

UNIVERSIDAD POLITÉCNICA DE VALENCIA

ESCUELA POLITÉCNICA SUPERIOR DE GANDIA

Licenciado en Ciencias Ambientales

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POLITECNICA  
DE VALENCIA



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SUPERIOR DE GANDIA

**"Current Landscape in the neighbourhood of  
Open Cast Mines in Northern Bohemia"**

**TRABAJO FINAL DE CARRERA**

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**GANDIA, 2011**



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# Abstract

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## 1. Abstract:

The classification of the landscape through different types of uses, it will be the basis of this classification of the work area. This study will explain in detail the method by which to classify the composition land units and the resulting land use composition.

Using the GIS (geographic information system that integrates hardware, software and data for capturing, managing, analyzing and displaying all forms of geographically referenced information) with the orthophotos identify are identified the different types of land use of the work area. Land uses refer to the existing activity in this area at the time.

GIS have proved to be very effective not only for determining the different types of land use in an area, but also for the classification collecting valuable information for interpreting and it can determine trends in land use by comparing these maps from different years, very useful to see how it evolves and how it will do in the future, allowing to make decisions in advance.

For land classification there are several methods, some also work using the GIS computer program but instead of classifying the land regarding its use, classified by their landscape value, others through the use of land of this area not only the actual but also in past years. In this project included different methods of classification, with a brief explanation of their methodology. Although some of these methods in addition to making the corresponding classification are also methods of analysis of changes in the work area over time. In this case working only with a layer of a specific year and I did not do this kind of study.

Therefore, after the vectorization and correction of the original layer, I made an assessment of the data, grouped the values of land use in stable and unstable. Commenting on the corrected changes, the original data and the proportion of different land use types, I mean making an ecological assessment, including the impacts of open pit mining and possible corrective measures both during activity and abandonment.

# Introduction

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## 2. Introduction:

This study of land classification is based on the use made of the land, land use is characterized by its physical characteristics, where in this area at north of the Czech Republic predominant land use is derived from the mining activity and most of the other existing uses are related to this activity classification of which is carried out through GIS.

Noteworthy in this area the importance of open pit mining of coal, much of the land is allocated to this activity. In this study in addition to the classification zone, I also detail the most important impacts on the environment caused by this mining activity, both during construction and decommissioning phase.

Due to this method of land classification, I can observe that the proportion considered as ecologically stable land are present in the area and as distributed each type of land use on the map.

Many of the computer-modelling approaches used in science are based on quite complicated and expensive techniques such as hexagonal-packing models, general neutral models, percolation theory, cellular automata and others, which would not translate easily into landscape-planning practice. This method is based on a visual classification based on aerial images, where from these I make the appropriate classification of land use for their activity and estimate the impacts of each activity.

## Literature review

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### 3. Literature review:

At this point I will make a brief summary of other methods used for land classification. In contrast to my approach in these methods to use layers or data from two different years that allow to compare and evaluate changes between years.

This section also explain besides that data are based, methodology, ... and conclusion of each of the methods.

#### **3.1.1.Ratclidde:**

The purpose was to develop an evaluation of the land use of the area, it was to give an importance value for conservation to each land use. Thus, measures are needed which reflect both the character of the landscape, and its importance locally and regionally.

Ratclidde (1977) developed a set of assessment criteria for nature conservation. He suggested 10 criteria, some of which are species-based such as diversity and rarity, others are related to spatial arrangement (e.g. size, position) and others are essentially subjective measures of importance.

Therefore, land uses which have a long history of intensive management are less natural and thus less valuable to nature conservation than those which have undergone minimal or very careful management. Rare or threatened habitats such as ancient semi-natural woodland and calcareous grassland are highly fragile, in that they have a limited existing distribution and a history of loss to development pressure, and are therefore valuable

The second criterion used was patch size which has two aspects. Firstly, large patches of a very natural land use have a high landscape value and large patches hold habitat more number of species than smaller patches, whereas similarly sized patches of a heavily managed land use such as arable farming will have low landscape value.

The third criterion reflects the importance of the land use and combines local and regional considerations. The area of land use is expressed as a proportion of the total for the county so that less valuable landscapes such as arable land and plantation woodland are, if regionally rare, highly valued.

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This GIS-based method to assess the landscape value, land-use data were used in conjunction with spatial statistics with the aim of producing a simple decision-making tool for the evaluation of landscape importance.

The classifications were based on descriptive accounts of topography, land use and visual elements in the landscape.

In this method aerial photographs were interpreted for their land uses. The three major categories of grassland, woodland and other land were separated into subclasses. The land-use data were transcribed to hardcopy and then digitized as field/patch polygon boundaries and labels in ARC/INFO GIS. The data layers for each year were thoroughly checked for errors and processed to give polygon topology.

Ratcliffe performed a land classification based on three criteria; these were land use, field/patch size and land use importance. The first of these associated land use with perceived landscape value based on ecological value, so that deciduous woodland and calcareous grassland were given the highest scores and arable land, improved grassland used for grazing and coniferous plantation are scored lowest.

The second criteria was the patch size of each land use. The patches were assigned different scores based on the range of sizes of each land use in the study area. Quintiles were calculated for each land use. Land-use importance was the third criteria used and was expressed as the amount of each land use as a proportion of the total for the county.

The method consisted a summation of scores according to the assigned landscape values for each patch.

$$LV_{TOTAL1} = LV_{LU} + LV_{AREA}$$

Where,  $LV_{TOTAL1}$  is the total landscape value;  $LV_{LU}$  is the landscape value due to land use type and  $LV_{AREA}$  is the landscape value due to patch size.

In Ratcliffe's study, each land use categories which are identified from aerial photographs we calculate the number of polygons, the total area and the percentage.

## Literature review

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A landscape assessment scheme is presented based on land-use type and some simple landscape indices. Land-use data were interpreted from aerial photographs and are used with a GIS to calculate patch size and relative importance of the land use. The use of GIS for landscape assessment at fine resolution is essential since large quantities of data are generated. The technology is a valuable tool in the assessment process allowing rapid manipulation of spatial and attribute data for the development of landscape indices. Although start up costs were potentially very high it is argued that the long-term benefits such as access to information and efficiency of data manipulation outweigh the short-term costs (Lee *et al.*, 1999).

### **3.1.2. Classify land use by GIS and Khat coefficient:**

Khat coefficient focuses on the quantitative and qualitative analysis of the spatio-temporal changes that have occurred in an area, and interpretation of the factors driving these changes.

Photointerpretation of historical aerial photographs by Geographic Information System (GIS).

Land cover mapping of recent history based on black / white aerial photographs were used. Orthorectification and mosaicing of the aerial photographs by applying photogrammetric methods with high accuracy ensured data quality and allow the further processing of the earth observational data. The images were radiometrically corrected prior to the mosaic process to adjust black and white tonal variation by using an empirical linear spectral normalization technique (Hall, Strebel, Nickeson, & Goetz, 1991).

Also the land cover mapping was based on multispectral (2.4 m) and panchromatic (0.60 m) Quickbird images. The satellite data were orthorectified using a 20 m pixel size Digital Elevation Model (DEM) with a maximum Root Mean Square error (RMS) of 1 m using ERDAS Imagine 9.1 software. Additionally, the two image components were merged by applying the GramSchmidt method of image fusion within the RSI ENVI 4.6 software (Laben & Brower, 2000).



## Literature review

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LCLU (Land cover / land use) categories were identified based on visual stereoscopic photointerpretation of panchromatic aerial photographs.

It was developed a common classification scheme. The definition of the thematic categories relied on the Level I scheme of Anderson's LCLU classification system (Anderson, Hardy, Roach, & Witmer, 1976) and includes: agricultural land (cereals and other irrigated crops, *Populus canadensis* and *Robinia pseudoacacia* plantations); barren land (representing only alluvial areas); urban or built-up areas; forest land (mostly *Populus alba*, *Fraxinus angustifolia* subsp. *oxycarpa*, *Quercus robur* subsp. *pedunculiflora* and *Ulmus procera*); rangelands (riparian scrub, *Arundo donax* reedbeds); inlandwaters; wetlands and sea.

Additionally, to measure the similarity between the different maps and assess the stability of changes, it was estimated the Khat Coefficient of Agreement for the whole area (global stability) and the Conditional Khat Coefficient of Agreement for each category as (Jensen, 2005):

$$\hat{K} = \frac{\sum_{i=1}^k P_{ii} - \sum_{i=1}^k (P_{i+}P_{+i})}{1 - \sum_{i=1}^k (P_{i+}P_{+i})}, \quad \hat{K}_i = \frac{P_{ii} - \sum_{i=1}^k (P_{i+}P_{+i})}{P_{i+} - \sum_{i=1}^k (P_{i+}P_{+i})}$$

Where  $\hat{K}$  Coefficient of Agreement for the whole area,  $\hat{K}_i$  Conditional Coefficient of Agreement for each category,  $P_{ii}$  representing the proportion of the landscape where a category  $i$  shows persistence between the first and last date of the analysis, and  $P_{i+}$ ,  $P_{+i}$  representing the proportion of the landscape in each category at the first and last date, respectively. The Coefficient of Agreement ranges between - 1 to 1, indicating the degree of similarity between the maps, and having been adjusted for chance agreement.

Qualitative and quantitative information on spatio-temporal LCLU changes and landscape dynamics was obtained by analyzing multitemporal earth observational data. The different components of LCLU changes that were identified, allowed the better understanding of the transformation processes and the driving factors (Mallinis *et al.*, 2011).

## Literature review

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### 3.1.3.A landscape approach for quantifying land-use and land-cover change

To analyse LULC, temporal Landsat series data available with the Global Land Cover Network (GLCN) were used.

ERDAS Imagine version 9.2 provided by Leica Geosystems was used for satellite pre-processing and analysis. ArcGIS version 9.2 provided by ESRI was used for visual interpretation, map preparation, and analysis.

Satellite data are downloaded from the Landsat website. Landsat series dataset were geometrically and radiometrically corrected. IRS P6 LISS III data are processed for geometric and radiometric correction.

On-screen visual interpretation using ArcGIS. For interpreting the satellite data, an interpretation key was developed and used. It was necessary to go in person for field check and find detailed ground truth information, attributes were given to each interpreted polygon. LULC classes are prepared from the interpretation of satellite data.

