: fundamental, significant and marginal, which goes from crutial for the landscape character to lesser importance for the landscape character. For the assesment the definition of rareness of attributes is necessary as well. The rareness is evaluateted in relevance with landscape character, region or state as unique, rare or common. At the end there are considered the positive, neutral or negative impressions, what the particular attribute gives, because each aspect of landscape makes an impression (Vorel et al., 2006).

The last step is the assessment of the impact of the intended project which is critical for greenway planning in a pluzina landscape. It is important to evaluate, how much does the intention influence the lanscape character, because it can be fundamental for the evaluation of acceptability of the project. The impact is assessed as positive or negative. When the impact is positive, then it is always in accordance with the landscape character protection and there is no need to evaluate its intensity. If it is called a negative impact, when the intended project somehow degradates the positive natural and aesthetic qualities of the landscape. For the negative impact the intensity is evaluated. The range is no impact, low impact, medium-size impact, strong impact and devastating impact. It should be pointed out that if the attribute of the landscape character is evaluated as negative, then the assessment of the intensity on that particular attribute is not performed (Vorel et al., 2006).

All theese collected facts can be filled in in a Summary sheet of the classification of intended attributes and the intensity of the impact of the intended project on theese attributes, which is found on the page 22 of the Method. In terms of landscape character protection, this is a sufficient set of information for a final statement on the acceptability of the intended project (Vorel et al., 2006).

The assessment of the impact of linear structure on the landscape character

Since a grenway is a linear structure, it is desirable to be aware of the assessment of linear structure on the landscape character. The linear structure assessment has four steps. They correspond with the Method, but the following figure, where the procedure is nicely pictured, is presented for better undestanding A brief description of it: First the Landscape Character Zones (LCZ) are identified. Second step is the delineation of Landscape Character Section Units (LCUS). The third step is the identification of positive landscape character attributes, their evaluation and classification and at the end the conflicts between described attributes and intended linear project are identified and the acceptability of it is assessed (Vorel and Kupka, 2011).

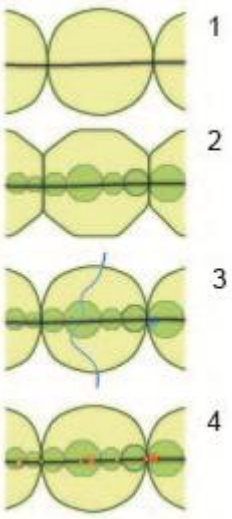


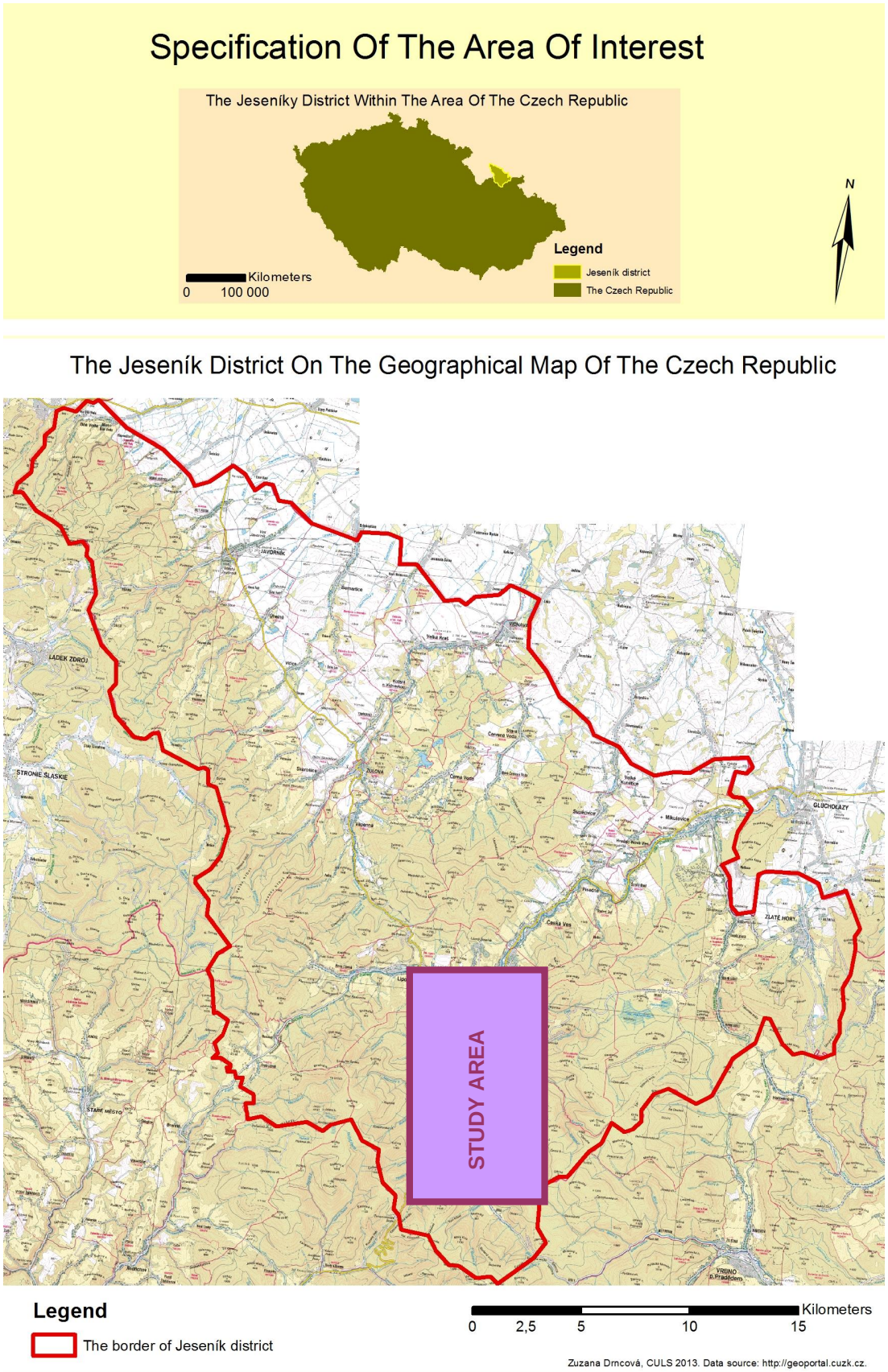
Figure 5 The genaral principle of the linear structure assessment on landscape character. 1 ï Delineation of the Landscape Character Zones (LCZ) within an area on the basis of natural, cultural-historic and aesthetic qualities of an area. 2 ï Delineation of the Affected Landscape Areas (ALA). The areas that would be affected by an intended project. 3 ï Identification of natural, cultural-historic and aesthetic attributes within ALA and their classification. 4 ï Identification of conflicts between an intended project and natural, cultural-historic and aesthetic attributes of the landscape character.

