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Czech Post-industrial Landscapes in the Border Zone with Austria: Identification, Typology and Value

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with 11 figures and 2 tables in the text

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Zusammenfassung

Die post-industriellen Landschaften Tschechiens im Grenzgebiet zu Österreich: Identifizierung, Typologie und Bewertung

Das industrielle Erbe einer Landschaft zeigt sich in Objekten und anderen Spuren der Industrie sowie der damit verbundenen Tätigkeiten des Menschen. Ihre Funktionen in der post-industriellen Ära unterscheiden sich grundlegend von jenen in der aktiven industriellen Periode. Räumliche Konzentrationen dieses Erbes bilden die post-industriellen Landschaften (PIL). Dieser Artikel befasst sich mit deren Identifizierung, Klassifizierung

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und Bewertung zum Zwecke des Regionalmanagements im tschechisch-österreichischen Grenzgebiet. Öffentlich zugängliche Datenquellen über anthropogene Landformen, Flächennutzung, Altstandorte, Bergbaugebiete, Altlasten, architektonisches Industrie-Erbe usw. wurden mit GIS-Technologie verarbeitet. Grenzen, Flächen, Inhalte und fachliche Beschreibungen dieser Objekte sind für Entscheidungen über die Zukunft dieser Gebiete wesentlich. Die generischen Typen von PIL wurden unter dem Gesichtspunkt ihrer möglichen Auswirkungen auf menschliches Leben und menschliche Aktivitäten bewertet. Einige vorläufige Management-Vorschläge wurden entwickelt.

Schlagwörter: Post-industrielle Landschaften, Daten und Indikatoren, GIS, Klassifizierung, Tschechien

Summary

The industrial heritage in any landscape is represented by objects and other traces left by industry and associated human activities, which do not serve the present industry and inhabitants in the same way as they did before. Spatial concentrations of objects of such heritage form post-industrial landscapes (PIL). The paper deals with the procedures for PIL identification on the Czech national level, classification of PIL and their initial assessment for management done for PIL in the Czech border zone with Austria. Publicly accessible data sources on man-made land forms, land use, brownfields, mined sites, contaminated sites, industrial architectural heritage, etc. were used with GIS technology. The outline, area, content and topic description are essential for decision making about PIL future. The generic classes of PIL were assessed from the viewpoint of their possible impact on human life and activities. Preliminary management proposals were developed.

Keywords: Post-industrial landscapes, data and indicators, GIS, classification, Czechia

1 Introduction to industrial and post-industrial landscapes

Geography of industry traditionally deals with location, structural, employment and commuting aspects of industrial production, possibly its other more detailed aspects. Identification and mapping of industrial landscapes or territories, where land use and landscape appearance are dominantly shaped by industrial activities and their social and economic aspects, do not rank among key objectives of contemporary geography. Yet, recent industrial landscapes have found their firm place in landscape studies (Vráblíková & Vráblík 2007). The Technical University of Munich [München] even established a Chair of Landscape Architecture and Industrial Landscape. Industry-shaped landscapes (according to Antrop 2005) are classified as landscapes of revolutionary periods. Such landscapes arise and disappear quickly due to technological and social changes as well as military conflicts. Industrial landscapes as landscapes with a significant, even dominant impact of industry on the landscape character, structure and functioning, are usually studied in close association with urban landscapes. As a rule, industrial landscapes in towns tend to form 'islands' and become the hub of ongoing reconstruction or change (Gospodini 2006).

In the long-term perspective, industrial production on the territory of Czechia has been one of the most common economic activities. We distinguish several stages of industrial development: (a) early industrialisation at the turn of the 18th and 19th centuries related to the development of manufactories and introduction of steam engines into production and later into transport, with primary focus on steelworks, textile, glass and mining industries; (b) industrial revolution climax in the last quarter of the 19th century with emphasis on steelworks, engineering, food and energy industries; (c) introduction of assembly line mass production in the interwar period, particularly in the engineering, consumer goods and defence industries; (d) post-war restoration of industry in the late 1940s and early 1950s emphasising the armaments, engineering and petrochemical industries; (e) industrial restructuring in the 1970s focusing on the automotive, electrical engineering and chemical industries; (f) computerisation and automation of industrial production since the late 1980s associated with energy, material and labour savings and stressing the environmental aspects of production. Each of these periods saw the establishment of small and large businesses, which failed to find application in some of the following periods. Unused industrial and industry-related objects and sites, unless used for different purposes, thus laid the foundations of post-industrial landscapes.