The LULC map prepared is overlaid on the satellite data of before years, for repair this vector map.

With this data, it was possible to do a change analysis, the vector maps of each year were converted into grid data. Change matrices were generated for the different time periods to analyse changes in the area covered by different LULC classes. This was done by comparing the number of pixels falling into each category of LULC in one time period with the categorization of the same pixels in same/different class in the previous time period

The probability of LULC changes were computed using the transition probability theory development by Markov (Munsi *et al.*, 2010).

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### 3.1.4. Classification of land by interviews:

It was developed drawing on a discursive data set from in-depth interviews, a sample of public submissions, and published reports and plans.

In other studies of land classification and assessment only takes into account the same soil classification, here in this method was added emotional value of the resident. This land classification was given more emotional or cultural value of the physical characteristics of it, but shall only considered the views of residents but also local associations, members of conservation groups and town hall environment.

While some have begun to measure place attachment using psychometric and cartographic approaches (Brown and Raymond, 2007), in the method of classify land by interviews prefers to discern its presence in narratives.

The affective and social bonds between people and place have often been overlooked in planning literature, yet they frequently motivate community opposition to development projects.

This mentioned method is usually performed when construction company wants to carry out some housing estates, construction company has to take account for the evaluation the of land use the views of resident groups, city council and the company is represented by some scientists that evaluate the visual and environmental quality in this area.

The opinion of the residents was usually clearly opposed to these new constructions in the area, since for them apart from the ecological value of the area for them is very important to protect the area concerned by the emotional and historical value is to them.

In classification land by interviews used three principal sources of data were drawn upon: official reports and proposals, public submissions to Council, and key informant interviews. First interviews were conducted, using a schedule of semi-structured questions. In the respondents can be included members of the public who can be interest

## Literature review

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the study area proposal, elected members of the local authority, and representatives of the regional council and the development company (one each).

Fieldwork also included attendance at a public meeting and visits to study area. Data that were gathered through these techniques were analyzed thematically, following the approach outlined by Braun and Clarke (2006). This consists in identifying patterns within the data set, and organizing and describing them in a systematic manner. Sampling framework of method was intended to produce data that was illustrative, rather than representative.

One problem may be the fact that those members of the public who choose to enter formal debate about the future of study area were generally motivated by self interest (Collins and Kearns, 2010).

### **3.1.5. Biosafe**

Biodiversity values were calculated using BIO-SAFE model meant to quantify biodiversity and to value ecotopes based on legally protected species.

Ecotopes were described as spatial units which are relatively homogenous in terms of vegetation structure and succession stage, and abiotic site factors that are relevant for plant growth.

The information on species and habitats was derived from a thorough survey of scientific literature (atlases, reports, books and journal articles describing the distribution of flora and fauna in relation to landscape characteristics), supplemented by expert judgment. The model includes species that meet both criteria: indigenous to study area and characteristic of the study area; and relevant in terms of national and international policy or legislation concerning nature conservation.

BIO-SAFE is a model that provides means to assess the impact of landscape change and physical reconstruction measures on actual and potential biodiversity values in terms of legally protected species.

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GIS-based analyses of remotely sensed landscape data were conducted by processing ecotope maps from digital black and white aerial photographs. Retrospective analyses of remotely sensed landscape maps require similar environmental conditions.

Available photographs of the different years showed large differences in ambient conditions of the study area, in the method they had to do analyses to prevent bias by incomparable environmental conditions.

The photos were scanned into grey-scale image data sets, which then were geo-referenced and merge to one image of the entire research area in ERDAS IMAGINE software. The result image was ortho-rectified using a topographic map. The maximum geo-reference error was about 10 m.

ArcGIS 9.0 was used to manually digitize the polygons of the landscape patches (riverine ecotopes) on the screen. Errors in the polygon creation and ecotope labeling process were minimized by stereoscopic verification of original photos and comparisons with topographical color maps (1: 25,000). The level of detail in remotely sensed landscape images was strongly determined by the quality of aerial photographs. The use of best quality black and white photographs and stereographic interpretation allow accurate mapping of ecotopes (landscape units).

The results in this method were shown in tables, where each type of land use showed the number of individuals of each species group and from these data is calculated the biodiversity for each ecotype.

It's an index to determine which land use has a greater biodiversity, so what land use has to be given greater protection and conservation methods.

The use of ecotopes provides a basis for assessing biodiversity at the landscape level in addition to the species level and gives a clear insight into the spatial consequences of species protection (Wozniak *et al.*, 2009).

### 3.1.6. Identifying patterns of land-cover change

They made a classification of landscapes which considered both current land-cover patterns and their dynamics.

In this context, the classification of current land-cover patterns with respect to their past dynamics allowed to systematically outline areas with a highly dynamic land use in the past.

Therefore, spatially differentiated knowledge about past land-cover dynamics was important in landscape planning and resource management. As land-use dynamics appear to be closely related to the physical attributes of landscapes, it was also important to consider the patterns of environmental conditions.

To obtain information on current land cover, it was used an available satellite image interpretation (Landsat-TM, 25 m). Where from these satellite images land-cover classes were defined. In order to derive information on historical land cover, agricultural statistics were analyzed.

Long-term spatially explicit land-cover changes may be reproduced by historical aerial photographs or historical maps, but area-wide interpretations of these sources required manual mapping techniques or the digitization of maps, which are time-consuming and costly and thus not feasible for large areas.

To characterize of the area; the elevation, slope, and soil moisture were quantified. Elevation data were obtained from a digital elevation model (DEM, 40 m). From this information, it was determined the median elevation expressed as meter. Slope was calculated from the modified DEM by the use of the slope function in the ArcGIS 9 Spatial Analyst tool, which calculates the maximum rate of change of elevation between each cell and its eight neighbouring cells. Soil moisture was derived from the official digital soil map of Hesse combining information on available water capacity (AWC) in the zone.

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In addition to the physical landscape attributes, the agricultural comparability index was applied (Landwirtschaftliche Vergleichszahl, LVZ) which incorporates the most important environmental variables to compare each area. This index was used to classify areas that are less favourable for agriculture.

It aggregated natural characteristics of agricultural areas such as soil quality, climatic conditions, heterogeneity of soils, and water management problems and was based on a points system ranging from 0 to 100 for the best value.

In order to classify types of agricultural land-cover patterns and dynamics (TLPDs), they performed a k-means cluster analysis using STATISTICA 6.0 software. The purpose of the k-means clustering procedure was to classify objects with respect to optional quantitative traits into a user-specified number of clusters. To quantify recent land cover for each area, it was calculated from the satellite data the percentage of each land-use.

With the aid of k means cluster analysis, each area was assigned to one of six types of land-cover patterns and dynamics. These types represent patterns of land cover and their dynamics between years of the study.

As socioeconomic factors also have an essential influence on land cover, this result suggests that in TLPD V socioeconomic variables are more important than physical. For the study area, it was analysed relations between numerous socioeconomic variables and land-cover patterns and dynamics.

The quality and outcome of the identified and characterised types of land-cover patterns and dynamics depend on the thematic and spatial resolution of the databases and the applied classification method.

Since satellite-derived data and agricultural statistics were collected in a very different way (i.e. computer-assisted techniques versus census data), land-cover was categorised differently. Whereas satellite-derived data were available at a fine resolution (i.e. raster cell), land-cover statistics are published at the comparatively coarse resolution of administrative

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levels (i.e. the rural district). Thus, the aim of an area-wide landscape classification was achieved at the expense of spatial resolution.

There are many possible ways to classify a landscape depending on the nature of input data and scales. The use of k-means cluster analysis has proven to be a simple and workable approach to classify patterns of recent and historic land cover for large areas at the district scale.

The authors conclude that the combination of remote sensing data with agricultural statistics is suitable to identify patterns of current land cover and land-cover dynamics at the landscape scale (Reger *et al.*, 2007) .

### **3.1.7. Geographical landscape change analysis based on cadaster maps and land registers**

It's a cultural landscape information system that assigns a value to the diachronic approach for direct applications within the planning process. In landscapes can be seen as topological variations of vegetation cover, and it is possible to determine these landscape units based on the various forms of anthropogenic use. Analyses were carried out by the use of GIS.

The analysis of cultural landscape change was generally based on a variety of sources, including topographic and historical maps, aerial and satellite photographs, land registers with geodetic survey maps and land plot records, original surveys of relict species (where available), as well as various statistical and archival data. A state of the landscape, which represents the traditional land use system, should be the starting point for the diachronic analysis of landscapes. From the cadastral data and remote sensing data, it was determined each type of land use of the area. Likewise, the continuity of the sources was of great importance.

The authors made time slices with cadastral maps, land registers and complementary data from agricultural administration. These data included particular information regarding the soil quality and the owner of the land parcel. It detailed the names and ages of farm owners as well as the type of agricultural activities and information on successors. Such socio-economic data were supplemented with spatial data that were derived from a digital terrain model (DTM), i.e. altitude, slope gradient and exposure.



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The GIS served in this method predominantly to analyze the changes and to calculate the proportion of each land use type.

The conceptual model for the GIS is, therefore, determined by land-register data. As a consequence, the cadastral landscape model consisted of types of land use, ownership status and other attributes (mainly for tax purposes). Thus, a database of land plot attributes can be compiled from data in older land plot records contained in the archives of the land register, and by entering the current data of the automated land tax register, which includes land cover, soil quality and property data. Nevertheless, in a diachronic comparison and in specifications of the land-register data, the terminology for the basic category “type of use” was adapted, because it may vary and sometimes change over time.

The implementation of GIS through the use of a vector model (in the present case, simple and complex polygons for sub-plots by type of land use) is consistent to describe objects in the real world. Then, the vector database was created on the basis of current and historic cadastral maps by digitising the land plots. The different time slices of our study were handled in a layer GIS model. A layer was created for each time period, beginning with the latest, and presumably most accurate cadastral map (if already available, by use of digital data), and working backwards in time to the earlier temporal layers. The older maps only served to identify the changes, possible distortions and projection errors in the historical maps needed to be visually corrected.

The conversion of data into a GIS offer more than simply a visual interpretation of thematic maps or statistical evaluation (plot use balance), because this geo-relational approach also permitted an assessment of development trends. It thus is possible to determine various changes in land use according to categories of change.