8 Case Study

There proposed greenway trail in this case study has been assessed for its potential impact on the landscape character of the area. The study area is situated in the Jesenická kotlina Valley, which is a part of Jeseník district. The locality is displayed on the Map 1.

Jeseníky district is located in the Olomouc region in the northeastern part of the Czech Republic. For the point of historical classification, the district Jeseník lies on the western reaches of the Czech part of Silesia. Jeseníky region spreads out on the Hrubý Jeseník Mountains on the south and Rychlebské Mountains on the west. On the northeast there is the hilly area known as Ţulovská pahorkatina. Through the area flows the rivers Ļ erná Opava and Vidnávka and BĎlá. The BĎlá river is the largest river in the Jeseníky district (Koţacký, 1997). The BĎlá also flows through the Jesenická kotlina Valley. The particular area of interest is shown on the Map 1.

According to Culek (2005), the study area belongs to the Jesenický Bioregion. There are highlands with the high-altitude 450-600 meters, however only the Jesenická koltina Valley and the borders of the bioregion are flatter. In general the bioregion altitude differs from 550 to 1420 meters above sea level. According to Quitt (1971), the area is situated in the cold climatic region and particularly in Jesenická kotlina Valley where the average annual temperature is approximately 7,1 °C and average annual precipitation 846 mm. This means that the area is colder and has higher amount of precipitation that the average of the rest of the Czech Republic. The prevailing soil type is cambisol. Jesenický Bioregion contains five altitudinal vegetation zones; from 4. beech vegetation zone to 8. subalpine vegetation zone. The biota is heterogeneous and rich and this is the only Czech area where larch (*Larix decidua*) is an autochtonous species (Culek, 2005).