The period following the political changes in 1989 saw a shift from heavy industry or energy- and labour-intensive production accompanied by a not very successful privatisation of the less efficient industries in the state sector. This process culminated in the mid-1990s. The collapse of some industrial plants resulted in the abandonment of many cultural, educational, trade, storage and agricultural (factory farming, granaries) facilities used to be supported by the state. Demilitarisation affected not only facilities used by the Soviet Army until 1991, but also facilities run by the Czechoslovak Army. The derelict objects and sites also tend to be characterised by the presence of non-removed old chemical contamination. The mining industry has also left numerous scars on the face of the landscape, as its development during the Communist regime was virtually unregulated with respect to its environmental impact. Open-air mining of raw materials for the building and energy industries was particularly large-scale. Due to this, the term 'industrial landscape' tends to be identified with landscapes affected by large-scale open-air mining, such as the Ruhr Region [Ruhrgebiet], Alsace-Lorraine, Lower Lusatia [Niederlausitz], Upper Silesia [Górny Śląsk], Saxony-Anhalt [Sachsen-Anhalt] or the Ore Mountains [Erzgebirge, Krušné hory], and the related energy and mining industry enterprises (see for Germany Hüttl 1998; for Czechia Sklenicka & Charvatova 2003; Vráblíková & Vráblík 2007; for Spain Conesa et al.2008; for Poland Czwartyńska 2008; Dulias 2010; Lamparska 2013).

Derelict industrial and other types of abandoned objects (military bases and training fields, agricultural, transport, water-management, mining, etc.), built parallel with the industrialisation processes, take up a significant part of the Czech (anthropogenic) landscape. Post-industrial landscapes thus represent heritage related to the previous industrial society. Post-industrial landscapes (hereinafter PIL) are understood as landscapes formed by industry and its associated activities and later abandoned and left to another dominant type of development. Geography's primary task in the study of post-industrial landscapes is to define their attributes, which will in turn provide a general basis for defining this type of cultural landscape, and to apply these attributes in practical delimitation and mapping of individual post-industrial landscapes in the given region. These tasks can be approached both theoretically and practically.

Current interest in industrial heritage cannot be denied. However, it tends to focus on individual objects rather than territories. The architectural value of individual buildings and entire industrial sites is particularly recognised. Many valuable industrial objects ceased to play their original role and many derelict production and urbanised facilities have turned into brownfields. Brownfields can be defined as land primarily resulting from de-industrialisation and suburbanisation (see ALKER et al. 2000). The English definition of brownfields is more extensive than this American definition, as it includes previously developed land – with or without contamination – that is currently underused or unused (LONGO & CAMPBELL 2016). A sceptical viewpoint present JACKSON et al. (2004), when they declare that brownfields represent a land with or without any utilising, but with negative impacts on the neighbourhood.

At present the area of officially recognised and registered brownfields in Czechia covers approximately 120 km^2 (REGNEROVÁ 2006). For comparison: Austria had in 2004 about 130 km^2 of brownfields, or 3,000 to 4,000 abandoned sites (CIZLER et al. 2014). An inventory of valuable and endangered objects was completed in some countries.[1)] A number of mostly non-governmental organisations deals with the inventory and conservation of industrial heritage objects at the national level in developed countries.[2)] In this respect, the so-called Nizhny Tagil Charter for the Industrial Heritage was adopted in 2003 to acknowledge the importance of industrial heritage for human culture, be it in town centres or open landscapes (LOURES 2008). The issue of industrial heritage is partly studied from the archaeological perspective (e.g., in Romania), as well as from the ecological one (the Institute of Ecology of Industrial Landscape of the Czechoslovak Academy of Sciences, now a limited company, was active in Ostrava). Vegetation succession in former industrial or other derelict facilities is an interesting aspect of industrial heritage. This spontaneous process helped to create a new scientific discipline called restoration ecology, which studies such phenomena (NAVEH 1998). The landscape thus gives rise and prosperity to "industrial nature" (CÍLEK 2002) or creates a "new wilderness" (LIPSKÝ 2011) as a landscape segment left to its spontaneous development regardless of the starting and entirely anthropogenic-based situation.