The use of a land record-based GIS can help to find explanations for cultural landscape change on a large-scale (1:5000) basis. Standardized approaches to changes in land use, including cultural and environmental factors, are developed in order to understand which plots are involved, and why changes occur on these plots.

The GIS-based simulation model assumes that the future parcel utilization is determined by the characteristics of the various attributes in the three categories of ownership structure, parcel structure and habitat quality.

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The attribute queries result primarily from a combination of attributes. Here one must be aware that these operations can simulate a causal chain of events but no definite outcome can be predicted. Ultimately, the simulation determines for each individual parcel whether a continued or subsequent use is anticipated by the owner or whether, under certain circumstances, the plot will become part of the leasing market, lay fallow or be completely abandoned.

The land-register based diachronic GIS proved to be advantageous especially for the quantification and description of landscape change at the local level.

Land-register based diachronic GIS seems to offer many opportunities for landscape planning. For example, it can be employed to quantify the surface areas of habitat types, and to assess how, when and why the sizes of different habitats have changed (Bender *et al.*, 2005).

### **3.1.8. Comparison of methods**

In all these methods mentioned above, a classification of land is made, each method using different techniques.

My classification is based on the use of GIS, there are also methods that work using GIS, but some of these are based on other criteria. Highlight the classification of land by interviews method in which the land classification is performed based on interviews with citizens, political groups, associations, companies, ... in this method is given great importance to the cultural value of the soil because many respondents valued the land from the culturally point. The problem with this method is subjective, because each interviewee gives a value to each land use based on their self interest.

Many methods rely on GIS for classification, for example the method that performs a land classification based on the number of species living, giving a value to each species according to their rarity and condition of hazard that is, for each habitat or ecotope. Ecotopes are classified into ranges according to their biological value

There is a method that is similar to mine when classifying the land, and is to perform the classification of land from aerial photographs, but does not express the result in relation to land use, but from these photographs defines the areas and then given a value depending on the patch size, land use and importance of land use.

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There is another method that works with a cadastral landscape model which is composed of types of land use, ownership and other attributes (mainly for tax purposes). This method also uses the GIS software to work with all the cadastral information and interpret this information in layers. This method is very useful for landscape planning.

## 3.2. Characteristics of the area:

The study area covers brown coal open cast area open. The area is located in the northern part of the Czech Republic (Fig. 3.1), it's closed to the town of Vrskmaň and very near to Most, at an altitude of 233 m. north center near geographic coordinates 13° 50' E, 50° 50' N. Besides this main activity there are many crop fields. The forestry typology belongs to the deciduous forest type, principally coniferous. Here I show an aerial photograph in which the study area is marked in red (Fig. 3.2) .

Fig. 3.1: Location of study area in Czech Republic



Source: Cenia\_t\_podklad

## Literature review

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**Fig. 3.2: Aerial photo of study area**



### **3.3. CORINE : Corine land cover**

Thematic mapping of the biophysical cover of the area's surface must be approached considering these aspects, land cover essentially that concerns the nature of features (forests, crops, water bodies, bare rock, etc.) and the land use that is concerned with the socio-economic function (agriculture, habitat, environmental protection) of basic surfaces.

My study shows the land cover project's technical unit that the use of satellite data necessitate detailed consideration of the unit area to be mapped.

Main characteristics of the each unit of land use, these land use correspond an area which is homogeneous (grass, water, forest, etc.) or to a combination of elementary areas (homogeneous as defined above). The unit must represent a significant area of land, it is clearly distinguishable from surrounding units.

The unit area has two functions to be conceptual tool for land cover analysis; one tool for reading and organizing space borne remote-sensing data

Furthermore, irrespective of how they have been processed, data acquired by space borne remote-sensing systems do not provide a representation of the actual land cover situation; nor can land cover be mapped in all its complexity/diversity.

Given these circumstances, each unit of land use must meet two requirements which are it must provide the thematic data required by the users, in this case land use, and it must provide an acceptable representation of reality.

Based on this logical framework, the selected nomenclature meet a certain number of requirements; all Community territory is classified; in other words there can be no heading for 'unclassified land' and the headings must correspond to the needs of future users of the geographic database, in this case the land use (Corine – land cover)

### **3.4. Open mining pit coal brown**

Open pit mining is an industrial activity of high environmental, social and cultural, and industrial activity is also unsustainable by definition. This is a non renewable resource whose extraction is limited.

Technical innovations that mining has experienced since the second half of this century have radically altered the activity so that it went underground veins of the use of high quality to the farm - in open pit mines - of lower quality ores, disseminated in large deposits.

Open pit mining removes the top layer or overload of the land to make available the vast deposits of low-grade. To develop this process, it requires that the site covering large areas and are near the surface. As part of the process, huge craters dug, which can have more than 150 hectares and over 500 meters deep.

Vaughan (1989) considers that "in environmental and social terms, no industrial activity is more devastating than open pit mining".

### **3.5. Impacts from open cast mining:**

Mining activities in each one stages produce specific environmental impacts. Broadly, these stages would be:

- Prospecting and exploration of mineral deposits,
- Development and preparation of mines
- Exploitation of mines
- Treatment of minerals obtained in the respective plants in order to obtain marketable products.

The main environmental impacts caused by open pit mining in its exploitation phase are:

Deteriorating air quality: Mining has a large effect on air quality. Due to the need to blast through rock to reach a mineral, the air is contaminated with solid impurities, such as dust and toxic fuels or inert, capable of penetrating into the lungs, during various stages of the process. Coal mines releasing methane, which contributes to environmental problems, since it is a greenhouse gas. Methane is sometimes captured, but only when economically feasible.

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Some cooling plants can release ozone-depleting substances, but the amount released is very small.

Also impact on water: Mines use a lot of water, although some water can be reused. Sulfur-containing minerals, when oxidized by contact with air, through mining are acid, sulfuric acid. This, when combined with trace elements, negative impact on groundwater. Another way in surface and ground water are affected by the tailings dams and waste rock piles, because are a source of acid drainage water. Chemical deposits of surplus explosives are generally toxic, and increase salinity of the water and pollution of mine. Groundwater can be contaminated directly through "in situ" mining, in which a solvent is filtered in rock untapped, leaching of minerals. In addition, there may be a decline in groundwater levels when these are sources of fresh water for mineral processing operations.

Land: There are many environmental concerns about the effects mining has on the land. Mining involves moving large quantities of rock, and in surface mining, overburden land impacts are immense. Overburden is the material that lies over top of the desirable mineral deposits that must be removed before the mining process begins. Moreover the use of heavy machinery creates roads which leads to soil compaction and encourages soil erosion. Some mines make an effort to return the rock and land to its original appearance by returning the rock and overburden to the pit that they were taken out of. Toxins used in the extraction of minerals can permanently pollute the land, which makes people not able to farm in certain places. Open-pit mining leaves behind large craters that can be seen from outer-space.

Ecosystem Damage: Mines are highly damaging to the ecosystems surrounding them. Mining destroys animal habitats and ecosystems. Pits that mines create could have been home to some animals. Also, the activity that surrounds the mine, including people movement, explosions, road construction, transportation of the goods, the sounds made, etc. are harmful to the ecosystems and will change the way the animals have to live, because they will have to find a new way to cope with the mine and live around it.

Impact on flora: involves the removal of vegetation in the area of mining operations and a partial destruction or modification of the flora in the surrounding area due to the alteration of the water table. It also causes pressure on existing forests in the area, which can be destroyed by the process of exploitation or the expectation that it occurs.



## Literature review

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Impact on wildlife: the wildlife is disturbed and / or driven away by noise and pollution of air and water, raising the level of sediment in rivers. In addition, the erosion of barren waste piles can particularly affect aquatic life. Poisoning can also occur in water content residual reactants from the area of operation.

Health and Safety: Mining can be very safe, but often it is extremely dangerous. The biggest health risks are from dust, which can cause breathing problems. Usually the problems are respiratory, mainly due to inhalation of dust and smoke, but there are also by contact. Common to all diseases of mining is their evolution that is long and protracted being considered as a chronic disease. As pneumoconiosis, fibrosis pulmonary and lung cancer.

Energy Consumption: Mining requires vast amounts of energy. The ore and rock has to be transported great distances by large vehicles, which require a large amount of energy in the form of gasoline. Pneumatic equipment, which is used a lot in the mining industry, also takes energy. Smelting ores and metal requires lots of energy.

Impact on populations: causes conflicts over use rights to land, giving uncontrolled rise to human settlements, causing a social problem. Can cause a decrease in the performance of farmers due to poisoning and changes in the course of the river. On the other hand, can also cause a negative economic impact by the displacement of existing local economic activities current and / or future.

Impact landscape both during operation and after operation: left deep craters in the landscape. Its removal may lead to such high costs that may prevent the exploitation itself. It is a very significant impact because can be appreciated the craters and waste deposits from great distances, severely deteriorating the visual quality of landscape that leads to a decrease of the tourist attraction.

Another factor is noise. Which produce the machinery used during the extraction process, explosions, vehicle traffic ... All these affect the population of the surrounding areas, disrupting normal life. And it affects not only humans but all living organisms from the surrounding areas.

# Method

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## 4.1. Methodology:

The first goal or task was to correct the topology of existing polygons shapefile.

First I added all necessary files. These data sets contains land uses Northern Bohemian layer. The source of geographic data was aerial images. These data were digitalized so I could work with these data in GIS. I worked in a polygon vector model, where two-dimensional polygons were used to represent geographic features that cover a particular area of the surface of the earth. These polygons transmit as much information on file with vector data; area and perimeter can be measured.

The data structure is compact. It stores only data digitized elements which requires less memory for storage and processing. The value of land use, area and the ecological stability were attributes that contain each one of the polygons of the working layer.

I used Coordinate systems S-JTSK, which is a coordinate system of Uniform trigonometric cadastral network is defined on Bessel ellipsoid so that it minimizes length distortions over the territory of former Czechoslovakia including Subcarpathian Ukraine. The system was introduced in 1922. Double projection means that the trigonometric points were projected onto gaussean sphere first. .

In property layer of work layer, on the symbology tab, I changed the symbology to quantitative by land use data. In this way, the layer showed on the map polygons with their respective land uses.