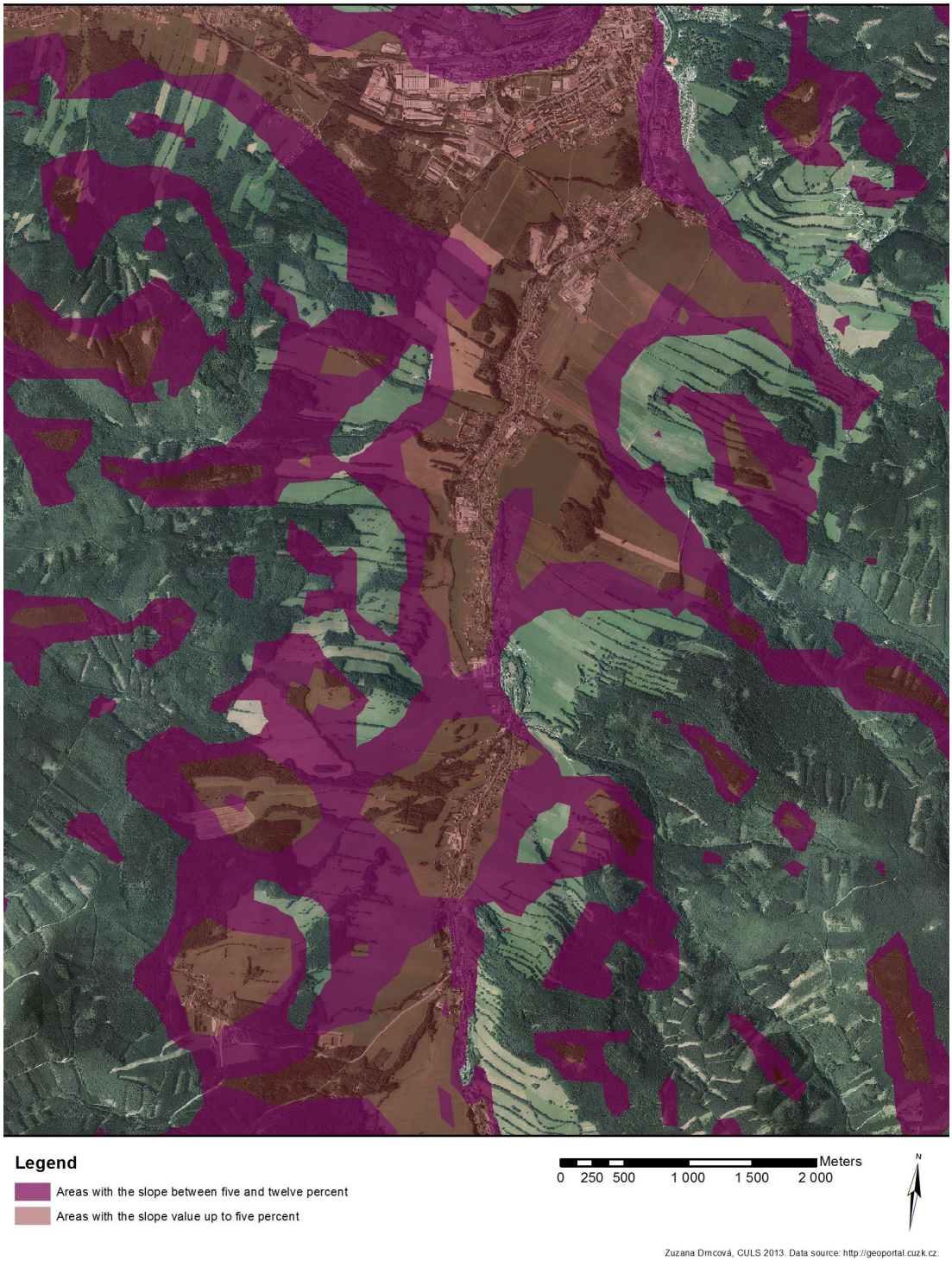


Map 1 Specification of the study area

8.1 Inventory

8.1.1 Slope Analysis

A Map Representing the Areas With Slopes Up To Five Percent And Between Five And Ten Percent On the Aerial Photograph Backgroung



Map 2 Slope analysis

The slope analysis demonstrates that the terrain with optimum slope, up to five %, is found mainly in the build up areas and its closest. The slope of up to

twelve % is commonly found in most of the study area, which create a bypass to the areas with the slope up to five %. In any case from the Slope analysis it is obvious that almost any of the five % slope areas are not covered by the remnants of pluzina hedgerows. In the case of twelve % terrain, the situation is only sligtly better.

8.1.2 Analysis of Historical And Current Maps

Figure 6 A cut-out of the study area from the II[nd] Military Survey map (ArcGIS server conection on http://geoportal.gov.cz)

Figure 7 A cat-out of the study area from the map of the III[rd] Military Survey (ArcGIS server conection on http://geoportal.gov.cz)

Figure 8 A cut-out of the study area on aerial map (Geoportal, 2013)

Figure 4 and 5 displays the cut-outs from the maps from IInd and IIIrd Military Survey where the situation of filed division in the second half of nineteenth century is visible. On the IIIrd Military Survey cut-out, the network of pathways and roads is clearly pictured. On the historical maps, it seems that the pluzina hedgerows were in the length from the forest stands located near the build-up area. On the aerial photo the situation is different. Pluzina structure is preserved in apporximately a half of the area in different range. Most of the remnants seem to not have their original length when compairing aerial orthographic photos and the Military survey maps. From the comparison of the historical and current map, the circled area seems to be the closest to the conditions that existed in the second-half of the nineteenth century.

8.1.3 Presence of Specially Protected Areas

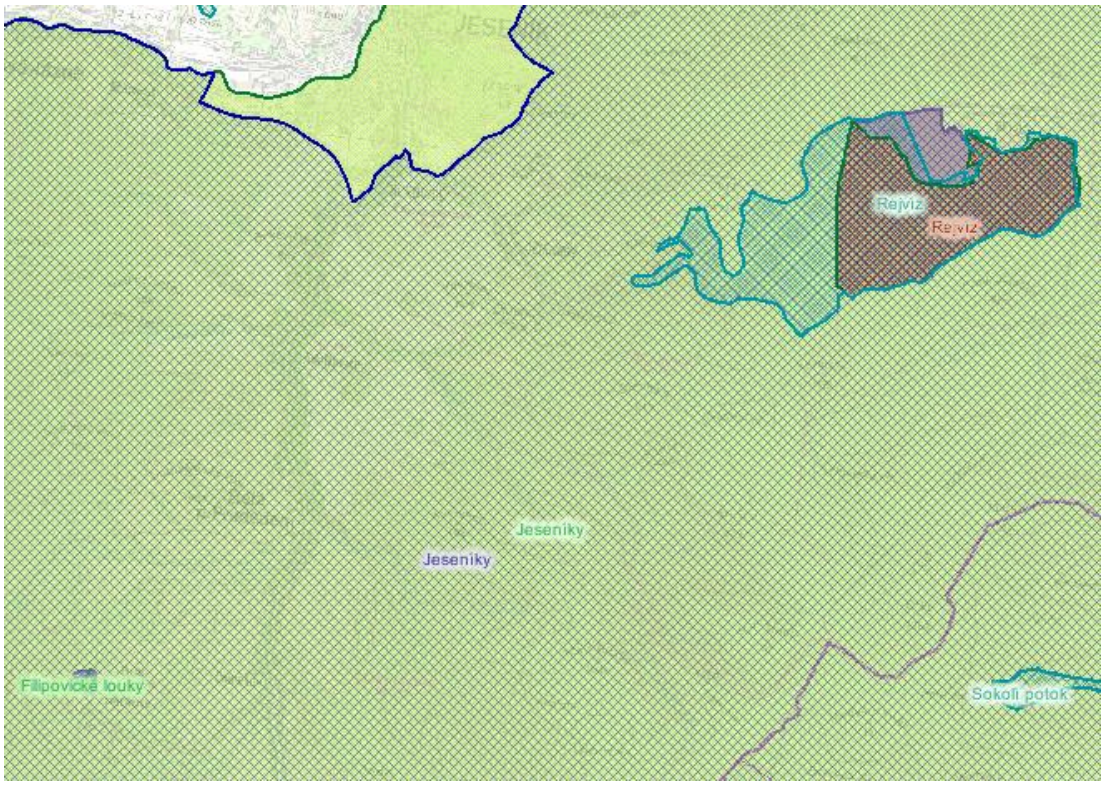


Figure 9 A cut-out form the map showing the specially protected areas in the study area (AOPK ĻR, 2013)