Many industrial towns have launched restoration of the originally industrial areas and the surrounding residential areas, usually with the aim to convert them into modern resi-

[1)] e.g., England <http://industrious.icserver26.de/index.php?pageId=1>, Scotland <http://www.sihs.co.uk/ index.htm>, Ireland <http://www.industrialheritageireland.info/>, Canada <http://www.canadian industrial-heritage.org/index.html>, Latvia <http://www.i-mantojums.lv/eng/frames/sakumlapa.htm>, Czechia <http:// www. brownfieldy.cz>

[2)] e.g., Výzkumné centrum průmyslového dědictví Českého vysokého učení technického in Prague [Praha], Cuffley Industrial Heritage Society – England, The Scottish Industrial Heritage Society, Association for Industrial Archeology, Canadian Industrial Heritage Centre, The Industrial Heritage Archives of Chicago's Calumet Region; and on international level European Route of Industrial Heritage (ERIH), The International Committee for the Conservation of the Industrial Heritage (TICCIH).

dential and service facilities characterised by a high standard of amenities. Modern application of findings acquired by industrial heritage research has thus registered particularly in cities in western Europe and northern America, as well as in New Zealand and Japan (e.g., London, Manchester, Glasgow, Hamburg, Vienna [Wien], Boston, Pittsburgh, etc., see Hall 1997; Whitehand & Morton 2004; Loures 2008). Industrial heritage has also become a tourist attraction. In towns and cities, it forms 'islands' surrounded by other forms of land use. Whenever possible, modern industries at present are moving outside the residential space to technological parks and sites.

Considerably less attention is paid to the environment in which industrial heritage objects are set, i.e. to the landscape. However, pioneer papers and monographs focusing on the issue of post-industrial landscapes (see Kirkwood 2001; Kirk 2003; Keil 2005; Hansen & Winther 2006, etc.) and their social and environmental aspects have already appeared. However, the expert community studying post-industrial landscapes still focuses predominantly on their architectural (Cashen 2007; Kubica & Opania 2015) and economic (Shahid & Nabeshima 2005; Dunham-Jones 2007) aspects. Post-industrial landscapes have failed to generate high numbers of papers in contemporary Czech publications (Fragner 2005; Kolejka 2006; Kolejka et al. 2012). Industrial objects, sites, the associated infrastructure and other derelict buildings and sites dating to the period of the industrial society are often found outside residential centres and are dominant in the surrounding territory. Areas affected by underground and open-air mining of coal, ores and building materials situated outside urban centres thus represent the 'rural' post-industrial space with associated, usually former facilities related to energy, metallurgic, engineering and building industries. These 'rural', formerly industrial landscapes outside large cities (where industrial heritage is not usually spatially dominant) have undergone a spontaneous transformation into post-industrial landscapes simply through de-industrialisation, i.e. through stopping or severely limiting mining activities and industrial production, abandoning the original industrial and other facilities from the same period or their transformation into different use.

At present the descriptive aspect of PIL is best developed, as it proved necessary in cases of conservation and inclusion of the remaining landscape industrial heritage into territorial planning documentation. Some larger areas, e.g., in Ruhrgebiet (Emscher-Park, see Fragner 2005), Wales (near Blaenavon as UNESCO World Heritage Site, see Rogers 2006), or England (Dearne Valley in South Yorkshire, see Ling et al. 2007) are examples. The spatial aspects, definition, classification and typology of post-industrial landscapes only exceptionally become the focus of research. Few authors have endeavoured to deal with the territorial aspect of the term 'post-industrial landscape' (e.g., Kirk 2003; Ling et al. 2007; Stuczynski et al. 2009). The geographical definition (borders and content) of PIL remains vague and unclear (see Loures 2008). In Slovenia, industrial landscapes as a special landscape type are defined in relation to the ratio of industrial areas (registered in CORINE Land Cover) within the total area of a cadastral area using GPS (Hladnik 2005). According to Ling et al. (2007) post-industrial landscapes can be conceived as areas significantly affected by mining, containing numerous derelict objects and brownfields, which are also subject to rehabilitation programmes and require a different approach to decision making about their future than the conventional one. Stuczynski et al. (2009)

drew on an original geographic concept of post-industrial regions in the European Union supported by the CORINE Land Cover 2000 database and GIS technology, registering industrial, mining and waste disposal sites. It is obvious that knowledge of the occurrence of different types of post-industrial landscapes represents the primary condition for state administration bodies, planning and conservation organisations and developers to adopt their respective viewpoints.

Efforts to assess post-industrial landscapes according to selected viewpoints are currently made. This paper attempts to offer some of the answers to such questions by presenting examples of post-industrial landscapes along the Czech-Austrian border, which may get into the focus of public interest, interest of industrial and service entrepreneurs and become sites of trans-border co-operation. We will demonstrate the methodology of mapping of post-industrial landscapes, results of their classification, what is critical for future decision-making of PIL´s inhabitants, visitors, users and protectors.