Also I add the ortophotos from Cenia, Czech agency of environmental information. In fact, our study area comprises 15 satellite images.

To make the necessary changes in land uses layer, I went to layer properties and I changed the transparency of the layer to 50%. In this way the working layer would be superimposed on the ortophotos, but transparent, I could compare the working layer and the real image, so I could correct each error.

From here I could start making the necessary corrections of the study map, these are the actions that I have done comparing the land uses layer with satellite images:

## Method

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There were some polygons that their boundaries were coinciding or including overlapping, this topological error is called overlay. Then I compared the work layer with orthophotos, edited the boundaries of these polygons and assigned the correct limit to each polygon.

There were also polygons in the layer without an assigned value, this problem was fixed by observing the image corresponding to this polygon, I attributed a land use value. Although most of these polygons of unknown value were of negligible size so that as often overlap with other contiguous polygons, I added the value of its neighboring polygons.

There were also polygons whose boundaries did not coincide with those that really have, so I sometimes had to change their limits both increases and decreases.

Another problem was the existence of polygons with a incorrect value assigned, there were selected and changed the value of land use for the most appropriate.

The precision in the changes was very high, all polygons after having made the appropriate adjustment coincide in their margins. This task involved much time to adjust the lines and vertices of polygons.

Once all these changes, I make a check through the zoom of the polygon boundaries so that are not overlap or void spaces are assigned, I started with calculations and statistics.

My study shows the land cover project's technical unit that the use of satellite data necessitate detailed consideration of the unit area to be mapped.

Main characteristics of the each unit of land use, these land use correspond an area which is homogeneous (grass, water, forest, etc.) or to a combination of elementary areas (homogeneous as defined above). The unit must represent a significant area of land, it is clearly distinguishable from surrounding units.

## Method

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### **4.2. Data check:**

To carry out the correction of polygons of land uses layer, I used a variety of tools and techniques. This part of the project is where I spent more time, I had to use ARCGIS to vectorize every incorrect polygon and also I had to check the rest of the polygons of the land uses layer.

I changed the transparency of the working layer to 50%, to work better this way and correct sites more quickly.

To assign a value of land use for those polygons with very small size, I apply a merge tool in the editor. With "merge" I combined the negligible polygons with other polygon, so that they combine in a single polygon with the value of the polygon which had a correct land use assigned.

I also created new polygons. With cursor I marked the vertices of the polygon that I created. Once I defined the polygon I assigned the value of appropriate land use. I created new polygons because there were areas without polygon, so I had to create a new polygon and assign the value of adequate land use comparing to satellite images.

I modified polygon with a value of land use covering an area with two types different of land use. I used Editor tool to modify the original polygons of the layer, so I could change the boundaries and vertices of the polygons.

Finally I selected the polygons that I considered their land use were not adequate to the reality by comparison between real images; and I changed their value. I selected the polygon and the attribute table will appear as selected. I changed their value by using the "field calculator".

## Method

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### 4.2.1. Nomenclature:

The nomenclature was taken from the project (Sykorové et. al., 2006) adapted by Sicorá (2000) to mining areas. For the purpose of assessing the ecological stability the land uses are in two categories unstable and stable areas. Stable areas are land uses 10.0.1, 2.3, 3.1, 4.0, 4.0+4.1, 4.1, 4.2, 6.1, 6.3 and 7. The rest of land uses are unstable areas.

Stable areas are covered by relatively ecologically land-use types: woodlands, water elements, grasslands, wetlands, gardens and orchards. Ecologically relatively unstable land-use types: arable lands, hop fields, spoil banks and residual holes, urban areas, roads.

Here I show below the description of each land use in my study, with a description of each one and the table (Table 4.1).

#### 1.1 Bare soil:

Absence of both vegetation and any element of anthropogenic origin, in this land use.

#### 1.2 Harvested field:

Cereals, legumes, fodder crops, root crops and fallow land. Includes flowers and tree.

#### 1.12 – 1.13 Poppy fields:

Herbaceous plants that reach one meter high with magnificent red flowers, purple or pink. The flowers can reach 15-20 cm in width. Crops are very characteristic for the color.

#### 1.3 Wheat field

Wheat is a cereal belongs to the family of Gramineae, herbaceous annual plant up to 1.2 m of deep green color.

#### 1.5 Oat field

Es una planta anual, un cereal, de 50-150 cm. de altura, con hojas alternas, anchas y planas. Constituyen campos de cultivo densos de avena.

#### 1.7 Corn field

Corn stems superficially resemble bamboo canes, 2–3 meters in height, with many nodes. The inflorescence of male flowers and his characteristic form, it causes that it is easy to identify this type of crop.

# Method

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## 1.8 Colza field

Rape is a crucifer taproot. The stem has a size of approximately 1.5 meters. The lower leaves are stalked, but the upper are lanceolate and entire. The flowers are small, yellow and grouped in terminal clusters. Usually occupy large areas.

## 10.0.1 Transitional woodland

Bushy or herbaceous vegetation with scattered trees. Can represent either woodland degradation or forest regeneration / colonization.

## 10.0.2 Forest reclamation height 1 - 2m

## 10.0.3 Forest reclamation height 0,5 – 1m

## 10.0.4 Forest reclamation height < 50cm

## 10.0.5 Dumps

Landfill or mine dump sites, industrial or public.

## 2.1 Clover

Low productivity grassland. Often situated in areas of rough uneven ground. Frequently includes rocky areas, briars, and heathland.

## 2.3 Mesophilous Meadow

Dense, predominantly graminoid grass cover, of floral composition, not under a rotation system. Includes areas with hedges (bocage).

## 3.1 Wetland with prevailing herbaceous layer: reeds, sedge

Non-forested areas either partially, seasonally or permanently waterlogged. The water may be stagnant or circulating.

## 4.0 Ruderal species, fallow (left field) - with trees up to 10%

## 4.0 + 4.1 Ruderal species and fallow

# Method

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4.1 Plates trees - grown ditches, limits, riparian vegetation, etc.

Plates or lines of trees, which define various land uses. Riparian vegetation of rivers delimiting the river vegetation around or cropping systems.

4.2 Covered by grasses with scattered trees, abandoned fields

Crop fields abandoned by man, where vegetation grows naturally and is combined with scattered trees and grass.

4.3 Bare rock with some scattered vegetation

Scree, cliffs, rocks and outcrops combined with some scattered tree.

4.4 Manure heap and junkyard

Area covered outdoor residential waste source

4.5 Abandoned field without vegetation

Abandoned fields by man where there is not has existed a natural succession or artificial revegetation.

6.1 Deciduous forests

Vegetation formation composed principally of trees, including shrub and bush understories, where broadleaved species predominate.

6.3 Mixed forests (coniferous and deciduous)

Vegetation formation composed principally of trees, including shrub and bush understories, where broadleaved and coniferous species co-dominate.

This category includes not only mixed forest in the strict silvicultural sense (single tree or clump mixtures), but also complex forest parcels comprising an intricate mosaic of broadleaved and softwood species

7. Fish ponds, pools, rivers

Body of water natural or artificial is in the area permanently.

9.1 Continuous urbanized area

Land is covered by buildings, roads and artificially surfaced area cover almost all the ground.

We can find ornamental trees between the buildings. Centers of urban districts can easily be identified on satellite images by reference to topographic maps.

## Method

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In some cases, distinguishing between continuous urban fabric and discontinuous urban fabric can be difficult. The boundary can be set principally by determining the presence and quantity of vegetation.

### 9.2 Industrial companies and warehouse

Artificially surfaced areas (with concrete, asphalt, or stabilised, e.g. beaten earth) devoid of vegetation, occupy most of the area in question, which also contains buildings and/or vegetated areas.

Typically, the texture will be heterogeneous (mixture of large buildings, car parks, sheds, etc.) represent entire industrial or commercial complexes, including access roads, landscaped areas, car parks, etc.

The category also includes major industrial livestock rearing facilities, waste water treatment plants, cement fish farming ponds.

Industrial or commercial units located in continuous or discontinuous urban fabric are taken into account only if they are clearly distinguishable from residential areas

### 9.3 Mine, sandpit, gravelpit, concrete surfaces, solar powerplants

Areas with open-pit extraction of industrial minerals (sandpits, quarries) or other minerals (opencast mines). Also includes spaces under construction development, soil or bedrock excavations, earthworks.

Quarries are easily recognisable on satellite images (white patches) because they contrast with their surroundings.

Disused open-cast mines, quarries, sandpits, slate quarries and gravel pits (not filled with water) are included in this category. However, ruins do not come under this heading.

Sites being worked or only recently abandoned, with no trace of vegetation, come under this heading. Where vegetal colonisation is visible, sites are classified under the appropriate vegetal cover category.

This heading includes buildings and associated industrial infrastructure (e.g. cement factories).

### 9.4 Roads

It corresponds to asphalt roads in the area of study.

Category is composed mainly of large road intersections with associated infrastructure and planted areas, and large marshalling yards.

I use nomenclature used at the various scales must enable me to identify, analyse and monitor land use in the areas. Generally, coefficient of ecological stability of the landscape is formulated as the proportion of ecologically relatively stable and ecologically relatively unstable areas.