It is apparent from Figure 8 that the study area is situated in two specailly protected areas. The light green colour is for the Protected Landscape Area Jeseníky and the blue hatch represents the Bird Area Jeseníky. The objective of protection in the Bird Area Jeseníky are the populations of hazel grouse (*Bonasa bonasia*), corn crake (*Crex crex*) and their biotops. In the government regulation from 27. 10. 2004 which delimitated the Bird Area Jeseníky area listed activities, which cannot be started before the competent agency of nature conservervetion approves it. One of them is placing of new trail for tourism, cycling and cross-country skiing (AOPK ĻR, 2013). Generally it means, that if the project is planned, a copy of the documentation has to be send to the competent agency for nature conservation. If the project did not have any significant impacts on the objectives of preservation of the protected area, it would be approved.

8.1.4 Analysis of the Existing Trail Network and Public Transportation Accesibility

Figure 10 A cut-out of the study area from the touristic map (Mapy.cz, 2013)

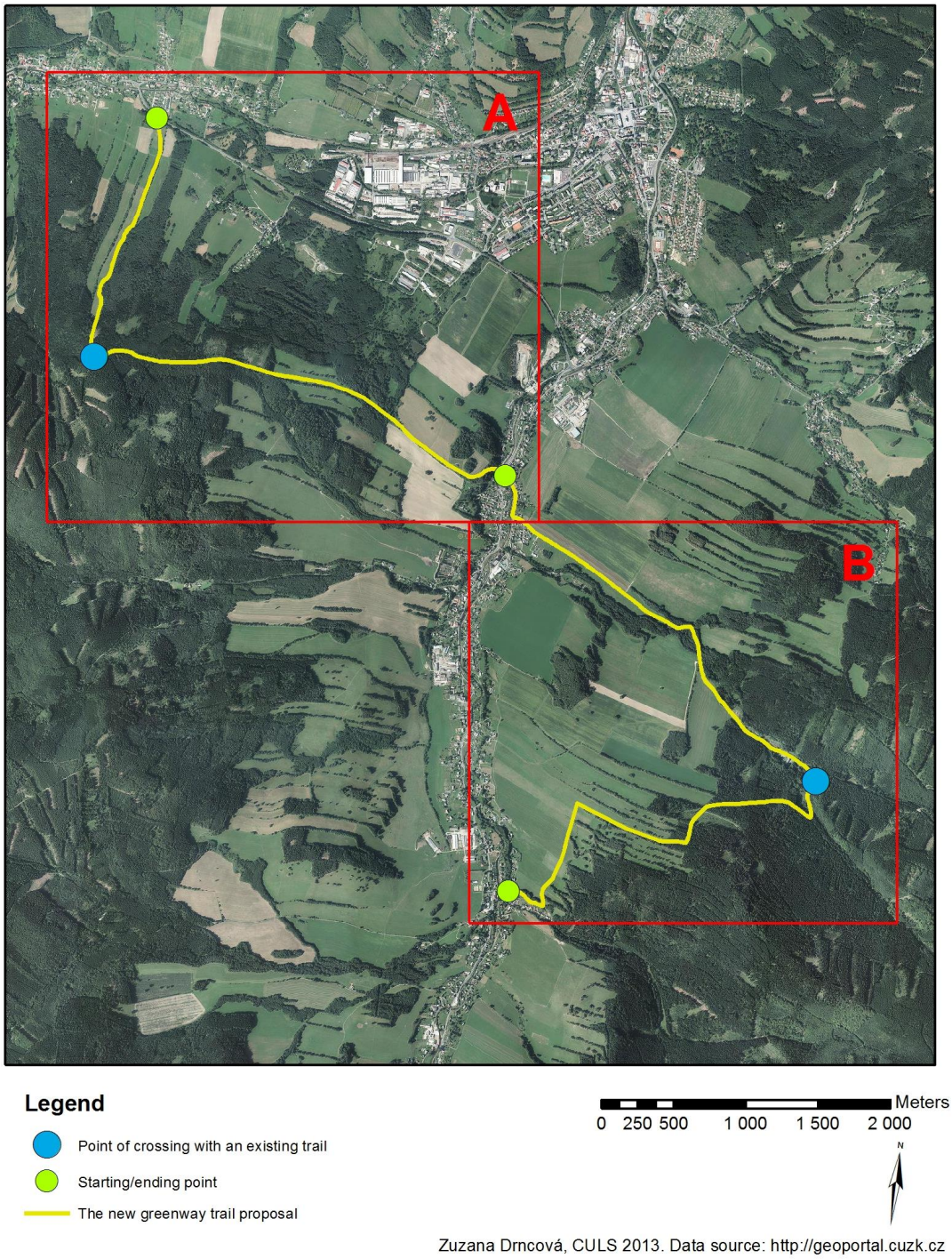
Figure 9 displays the existing trails in the area. They are marked as the colourful lines. There are shown also the cross-country skiing tracks, marked as the grey line with the picture of cross-country skier. Viewpoints are marked as a blue ñanà Hilltops are marked a little triangle with given altitude, etc.

From Figure 9, it is obvious that there are already trails in the study area that could be partially used as a greenway trail, particularly the green route which goes along the river.

On the way from BÞlá pod PradÞdem to Jeseník, there are several bus stops, where service is also available on Sunday. In the city Jeseník and Lipová-LáznÞ there is also a train stop. This all suggests that public transportation is available in the build-up areas of the study area on non-working days for many users.