2 The case study: Border zone with Austria

In Czechia, the zone along the border with Austria abounds in natural beauty (It houses two of the country's four national parks, five protected landscape areas and three biosphere reserves.) as well as cultural and historical monuments. Six of twelve Czech World Heritage Sites, many urban conservation areas and urban conservation zones, many castles and chateaux, picturesque towns and villages are there. These Czech regions are least affected by industrial production, offering ideal conditions for tourism, sports and relaxation. Apart from large towns (see Fig. 1) with major industrial enterprises, industrial production comes in the form of smaller businesses. During the time of the Communist regime, the region saw efforts to introduce modern industrialisation to the relatively economically backward region and to increase the standard of living of its inhabitants. The pinnacle of this industrialisation process was the location of both Czech nuclear power plants (Temelín near České Budějovice, Dukovany near Třebíč). It is particularly the issue of nuclear power plants, which is addressed by the Austrian public.

In the period from the mid-19th century to the end of the 20th century industrial society has left numerous traces in the area, as data from publicly accessible geo-databases attest too. They reveal a clear synchoric effect. In places where objects of a single type occur, objects of different types can be found in their vicinity, and in some places, they even merge. Territorial concentrations of industrial heritage objects can be found in places, giving the landscape its distinctive appearance. Such areas can be termed as post-industrial landscapes. Their definition, mapping, classification and assessment in the border zone with Austria is the aim of this paper.

There are several ways how to define the border zone with Austria, particularly with respect to its shape and size. We may adopt the definition based on administration units from the level of cadastres adjacent to the state border, or similarly positioned districts to regions. Another option is to use the former pre-war ethnic Czech-German border, e.g., based on the population census of 1930 reflecting people's mother tongue or based on the 1910 population census, which took into account the dominant official language in a given municipality, or the commonly used delimitation of the borderland based on the Nazi German annexation of 1938. However, it seems sensible to avoid the problematic and changeable political borders and fall back on a neutral geometric delimitation of the border zone, which by its nature remains normative, as the zone's width must be defined by a figure. Although any such solution remains subjective, we opted for a 50 kilometres wide border zone oriented inwards into Czechia (Fig. 1), so that the borderland was accessible from the regional centres of the southern parts of the country (České Budějovice, Jihlava, Brno, and Zlín).

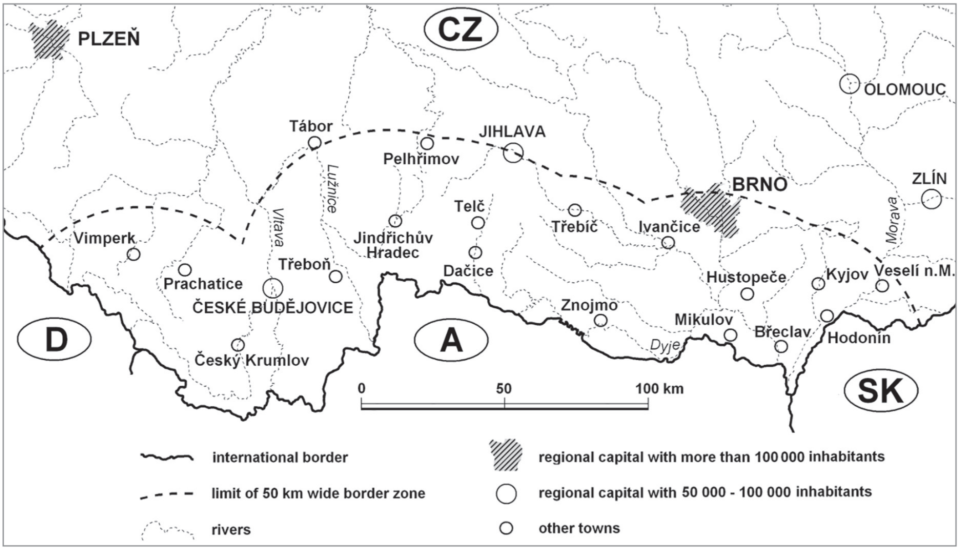

Fig. 1: Area of the border zone with Austria in the southern part of Czechia

3 Indicators of post-industrial landscapes, and data sources

Post-industrial landscapes are characterised by several specific physiognomic, structural and functional attributes, which represent relics of the past industrial period. While in a fully working industrial landscape these parameters are 'recent', in a post-industrial landscape they become 'fossil'. Physically they represent characteristics of the original natural landscape transformed by the influence of the previous industrial society into the existing land use forms.