## Method

**Table 4.1: Legend of land uses of study area**

<b>Ecologic</b>	<b>Landuse</b>	<b>Unit</b>
U	<b>1,1</b>	Bare soil
U	<b>1,12</b>	Harvested field
U	<b>1,13</b>	Poppy field
U	<b>1,14</b>	Poppy field
U	<b>1,2</b>	Harvested
U	<b>1,3</b>	Wheat field
U	<b>1,5</b>	Oaks
U	<b>1,7</b>	Corn field
U	<b>1,8</b>	Colza field
S	<b>10,0,1</b>	Forest reclamation height > 2m
U	<b>10,0,2</b>	Forest reclamation height 1 - 2m
U	<b>10,0,3</b>	Forest reclamation height 0,5 - 1m
U	<b>10,0,4</b>	Forest reclamation height < 50cm
U	<b>10,0,5</b>	Dumps
U	<b>2,1</b>	Clover
S	<b>2,3</b>	Mesophilous meadow
S	<b>3,1</b>	Wetland with prevailing herbaceous layer: reeds, sedge
S	<b>4,0</b>	Ruderal species, fallow (left field) - with trees up to 10%
S	<b>4,0+4,1</b>	Plate trees + Ruderal species, fallow
S	<b>4,1</b>	Plates trees - grown ditches, limits, riparian vegetation, etc.
S	<b>4,2</b>	Covered by grasses with scattered trees, abandoned fields
U	<b>4,3</b>	Bare rock with some scattered vegetation
U	<b>4,4</b>	Manure heap and junkyard
U	<b>4,5</b>	Abandoned field without vegetation
S	<b>6,1</b>	Deciduous forests
S	<b>6,3</b>	Mixed forests (coniferous and deciduous)
S	<b>7</b>	Fish ponds, pools, rivers
U	<b>9,1</b>	Continuous urbanized area
U	<b>9,2</b>	Industrial companies and warehouse
U	<b>9,3</b>	Mine, sandpit, gravelpit, concrete surfaces, solar powerplants
U	<b>9,4</b>	Roads

Source: Self elaboration. Where U means unstable ecological land use and S means stable ecological land use.

## Method

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### 4.2.2. Aerial photographs:

I used these aerial photos because land cover methodology requires the use of such photographs. Along with the standard topographic maps, aerial photographs play a major role in the land cover project. They were used to determine the exact boundaries of units which are not resolved clearly on the satellite image and to verify and validate the results of the land cover mapping.

The photographs help to identify and delineate the various land cover categories by their spatial resolution, which is considerably greater than that of Earth observation satellite sensors (1 to 3m, as against 20 to 80m), and by the three-dimensional view they provide through systematic 60% overlap coverage of the successive photos.

Although the aerial photographs themselves are not included with the initial ancillary documentation (since they are used only as needed) the list and flightline index maps of photographs which may be of use, are part of the ancillary data.

#### Use of aerial photographs

Through observation of aerial images, overlapping on my study layer makes it possible to identify the following categories of land cover:

#### Natural vegetation

- Forest: clearly visible by the height and shape of trees. The color on the satellite false-color image suggests that it is a coniferous forest.
- Sclerophyllous vegetation: this can be identified from the density and height of the shrubs visible on the photo.
- Reclamation forest: it is possible to identify individual trees and low vegetation.
- Scattered habitation: easy to identify.

## Method

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### Artificial land

- Complex cultivation patterns: the air photos clearly depict the complexity of the field pattern and the occurrence of grassland, orchards and crops.
- Land principally occupied by agriculture, with areas of natural vegetation: while the image suggests a wooded area, the photographs show overlapping agriculture and forestry.
- Urban and industrial areas are very easy to identify by their characteristic colors.
- Highways and roads are linear features that connect urban areas, so they tend to be useful for determining certain areas, because they limit the different types of land cover categories.

# Results

## 5. Results

### 5.1. Comparison of land uses in the study area:

After performing the classification of the land use and considering the use of land from each area, I made the calculations respective areas of each polygon and have calculated the total area of each land use, I sum all the polygons with the same value.

The results are shown in Table 5.1 Where each land use is present in my study area with total area of each, the share of each land use compared to the total area of the area and the number of polygons that exist for each type of land use.

Table 5.1: Proportion of land uses of study area

Land use text	Landuse	Area (m2)	Proportion %	N° polygons
Bare soil	1,1	100691	0,24%	1
Harvested field	1,12	230602	0,55%	2
Poppy field	1,13	76776	0,18%	1
Poppy field	1,14	537420	1,27%	4
Harvested	1,2	8067176	19,11%	57
Wheat field	1,3	1121490	2,66%	10
Oaks	1,5	724299	1,72%	8
Corn field	1,7	294297	0,70%	3
Colza field	1,8	38078	0,09%	1
Forest reclamation height > 2m	10,0,1	1732481	4,10%	4
Forest reclamation height 1 - 2m	10,0,2	1188658	2,82%	9
Forest reclamation height 0,5 - 1m	10,0,3	177224	0,42%	2
Forest reclamation height < 50cm	10,0,4	1396592	3,31%	8
Dumps	10,0,5	594581	1,41%	4
Clover	2,1	9413	0,02%	1
Mesophilous meadow	2,3	204654	0,48%	5
Wetland with prevailing herbaceous layer: reeds, sedge	3,1	174467	0,41%	6
Ruderal species, fallow (left field) - with trees up to 10%	4,0	861456	2,04%	18
Ruderal species, fallow	4,0+4,1	361823	0,86%	2
Grown ditches, limits, riparian vegetation, etc.	4,1	1440310	3,41%	28
Covered by grasses with scattered trees, abandoned fields	4,2	300336	0,71%	7
Bare rock with some scattered vegetation	4,3	320895	0,76%	6
Manure heap and junkyard	4,4	13035	0,03%	1
Abandoned field without vegetation	4,5	497355	1,18%	7
Deciduous forests	6,1	497388	1,18%	2
Mixed forests (coniferous and deciduous)	6,3	3141158	7,44%	18
Fish ponds, pools, rivers	7	166085	0,39%	6
Continuous urbanized area	9,1	1156083	2,74%	4
Industrial companies and warehouse	9,2	1184519	2,81%	20
Mine, sandpit, gravelpit, concrete surfaces,	9,3	15427210	36,54%	4
Roads	9,4	188065	0,45%	3
<b>TOTAL</b>		<b>42224616</b>	<b>100%</b>	<b>252</b>

Source: Self elaboration. Proportion of land use respect total area, area of each land use in square meters and number of polygons.

## Results

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Also I classified land uses into two groups, stable areas like forests, waters, grasslands and unstable areas like arable lands, built-up and disturbed areas, industrial sites etc. . The predominant land use is 9.3 (Mine, sandpit, gravel pit, concrete surfaces) is because my classification is made in an area where mining is of great importance. This kind of land use is the 36.53% of the total area that is one third of the territory. This land use represents not only the open cast mining areas but also storage areas for waste from the extraction, sanders, gravel and concrete surfaces adjacent to mining areas. Clearly the nature and activities in this area will include the use of land in the unstable group. This land use is only made up of only four polygons, all polygons are large, there is especially a polygon (FID polygon n° 117) which constitutes a large part of the map and is located in the central area of the studied area, which area is 15.251.838 square meters. Unlike other uses, this land use 9.3 is represented by very large polygons because representing the 36.54% of the total area of the map in only 4 polygons and in others land uses can see that they are composed of many polygons but much smaller size, which means that land use is much more concentrated, because its activity required it and is not as dispersed as other land uses that are represented as spots patches the map.

Another land use is harvested field, land use 1.2 that represents a very important area. This land use is very abundant in the Czech Republic, in fact it's the second most widespread land use in the area. In this land use we can find crop fields. All land uses 1. are crop and lands basically represent several types of crops. In particular land use 1.2 is the most abundant by far to the others with a 19.10% regarding the total area of the zone. Apart from the mining activity which is the main resource of the area, consider that a percentage of the population lives off also of the crops.

Land use 6.1 and 6.3 represent forest areas, both together constituting 8.60% of total area, with a total of 20 polygons. These forest communities have been greatly reduced by residential areas that fragment the forest area, also implementation of crops which have reduced the forestry area, but have mostly fallen by the implementation of the open cast mines that occupy a very important area in this zone. When the mines are abandoned because they are no longer economically profitable or for another reason, a way to restore this area of environmental impact would be recovered through reforestation with native species in the area.

Also I must emphasize forest of less 50 cm height area, with very low vegetation, which area is 3.31% of total area. They are easy to identify areas and are usually found in areas near mining operations.

## Results

Other land uses, should be noted, land use is 9.1 (2.73%) are residential area mainly composed of urban houses. In the map we can observe four main population centers, these centers are similar in size and are surrounded by grass lands. Another use of unstable land is 9.2, which are all areas of industrial activity, where we see warehouses, manufacturing facilities and more industrial facilities. All these facilities are connected by highways and roads between them and residential areas and sometimes crossing a forest area, causing fragmenting action. Land use 9.4 includes all paved roads in the study area; the area is small size because it is a linear land use.

The overall trend of landscape changes shows a considerable decrease in the structural heterogeneity of the landscape, and especially in the agricultural landscape.

### **5.2. Proportion of stable landuse and unstable landuse:**

Proportion between these two groups (stable and unstable land use) will indicate us the intensity in which the soil has been altered from their natural land use, indicating the influence of man as it has been over this area. It's the proportion between ecologically stable and unstable lands from the environmental point (table 5.2).

**Table 5.2 Proportion between stable and unstable land use**

	<b>Area (m<sup>2</sup>)</b>	<b>Proportion %</b>	<b>N°polygons</b>
<b>Stable landuse</b>	8880159	21,03%	96
<b>Unstable landuse</b>	33344457	78,97%	156
<b>TOTAL</b>	42224616	100%	252

Source: Self elaboration. Ecologically stable and unstable proportion of area respect total area.

The development of the ecological stability changes in the landscape of the study area is expressed by means of the temporal development of the ecological stability coefficients (KES).

Phenomenon of ecological stability of the cultural landscape is based on the proportion of different land use categories in the area under investigation. Generally, coefficient of ecological stability of the landscape is formulated as the proportion of ecologically relatively stable

## Results

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(positive) areas like forests, waters, grasslands and ecologically relatively unstable areas (like arable lands, built-up and disturbed areas, industrial sites etc.). The simplest coefficient of ecological stability after MÍCHAL (1992) is counted as:

$$K_{es} = S/L$$

To establish the proportion between these two groups using the KES index, which is very simple. It is simply a division between stable and unstable land use, in this case the result is 0.266, a very low mainly due to the large area of The ecological stability of the study area is exceptionally low, which indicates a not balanced and ecologically highly unstable landscape, also indicates a disturbed ecologically unstable landscape.

### **5.3. Comparison results about original map and vectorized map:**

Once I've made all the changes in the final map, the result was that in almost all land uses there was a reduction in the number of polygons present each use on the map, because I had homogenized the map previously, since in the original map there were abundant polygons with very small areas, what I did it was remove and expand the area of the polygon that is adjacent to the eliminated polygon and which value is appropriate for this area.