8.2 Greenway Trail Proposal

The New Greenway Trail Proposal on an Aerial Photograph Background
And the Division to Map Sheets for the More Detailed Maps



Map 3 Greenway Trail Proposal

Map 3 shows the proposed design of a greenway in the study area. The proposal was done on the basis of a previous inventory. One of the most

problematic tasks was the placement of the trail within the quite steep study area. It is partially solved by placing the trail on the already existing one, where it was in accordance with the general idea of a new greenway. In the steep places, where a new section is planned, the effort is put to either make it as short as possible or to avoid placing the trail perpendicular to the contours.

The whole proposal was divided into seven sections, which are described in greater detail below. The directions are described in a way, that the visitor is going from section one to section seven, however it is just for the purposes of description. The greenway can be started and also ended at various points. The division into sections is displayed in Map 4 and Map 5.

Section 1

Section 1 copies the already existing blue trail and this part of the blue trail is used as an access path to the new greenway trail. This section is 260 meters long.

Section 2

A newly designed section of the greenway trail. It can be divided into two parts. The first part leads to the sharp turning to the right. It is perpendicular to the pluzina remnants and also serves as a viewpoint. From this part of the trail the pluzina remnants on another site of the village are apparent. This section is placed there to show the spatial distribution of pluzina. The second part of the section is placed directly along the hedgerow and shows the pluzina from close distance. The length of this section is 1850 meters.

Section 3

Section 3 is based on an existing green trail. The first part is going through the forest. Then it still follows the green line, which is placed along the river. In the part of the section, where the landscape is open, it is possible to observe the pluzina structure on the right. It is the longest part of the proposed greenway, it has 3960 meters.

Section 4

Section four with its length 400 meters is placed in a build-up area. It serves as a linkage between Section 3 and 5.

Section 5

Section 5 introduces the part of the land of the study area, where the landscape used to be much more open. It is captured in the Map especially from the time period, when the IIIrd Military Mapping was carried out. The lnegth of this section is 1770 meters.

Section 6

Section 6 with its length 1540 meters serves basically as a linkage between two other sections. It goes through the forest. It is partially placed on the existing yellow trail, partially on a path marked as the cross-country skiing tracks going adjacent to a stream, which variegates the view from the trail.

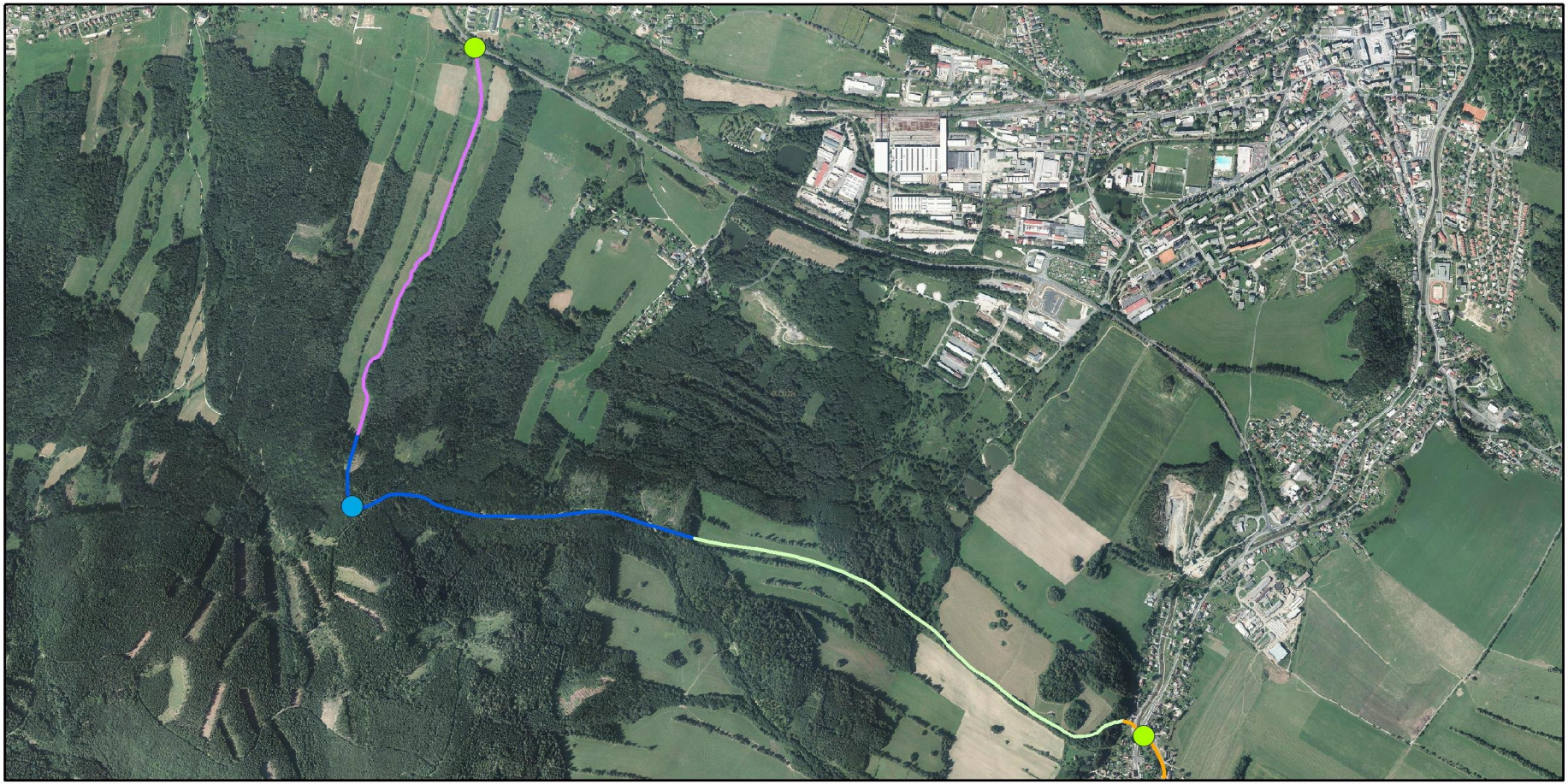
Section 7

Section 7 is adjacent to the longest pluzina hedgerows in the study area and offers 1500 meters of walking in a close contact with the structure.