Among the former objects a heat island containing atmospheric pollutants (gases and dust, usually from unmaintained surfaces and objects) continues to exist in its weakened form. Changes in runoff relations (man-made surfaces, drained areas, man-made water bodies, tailings ponds) remain. Soils were removed or covered either by the buildings themselves or by ground terraces. Another characteristic feature are terrain changes caused by mining, industrial and water-management activities, military facilities, transport and other types of activities. The contact with the geological environment changed after weathering residues had been removed in the course of constructing buildings, isolation and countervailing earth deposits, building and communal waste dumps and industrial dumps. Sites related to underground and open-air mining are abandoned. The existing biota suffered radical changes, in extreme cases by the total removal of natural or cultural vegetation and the creation of man-made surfaces with advancing ruderal and segetal communities, by a complete change in fauna with dominant synatropic or invasive species, but with returning elements of native flora and fauna.

No.	Data source	Source administrator	Resolution/ geometry/ coordinate system	Relation to industrial heritage
1	ZABAGED – basic set of geographic data	Czech Office for Surveying, Mapping and Cadastre	1:10,000/ polygons/ S-JTSK	mining sites, industrial sites, waste deposits, slag heaps
2	CORINE Land Cover 2006	Ministry of Environment of the Czech Republic	1:50,000 (min. area 25 ha)/ polygons/ WGS84	industrial and commercial areas – class 121, mining sites –131, waste deposits –132
3	National inventory of contaminated sites	CENIA state organisation	gravity points GPS coordinates/points/ S-JTSK	chemical contaminations
4	Czech national brownfield database	Czechinvest state organisation	App. 1:10,000/ points/ S-42	brownfields according to their original use with additional information
5	Undermined areas	Czech Geological Survey	App. 1:50,000 (min. area 4 km^2 as polygon)/ less than 4 km^2 as points/polygons and points/ S-JTSK	open-air and underground mining areas and sites
6	Objects of industrial architectural heritage	Research centre for industrial heritage, Czech TU in Prague	Objects gravity points GPS coordinates/ points/WGS84	preserved objects of valuable industrial architecture
7	Regional and district capitals	Czech Statistical Office	Cadastral areas in 1:10,000/polygons/S-JTSK	separating large urban landscapes in thematic data processing

Tab. 1: Czech data sources containing post-industrial landscape indicators

Object-oriented land use encompasses derelict, converted or dilapidating production facilities with typical objects (halls, chimneys, boiler houses, warehouses), vast abandoned or little-used transport facilities and means of transport (handling sites, reloading areas, railway stations, pipeline bundles, conveyor belts, parking areas, presently inefficient dense road and railroad network, freight cableways, etc.), abandoned and neglected original residential and service areas (housing colonies for workers, residential districts, blocks of flats depending on the period of construction) struggling with social problems. The same category includes derelict facilities for livestock production, military barracks, warehouses or logistic facilities. Unused buildings of educational, healthcare, catering, sports, recreational or entertainment facilities once accompanying the industrial society are also quite numerous. Some objects have also been listed under different conservation schemes. The social status of many inhabitants has changed, resulting in out-migration of some and in-migration of other groups of inhabitants into the neglected buildings.

Only in an ideal case can all the listed indicators be supported by data. Yet, several data related to the individual groups of sites and objects, including those related to industrial heritage, can be obtained from existing archival sources (for large-scale mapping) and through field work (at the local level). Selected geo-data are used as post-industrial landscape indicators in the study area of the Czech-Austrian border zone (Table 1). The data listed in the table require special interpretation in selected cases to extract data allowing the localisation and definition of post-industrial landscapes.

4 Data processing and post-industrial landscape mapping

As the first step, data processing in GIS (ArcGIS, v. 10.3.1) required unification of data into identical technical parameters. All data were converted into the WGS84 coordinate reference system, as it best suits the contemporary standards. An extract (see Table 1) for a predetermined Czech-Austrian border zone reaching 50 km inland in Czechia was deducted from the data sets. These sets were further processed.