In this way, the 1467 polygons on the original layer were reduced to 252, so 1215 polygons are removed. Because these 1215 polygons, 1206 polygons didn't have land use value assigned on the original map, primarily because whose area were negligible (Table 5.3).

## Results

Table 5.3 Comparison number of polygons between original map and corrected map

Landuse	Initial N°polygons	Final N°polygons	Difference N°polygons
no value	1206	0	-1206
1,1	1	1	0
1,12	4	2	-2
1,13	1	1	0
1,14	5	4	-1
1,2	65	57	-8
1,3	9	10	1
1,5	5	8	3
1,7	2	3	1
1,8	1	1	0
10,0,1	5	4	-1
10,0,2	8	9	1
10,0,3	3	2	-1
10,0,4	8	8	0
10,0,5	6	4	-2
2,1	1	1	0
2,3	5	5	0
3,1	7	6	-1
4,0	17	18	1
4,0+4,1	2	2	0
4,1	27	28	1
4,2	7	7	0
4,3	7	6	-1
4,4	1	1	0
4,5	8	7	-1
6,1	2	2	0
6,3	21	18	-3
7	4	6	2
9,1	9	4	-5
9,2	16	20	4
9,3	3	4	1
9,4	1	3	2
<b>TOTAL</b>	<b>1467</b>	<b>252</b>	<b>-1215</b>

Source: Self elaboration. It's the difference between the number total of polygons in the original map and vectorized map.

The value of land use 1.2 also suffer a considerable reduction both in the number of polygons in the map and in total area, that means that the polygons of this land use value were eliminated or changed to other different value, which is to be considered for his reduction in the size. The land use value 9.3 suffer a reduction in area of about 2.60% but its presence on the map is so large, this occupied in the original map almost 40% (39.19%) that its decrease is not visually identifiable on the map.



## Results

There are certain land uses that increase the area on the map but very little significance, the only case in which there is an important increase in the land use 6.3 (mixed forests) where even though as number of polygons decreases, undergoes an increase of 6.17%, a sharp rise.

All these calculations and results about the difference in the area and proportions are expressed in the table (5.4)

**Table 5.4 Comparison number of polygons between original map and corrected map**

	<b>Initial</b>	<b>Final</b>	<b>Difference</b>
<b>Landuse</b>	<b>Area (m<sup>2</sup>)</b>	<b>Area (m<sup>2</sup>)</b>	<b>Area (m<sup>2</sup>)</b>
<b>no value</b>	182550	0	-182550
<b>1,1</b>	97963	100691	2728
<b>1,12</b>	430707	230602	-200106
<b>1,13</b>	74751	76776	2025
<b>1,14</b>	531273	537420	6147
<b>1,2</b>	8211878	8067176	-144702
<b>1,3</b>	1014693	1121490	106797
<b>1,5</b>	351133	724299	373166
<b>1,7</b>	281492	294297	12805
<b>1,8</b>	38085	38078	-7
<b>10,0,1</b>	1723686	1732481	8795
<b>10,0,2</b>	896049	1188658	292609
<b>10,0,3</b>	234041	177224	-56817
<b>10,0,4</b>	1408656	1396592	-12065
<b>10,0,5</b>	608435	594581	-13854
<b>2,1</b>	9379	9413	34
<b>2,3</b>	202417	204654	2237
<b>3,1</b>	170626	174467	3841
<b>4,0</b>	795786	861456	65670
<b>4,0+4,1</b>	357313	361823	4510
<b>4,1</b>	1306524	1440310	133786
<b>4,2</b>	382194	300336	-81859
<b>4,3</b>	316682	320895	4213
<b>4,4</b>	12991	13035	45
<b>4,5</b>	484463	497355	12892
<b>6,1</b>	488126	497388	9262
<b>6,3</b>	488126	3141158	2653032
<b>7</b>	157880	166085	8206
<b>9,1</b>	985410	1156083	170673
<b>9,2</b>	1071200	1184519	113319
<b>9,3</b>	15113242	15427210	313967
<b>9,4</b>	137903	188065	50162
<b>TOTAL</b>	<b>38565653</b>	<b>42224616</b>	<b>3658963</b>

Source: Self elaboration. It's the difference between the area on the original map and vectorized map.

## Discussion

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### 6. Discussion: Correction method of these impacts

Dust on mines is generated by coal mining operations and overburden stripping, as well as by their transportation. In practice, dust generation on both mines is reduced by building dust-free roads and sprinkling dusty roads, also I can cover conveyor belt transfer points. I can install wet surface separators and steam sprinklers in coal processing plants, deploying industrial vacuum cleaners and put all coal-fired boilers on both mines out of operation, (<<http://www.scribd.com> > 2011), Mining and its Effects on the Environment (2007).

Different water protection regime is deployed for mine waters and for waste waters. Mine waters, i.e. those which penetrate the mine and which are usually removed by pumping, very often have a fluctuating low pH factor, carry with them non-soluble substances and as a rule have an increased content of metals. The first measure is to separate surface waters to reduce the volume of mine waters to a minimum. Mine waters are first treated in sedimentation ponds and then in mine water purification plants which work on the oxidation-neutralisation principle. Removed are primarily iron, manganese and non-soluble substances.

Industrial waste waters originate from various operations, e.g. when washing technological equipment, vehicles and auxiliary machinery. In order to render them harmless, a number of purification plants have been built, mostly working on the recirculation principle. Communal waste waters from various amenities are cleaned in highly efficient and reliable mechanical-biological purification plants.

The main objective is to reduce the generation of wastes, in particular dangerous wastes, to a minimum. If waste is generated, its collection, sorting, treatment, utilisation and recycling is organized. No longer usable waste is finally disposed of, depending on its character either by incineration or by depositing on waste dumps.

Utilisation of treated products of coal burning: Treated and certified products of coal burning are used on the mines for instance for land reclamation purposes or as a stabilising material in building dumps

The waste dump is built in an interior dump in the location of a thick layer of Tertiary clays. It is a managed and fully secured facility, to which wastes Class S-IO (inert waste), S-OO (other waste) and S-NO (dangerous waste) can be deposited.

## Discussion

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The source of noise on open cast mines are the huge excavation machines and auxiliary machinery. The most important aspect in noise propagation is the distance from the source and the shape of the terrain. The most effective way how to reduce noise is to do so right at source which, however, is sometimes technically very difficult.

In practice, implemented have been primarily the following measures; use balanced conveyor belt rollers; building acoustic screens around certain conveyor drives and central components and the last one is building protective earth bulwarks and forest strips in advance.

Noise monitoring in all residential communities which are affected by the mining operations is done monthly on a regular basis by an independent laboratory accredited for noise measurements, and the results are sent also at monthly intervals to the affected communities. If they wish, council representatives can be present at these measurements.

Without subsequent reclamation, the countryside affected by mining would remain for a long time a technogenic wasteland, not dissimilar to deserts or a "moon landscape". This alternative is out of the question. Therefore an integral part of mining activities is countryside reclamation which returns the countryside back to the nature and to people in the form of new farm land, forests, lakes, rivers and a number of other cultures with recreational functions.

### How to get open pit mining greener:

Experts offer a series of recommendations when managing a surface mining and later retrieve the area. It must be a selective extraction of materials, use drainage networks and effluent purification.

Reuse of debris, which can be utilized as material for road pavement, concrete, ceramics, as a source of energy in the case coal, as fertilizer for agriculture, or as an element to restore degraded soils.

Restoration of the land, filling the cavity using the ponds and mining tailings. When this is not possible, we use the so-called "mining transfer ", which retrieves an area of the site through the materials removed in another part of it.

Remediation of land by encouraging the formation of mycorrhizae, using nutrient-rich sludge, or by adding lime to neutralize acidification. Subsequently, we proceed to the introduction of plant species and it is recommended the planting of clover or other legumes

## Discussion

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(<<http://www.scribd.com> > 2011), Reflexiones sobre las actividades extractivas a cielo abierto (2008).

## Conclusion

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### 7. Conclusion:

From the correction and appropriate classification of land uses in the study area I could get the area occupied by each land use, noting all uses related to open pit mining which is the largest area occupied. The classification was made using the ArcGIS software, which turned out to be a very useful and which can save much time for qualifying.

ArcGIS is much more efficient than direct work on planes, but also represents an initial expense to get the information needed work, but to long-term is compensated. All my project classification and calculations I have made through ARCGIS.

During the correction I had some problems with the program, as it is blocked many times when I was vectoring, causing loss of work. But I think that was an effective method in classifying the soil according to use and to estimate the ecological quality of the area from this information.

In conclusion remarked the importance of making such classifications, to know is area proportion is of each type of soil so from here to make planning and improved land management.

## 8. Maps

[Original data of land uses in northern Bohemia](#)

[Final map of land uses in northern Bohemia](#)

[Map of ecologically stable and unstable land uses in northern Bohemia](#)

[Exact location map of open cast mining of coal brown in Bohemia \(ortophoto\)](#)

[Exact location map of open cast mining of coal brown in Bohemia \(RETM\)](#)

[Exact location map of open cast mining of coal brown in Bohemia \(poklad\)](#)



Current landscape in the neighbourhood  
of open cast mines in Northern Bohemia

Date: May - 2011	Original data of land uses of Northern Bohemian	Plan n°
Scale: 1/50.000	Developer: Ceska Zemedelska Univerzita	1