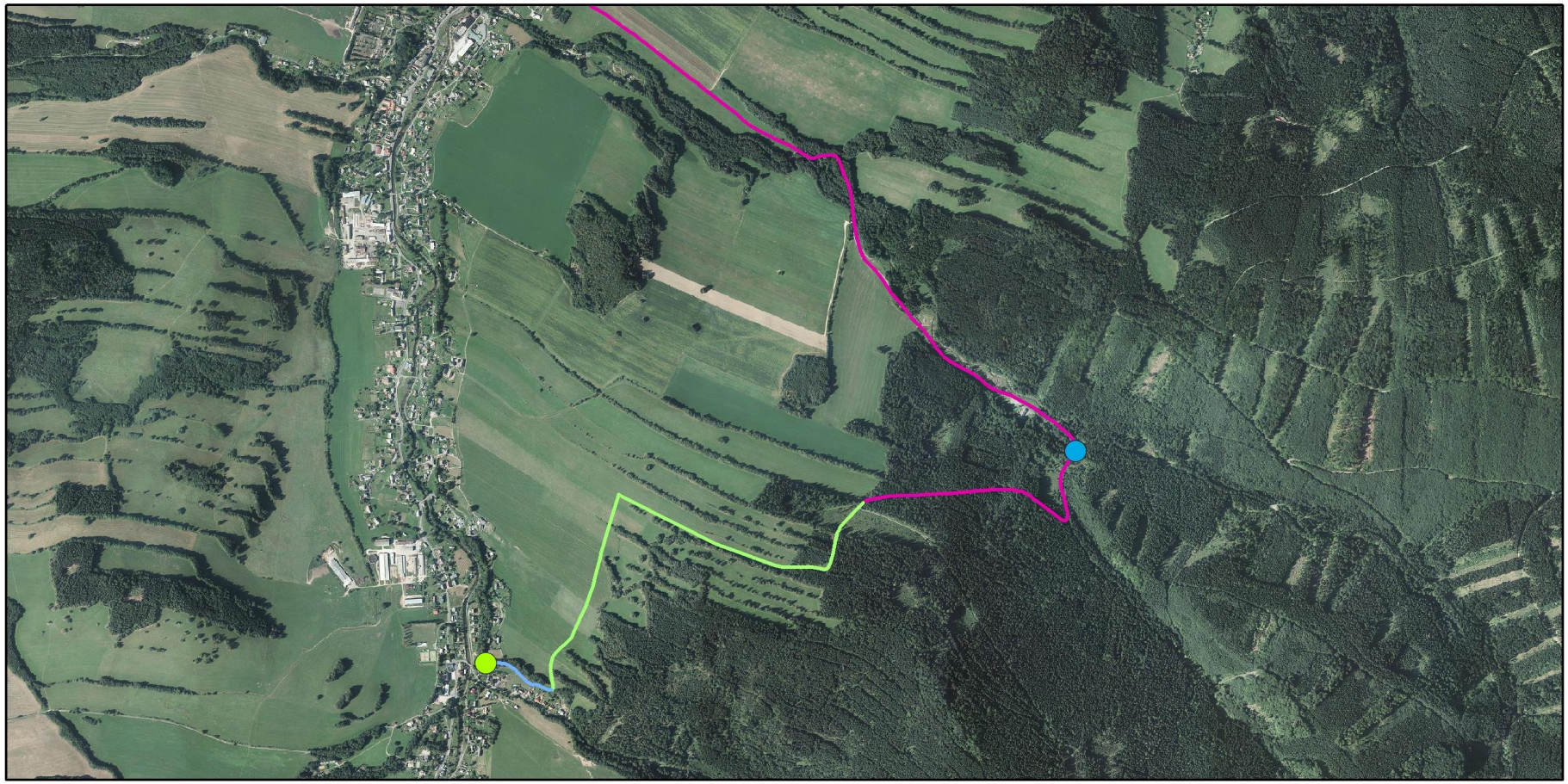
Three potential starting and ending points were defined in the area and also two points, where the greenway proposal crosses with the existing trails.

Sections 1-3 (length around 6 kilometers) basically fulfil the recreational and educational function of a greenway. Sections 5-7 (total length aroung 5 kilometers) can in certain cases also be used as a linkage between two build-up areas, which is another greenway function. The total length of the proposed greenway is around 11 kilometers.

Map Sheet A. The New Greenway in Greater Detail. Division into Sections



Map Sheet B. The New Greenway in Greater Detail. Division into Sections.