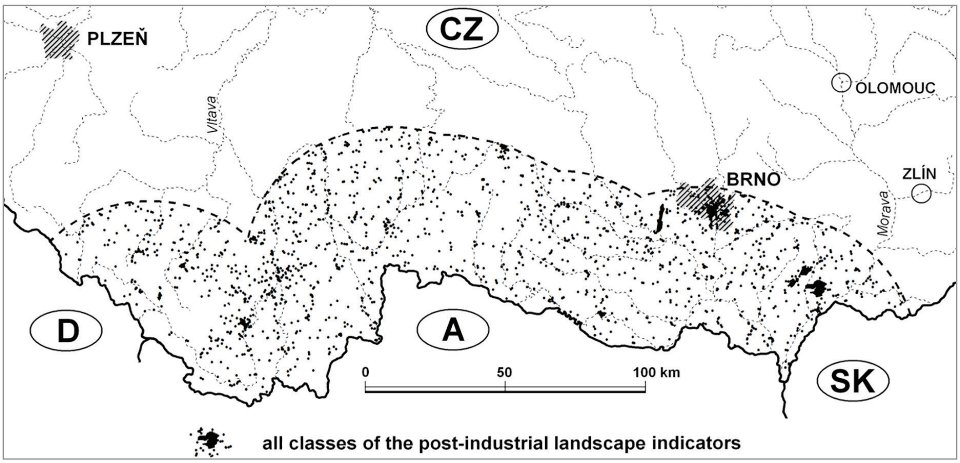

Fig. 2: Indicators of post-industrial landscapes in the border zone with Austria

Point data on chemical contaminations, industrial architectural heritage, brownfields and small-scale mining sites (up to 4 ha) may play the role of industrial landscape indicators if they come in 'denser' concentrations. However, the question remains what can be the maximum distance between point indicator objects to include them in a single area. GIS technology offers the possibility to wrap point objects by a wrapping zone (a buffer), which, apart from the conversion function point to polygon may also represent the impact of these objects on their environment. Such an impact exists, but is highly diverse with respect to the ground plan, intensity and the carrying/target medium (environmental component). Determination of buffer width (wrapping zones around potential impacts of point PIL indicators on their environment) represents a case of a subjective intervention in the otherwise 'objective' mapping process controlled by GIS technology (of course regardless of the 'subjective' selection of data or their 'subjective' existence).

The determination of the buffer width may be debatable. Experiments with several options (100, 500 and 1,000 m) resulted in setting the buffer size at 500 m. The resulting circle around a central point has 1 km diameter. The distance between two neighbouring 'wrapped' points, which may constitute a single polygon, is then a maximum of 1 km as well (in an extreme case, the buffers touch each other in a single point). The 500 metres distance from the source of impact (environmental, aesthetic, visual, etc.) may also be conventionally considered the range of the source's impact, although the factors of soil, rock and hydro-geological environments or the actual outlook may obviously distort its impact range significantly (e.g., sources of pollution). However, it is impossible to study and determine the shapes and dimensions of buffers around the more than 2,000 used 'point' localities in the course of data processing (Fig. 2). It is even not possible in a detail view on the processing procedure (Fig. 3).

The final decision on buffer width was partly inspired by experience from abroad (HLADNIK 2005). Apart from isolated outstanding objects of industrial heritage, the interviewed inhabitants of the PIL studied did not perceive the objects as intrusive if their distance was approx. 500 m. The final, if conventional estimate of point (and polygon) post-industrial landscape indicators' (dumps, contaminated sites, brownfields, etc.) impact range supported by a survey was determined at 500 m from the source. Buffers of this scale were then gradually applied first on point objects (thus acquiring an 'area' character) and then equally on areal (polygon) objects in the study area (Fig. 4).

The available data from the CORINE Land Cover database do not allow us to differentiate which mapped areas (mostly covering over 25 ha) are active (thus indicating an industrial landscape) and which are already fossil (indicators of post-industrial landscape). While in mining and dump sites (in the form of large deposits of earth or mine waste, mining pits as remnants of open-air mining, including mining of building materials), only a small part of these sites is really active, in industrial sites we had to select such sites for further processing, which either contain at least one brownfield or where a brownfield is situated within 100 m of their edge, which is within the tolerance of a possible error in CORINE Land Cover in the original resolution of 1 : 50,000. Only then it was possible to wrap the remaining sites from the CORINE Land Cover database in 500 m buffers. This method may overrate the surface area particularly of smaller objects, but it needs to be taken into consideration that the impact of such objects on their surround-