**Legend**

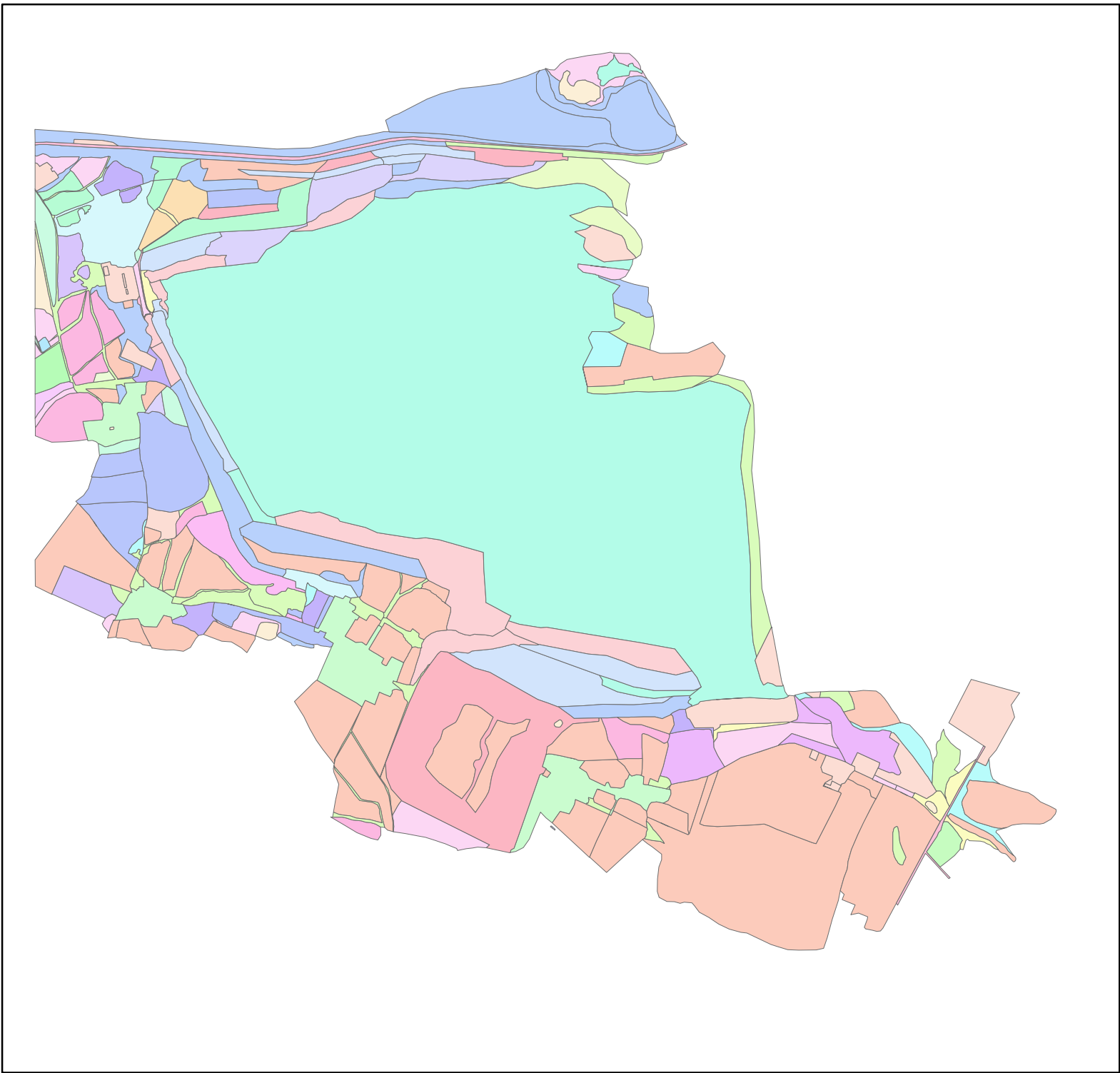
<b>Types</b>	<span style="display: inline-block; width: 15px; height: 15px; background-color: #f08080; border: 1px solid black;"></span> 10.0.1	<span style="display: inline-block; width: 15px; height: 15px; background-color: #80ffff; border: 1px solid black;"></span> 4.3
<b>landuse</b>	<span style="display: inline-block; width: 15px; height: 15px; background-color: #add8e6; border: 1px solid black;"></span> 10.0.2	<span style="display: inline-block; width: 15px; height: 15px; background-color: #d9ead3; border: 1px solid black;"></span> 4.4
<span style="display: inline-block; width: 15px; height: 15px; background-color: #8b4513; border: 1px solid black;"></span>	<span style="display: inline-block; width: 15px; height: 15px; background-color: #f4a460; border: 1px solid black;"></span> 10.0.3	<span style="display: inline-block; width: 15px; height: 15px; background-color: #90ee90; border: 1px solid black;"></span> 4.5
<span style="display: inline-block; width: 15px; height: 15px; background-color: #90ee90; border: 1px solid black;"></span> 1.1	<span style="display: inline-block; width: 15px; height: 15px; background-color: #f08080; border: 1px solid black;"></span> 10.0.4	<span style="display: inline-block; width: 15px; height: 15px; background-color: #add8e6; border: 1px solid black;"></span> 6.1
<span style="display: inline-block; width: 15px; height: 15px; background-color: #ff69b4; border: 1px solid black;"></span> 1.12	<span style="display: inline-block; width: 15px; height: 15px; background-color: #9370db; border: 1px solid black;"></span> 10.0.5	<span style="display: inline-block; width: 15px; height: 15px; background-color: #4169e1; border: 1px solid black;"></span> 6.3
<span style="display: inline-block; width: 15px; height: 15px; background-color: #90ee90; border: 1px solid black;"></span> 1.13	<span style="display: inline-block; width: 15px; height: 15px; background-color: #6495ed; border: 1px solid black;"></span> 2.1	<span style="display: inline-block; width: 15px; height: 15px; background-color: #f5deb3; border: 1px solid black;"></span> 7
<span style="display: inline-block; width: 15px; height: 15px; background-color: #9932cc; border: 1px solid black;"></span> 1.14	<span style="display: inline-block; width: 15px; height: 15px; background-color: #90ee90; border: 1px solid black;"></span> 2.3	<span style="display: inline-block; width: 15px; height: 15px; background-color: #f0e68c; border: 1px solid black;"></span> 7.
<span style="display: inline-block; width: 15px; height: 15px; background-color: #ff8c00; border: 1px solid black;"></span> 1.2	<span style="display: inline-block; width: 15px; height: 15px; background-color: #ffff00; border: 1px solid black;"></span> 3.1	<span style="display: inline-block; width: 15px; height: 15px; background-color: #90ee90; border: 1px solid black;"></span> 9.1
<span style="display: inline-block; width: 15px; height: 15px; background-color: #6495ed; border: 1px solid black;"></span> 1.3	<span style="display: inline-block; width: 15px; height: 15px; background-color: #ffb6c1; border: 1px solid black;"></span> 4.0	<span style="display: inline-block; width: 15px; height: 15px; background-color: #ffcc99; border: 1px solid black;"></span> 9.2
<span style="display: inline-block; width: 15px; height: 15px; background-color: #ff69b4; border: 1px solid black;"></span> 1.5	<span style="display: inline-block; width: 15px; height: 15px; background-color: #d9ead3; border: 1px solid black;"></span> 4.0+4.1	<span style="display: inline-block; width: 15px; height: 15px; background-color: #80ffff; border: 1px solid black;"></span> 9.3
<span style="display: inline-block; width: 15px; height: 15px; background-color: #9370db; border: 1px solid black;"></span> 1.7	<span style="display: inline-block; width: 15px; height: 15px; background-color: #90ee90; border: 1px solid black;"></span> 4.1	<span style="display: inline-block; width: 15px; height: 15px; background-color: #ff69b4; border: 1px solid black;"></span> 9.4
<span style="display: inline-block; width: 15px; height: 15px; background-color: #ffb6c1; border: 1px solid black;"></span> 1.8	<span style="display: inline-block; width: 15px; height: 15px; background-color: #8a2be2; border: 1px solid black;"></span> 4.2	

N

0 0,375,075 1,5 2,25 3 Km

Author of study:

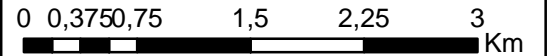
Alejandro Hidalgo Escrihuela



Current landscape in the neighbourhood of open cast mines in Northern Bohemia		
Date: May - 2011	Modified data of land uses of Northern Bohemian	Plan n°
Scale: 1/50.000	Developer: Ceska Zemedelska Univerzita	2

**Legend**

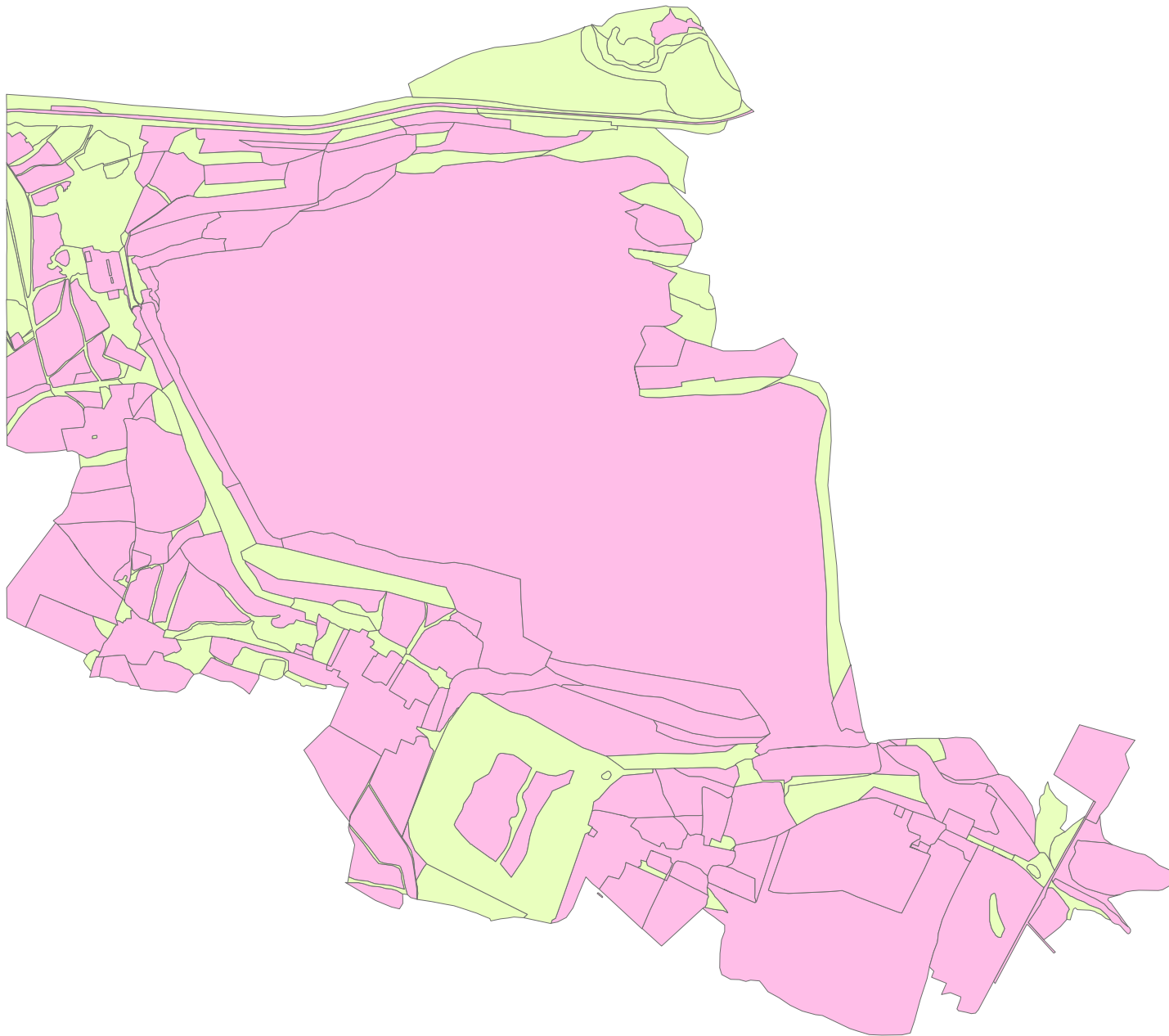
<b>Types</b>	10.0.2	4.4
<b>landuse</b>	10.0.3	4.5
1.1	10.0.4	6.1
1.12	10.0.5	6.3
1.13	2.1	7
1.14	2.3	7.
1.2	3.1	9.1
1.3	4.0	9.2
1.5	4.0+4.1	9.3
1.7	4.1	9.4
1.8	4.2	
10.0.1	4.3	