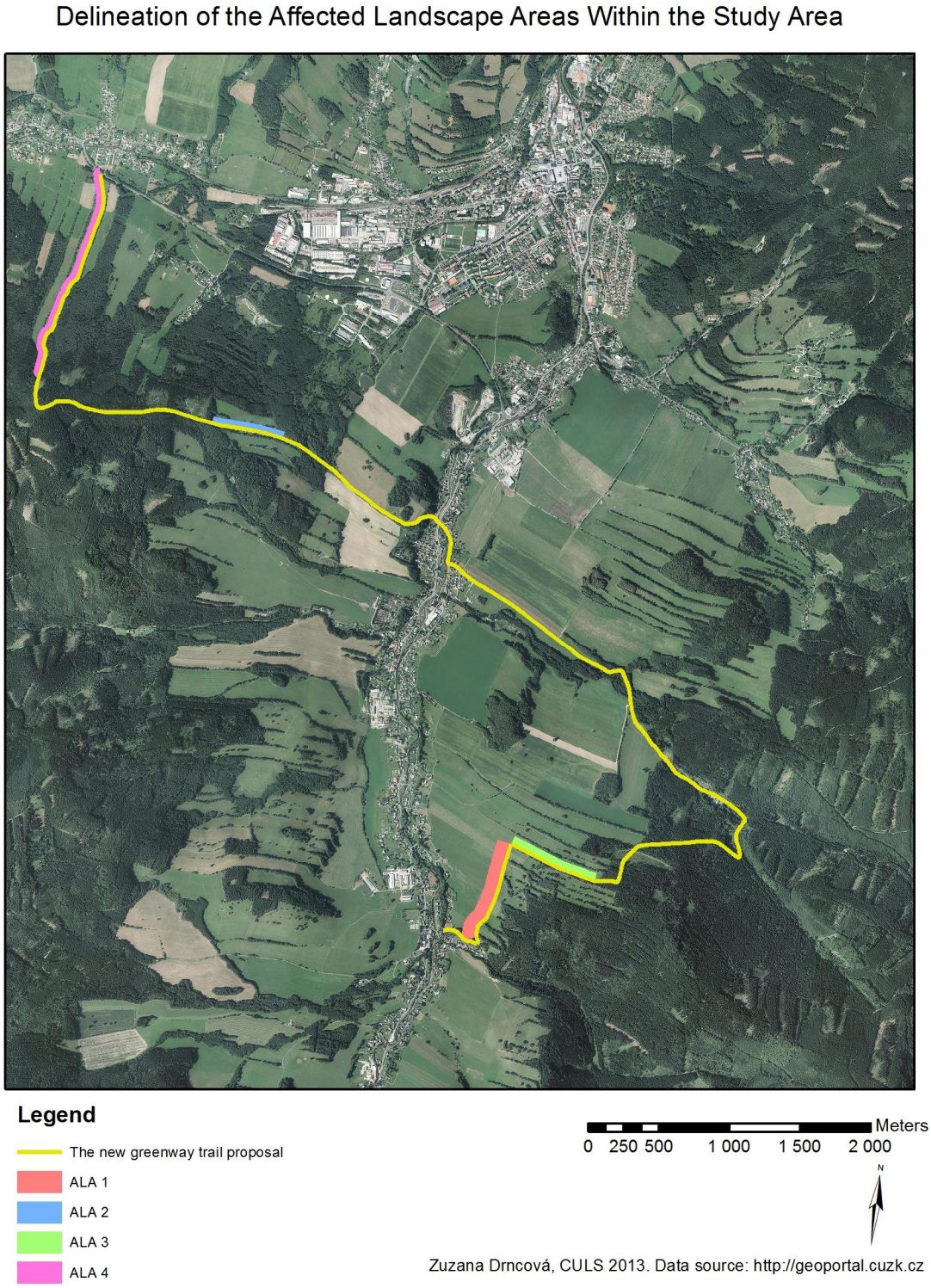
8.3 Ladscape Character Assessment

In the Method disccussed in chpeter 6.2 is stated that if an intended project has a positive impact on the ladscape character, then there it is not assessed further. The intended greenway trail is assumed to be having a very low or even no impact, however it most likely would not have a positive impact, therefore the potential extent is assessed.

8.3.1 Delineation of the Affected Landscape Area (ALA)

To delineate the ALA the project has to be described first, it is already described in the chapter 7.2. Just to summarize it is the intention of creating a new greenway trail in the historic pluzina ladscape. The trail is placed in most of its lenght on the meadows and certailn parts also in forest. There will be no surfacing or just as less as possible using the local resources.

The sections of the intended greenway, which copy the existing trails are taken as a component of the landscape character, because they are already there, therefore their impact is not assessed. There were identified four ALA within the study area shown on the Map 6. Because the trail is going on the ground, has no height and its surface should be natural it will not be visible from big distances. The ALA 2,3 and 4 is defined by the closest hedgerows. If one looked on the pluzina structure, which the trail would go through, from further distance, the trail would be unnoticed on the hedgerow background. In case for ALA 1 is the situation a little bit different. The trail there is placed on the meadow, where pluzina is also present, but it does not make a background for it in whole its lenght. It might be visible, when looking from lower point of the hillside, however this hillside has a certain steepnes and it breaks more steep in about 100 meters far on the left side of the trail. From further distance it would not be visible. That is, how the ALA 1 was delineated.



Map 4 Affected landscape areas (ALA)

8.3.2 Landscape Character Assessment of the Study Area

The study area is situated within the Protected Landscape Area (PLA) Jeseníky. A preventive assessment of the landscape character of PLA Jeseníky was performed by the AtelierV office in 2011. On the basis of the preventive assessment the assessment of the intended trail is done. In the preventive assessment the

landscape of the PLA Jeseníky was divided into 13 Ladscape Character Zones (LCZ). The study area belongs to the LCZ River Bělá Valley and Jesenická kotlina Valley. The LCZ is divided into three Landscape Character Landscape Units (LCUS) and the new intended greenway trail is proposed in the LCUS River Bělá Valley (AtelierV, 2011).