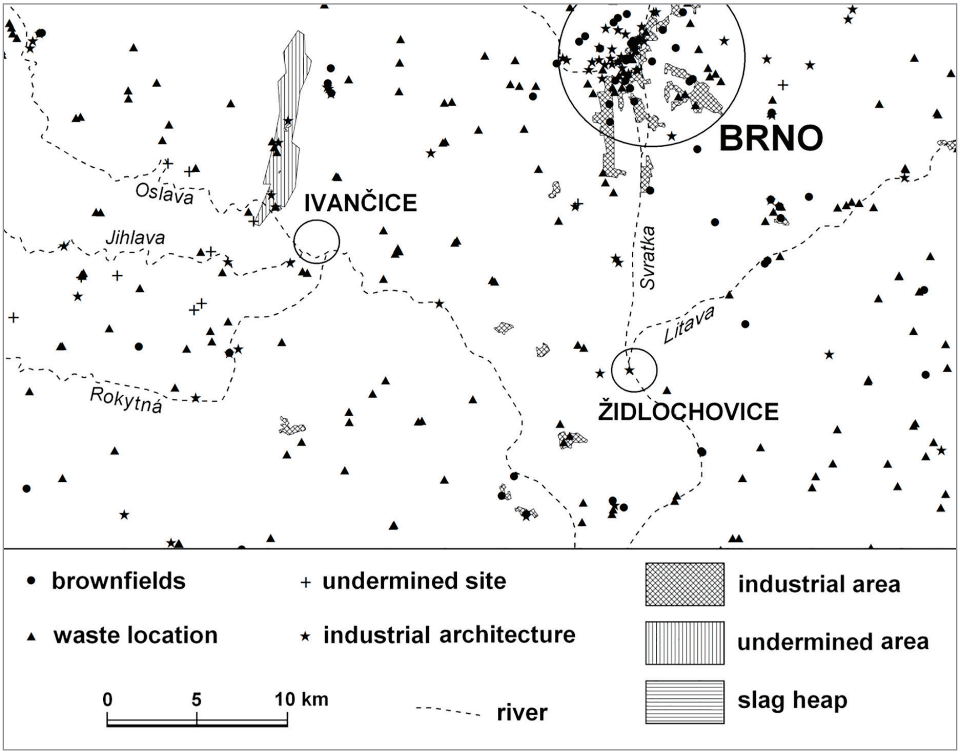

Fig. 3: Detail distribution of PIL indicators to the south of the City of Brno

ings does not cease on their edges. The applied buffer width is therefore a compromise between the knowledge on the expected impact range of all types of objects of all sizes on the one hand and the virtually absolute lack of data on the specific situation around them on the other hand.

Through integrating the polygon layers of buffers around point indicators and areas of polygon indicators, including their buffer zones, a polygon layer with a wide spectrum of different size sites was created (see Fig. 4). The minimum area is the area of a single isolated buffer around a point object (approx. 0.8 km^2). The upper size limit is not predetermined. The heterogeneous areas then encompassed (with regard to the maximum allowable distance of 2 x 500 m) up to all seven types of polygons – PIL indicators. By combining (‘fusing’) the individual, yet overlapping or at least touching areas we obtained areas indicating post-industrial landscapes. A total of 1,092 areas of different sizes were thus defined in the Czech-Austrian border zone.

Some large-scale combined areas can be found within large cities, mostly regional and district centres. We can confidently say that within the built-up area even high concentrations of these objects ‘disappear’ when contrasted with the competing, more numerous and functional objects, which fulfil their predetermined functions in the urban environment.