Author of study:

Alejandro Hidalgo Escrihuela





Current landscape in the neighbourhood  
of open cast mines in Northern Bohemia

Date: May - 2011	Land use ecologically stable and unstable	Plan n°
Scale: 1/50.000	Developer: Ceska Zemedelska Univerzita	3

**Legend**

**Types**

**ecological**

 Stable land use

 Unstable land use



0 0,375,75 1,5 2,25 3 Km

Author of study:

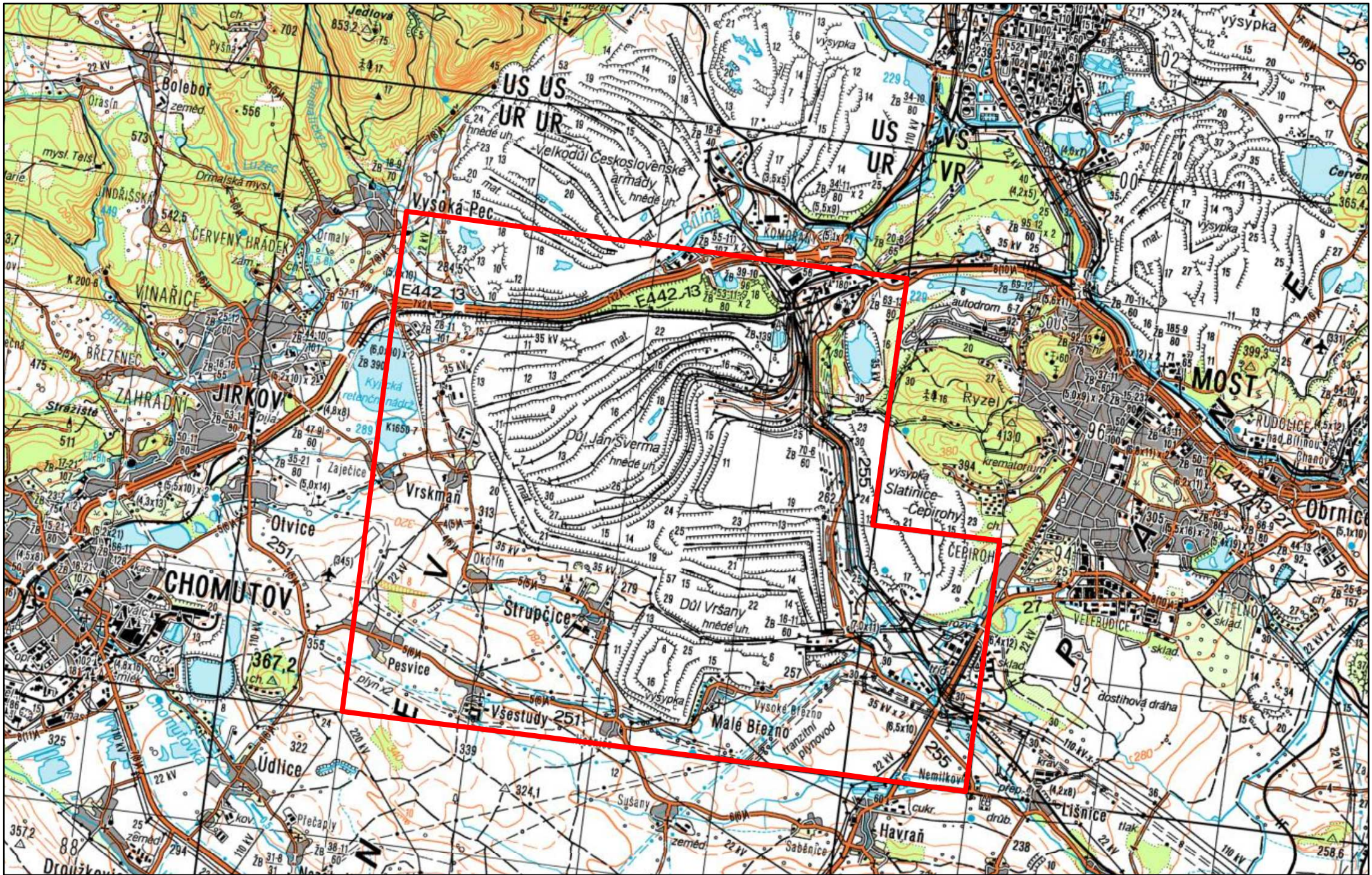
Alejandro Hidalgo Escrihuela

# Location of the area



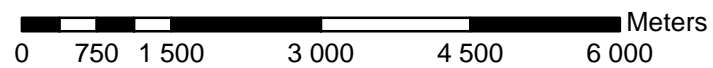
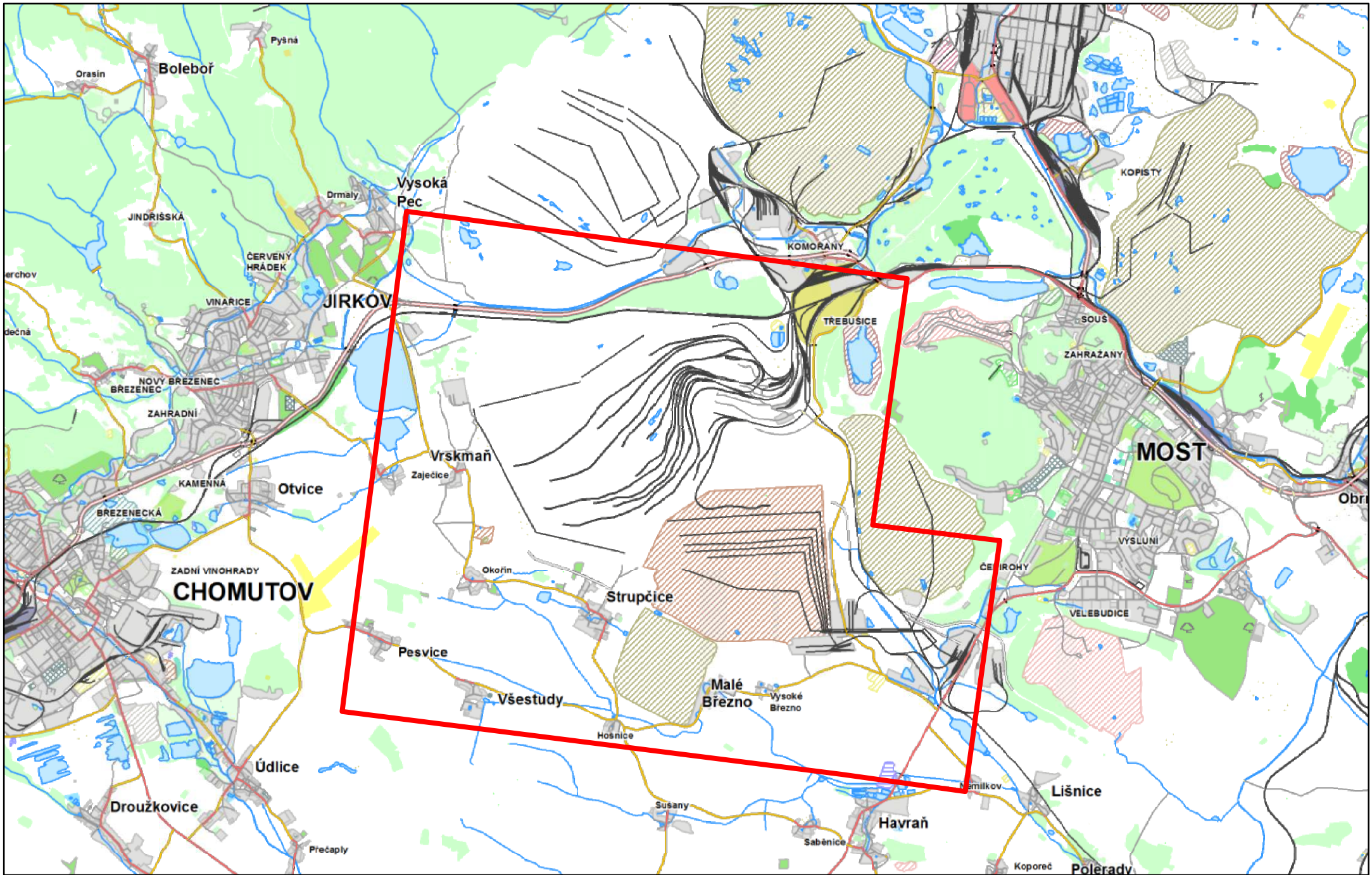
0 750 1 500 3 000 4 500 6 000 Meters

# Location of the area



0 750 1500 3000 4500 6000 Meters

# Location of the area



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