8.3.2.1 Description of the LCZ River Bělá Valley

A wide valley of the River Běla is bounded by the east hillsides of the Keprník Mountain (1422 meters above sea level) and Ġerák (1350 meters above sea level) and the west edges of Můdvedské highlands with steep woody hillslopes of Lysý vrch (1128 m). There is a wide profile of the valley with predominantely linear (already altered) housing developement of the villages Adolfovice, Domaġov, Bělá. There are units of cultivated agricultural land with remnants of the historical pluzina structure. At higher elevations of the Bělá river the area is more closed and swelling up to the mountaneous character with more free buil-up areas of cottages. The area is remarkable with its unique sceneries of huge valley with expressive dominants of mountain ridges and hilltops, with the contrast of continuous forest stands and structure of pastures and meadows on the hillsides (AtelierV, 2011).

8.3.3 Landscape Character Assessment

AtelierV (2011) it its preventive assessment of PLA Jeseníky identify also the attributes of the landscape character of LCUS Bělá River Valley. In the following chart there are listed the attributes, which were identified within the Affected Landscape Areas and there is also classified their impression, significance and rareness. The affected landscape areas are very small, that is why there is not so many of the attributes. In the last column of the chart is assessed the extent to which the intended greenway can influence the landscape chraracter of the area.

Summary Sheet Of the Classification of Intended Attributes And the Intensity of the Impact of the Intended Project on These Attributes	**Classification of identified attributes**			**Intensity of the impact of the intended project on the identified attributes**
	According to attribute impression	**Acording to attribute significance**	**According to attribute rareness**	**Positive impact** **No impact** **Low impact** **Medium-size impact** **Strong impact** **Devastating impact**
Attributes of landscape character	+ Positive N Negative 0 Neutral	XXX Fundamental XX Significant X Marginal	XXX Unique XX Rare X Common	
NATURAL ATTRIBUTES, INCLUDING DOMINANT NATURAL FEATURES				
Rugged topography of B□ská highland	+	XXX	XX	No impact
Spruce and mixed forests	+	XX	XX	No impact
Areas of meadows and pastures divided by nonforest greenery	+	XXX	XX	No impact
CULTURAL AND HISTORIC ATTRIBUTES, INCLUDING DOMINANT CULTURAL FEATURES				
The presence in the ladscape of late medieval colonization	0	X	X	No impact
Pluzinas structures	+	XX	XXX	No impact
Remains of the borderline barriers from the first hals of 20th century	+	X	XX	No impact
Area of the witch-hunts	+	X	XXX	No impact
AESTHETIC ATTRIBUTES, INCLUDING SCALE AND RELATIONSHIPS				
A lot of linear scattered greenery, creating the typical structure of cultural landscape	+	XXX	XX	Low impact

9 Conclusions and Discussion

Conclusions of the literature review are simply the same as the result of the paper discussed in the chapter 4. Greenways seem to have a great potential for preservation of the pluzina structure and also introduction of the pluzina structure to a wider range of people. Planning of a greenway may increase the tourism of the area, so wider range of people would get to know the pluzina landscape. In the locations where the tourism is based on the historical pluzina structure, the local people may be willing to take better care of pluzinas, because they might not like to lose the qualities thanks to which the tourism increases. The local people do not want to lose the qualities of pluzina, because the increase of tourism can bring economical benefits. It is desirable, because the pluzina landscape is, among others, threatened by self-seeding and development. Altogether it corresponds with the main idea of ecotourism; a greenway in the pluzina landscape is sustainable, educates people and also has benefits for the local residents.

The greenway design proposal for the pluzina landscape is discussed in chapter 5. The greenway design for pluzina landscape proposal was one of the objectives of the thesis, therefore the chapter 5 can be considered as one of the results of this work.

If one looked at the design proposal itself at first, it might not seem to be very different from a design of a random trail, however there are important differences. Greenway is a feature based on a linear structure (e.g. river, ridge line). It means that if there is a plan to design a greenway in a pluzina landscape, the layout has to follow this basic idea. In the case study it turns out that it might not be that easy. First of the problems was the slope. The area of Jeseníky district is very steep in general, but also the study area, situated in a valley, is. However, the steepness is a technical problem, which can be solved by a good project, which places the trail paralel to the contours. Another, and a more crucial problem, is the extent to which the pluzina landscape is preserved. The idea in the proposal is to design the greenway in a way, that it shows different levels of preservation and different perspectives. When trying to accomplish this, respecting the main greenway idea, that is following a linear structure, becomes problematic. The pluzina structure is not continuous. If the plan is to for example connect two different villages, it can hapen that a certain part of the greenway would have to be based on other than a linear structure, because of the pluzina discontinuity. In this case study, a stream going

through the forest was found, which serves as the linear structure between two not interconected pluzina hedgerows, but it might be different at a different site, where no such stream is.

The question can arise, how one can be sure, that the pluzina structure has really its roots in the Middle Ages. The answer to this question is, that nobody can be sure about the origin of the structures without some archaeological survey (Lukáģ Pospíģil, IV. 2013, in verb.). On the other hand, the remnant structures are obvious on the maps of IInd and IIIrd Military Survey, so the fact that it is not proven by archaeological research is neglected.

The last part of the work is dedicated to the landscape character assessment. Landscape character is protected by law in the Czech Republic, so it is very important to know, if the greenway had significant impact on the landscape character. If the greenway was planned in a way that was suggested in this thesis, the potential impact was assessed as very low or even none.

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11 Apendix

11.1 A Method for Assessing the Visual Impact on Landscape Character of Proposed Construction, Activities, or Changes in land Use