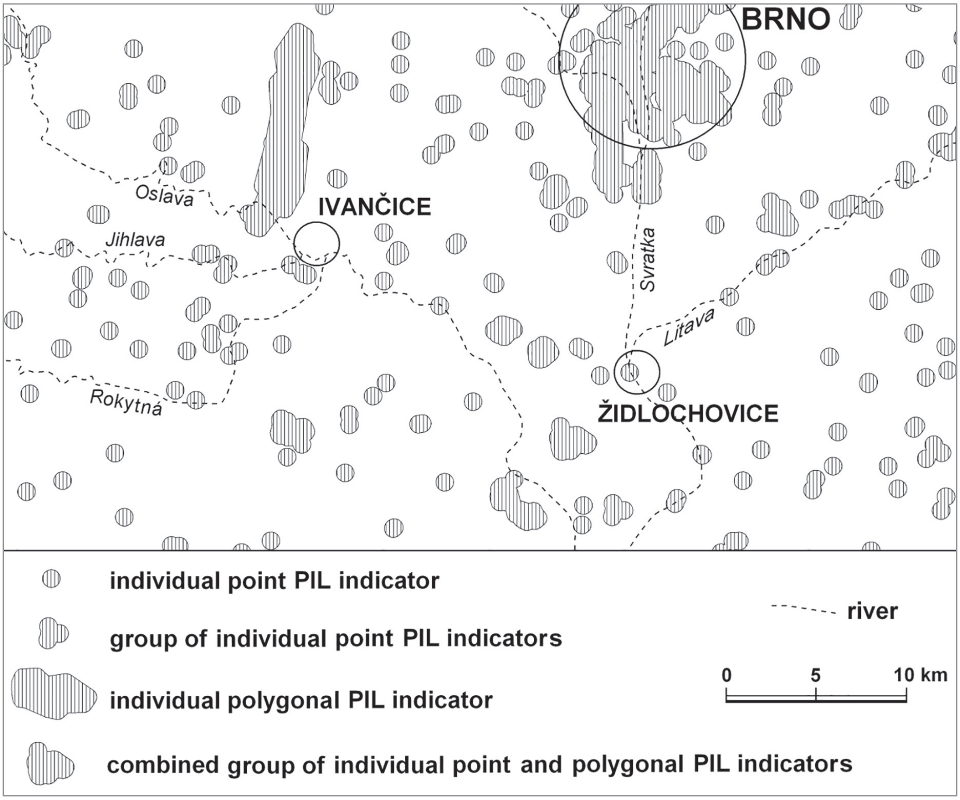

Fig. 4: Point and polygonal PIL indicators wrapped with 500 m wide buffers in GIS

Regional and district centres contain large numbers of industrial heritage objects within their cadastres, but their character is defined by contemporary activities, such as housing, modern and traditional industrial production, services, cultural, business or sports activities and related objects. Areas of PIL indicators on the territories of regional and district centres are therefore excluded from further data processing (Fig. 5). Only areas where post-industrial indicators play an equal role with other objects in the landscape, which can be expected outside large cities, can be defined as post-industrial areas and consequently post-industrial landscapes.

While the minimum area around an industrial heritage object is determined by the 500 metres radius of a circle (= 0,785 km^2), the maximum extent of an industrial heritage area does not exist. Determination of the minimum area of a territory, which is to be labelled as a post-industrial landscape is therefore another subjective interference in data processing and involves exclusion of all smaller areas representing mere ‘post-industrial sites’. The most common size of a cadastre unit in Czechia is 5 km^2. This size was therefore used as a conventional means of differentiating a post-industrial landscape (5 km^2 and more) from a post-industrial area (up to 5 km^2).

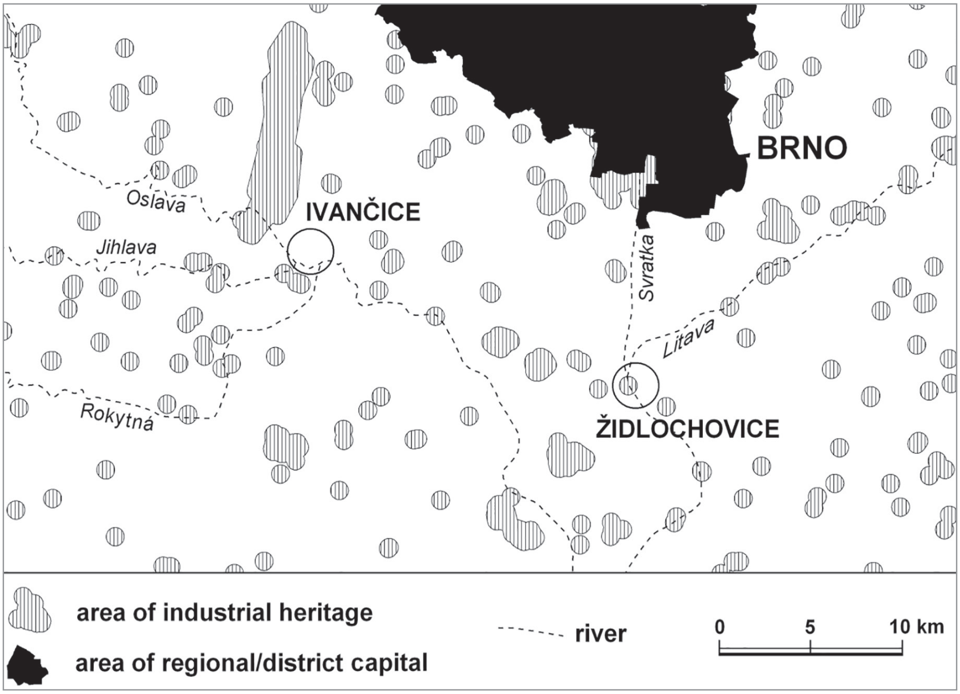

Fig. 5: Delimitation of PIL indicators with buffers in the larger urbanised zone of the regional capital Brno

The existing methodology resulted in the creation of areas of bizarre shapes in some places. The excessively jagged edges had to be geometrically smoothed out to be practically applicable in the decision-making process in the given area. Methods of cartographic generalisation, which maintain the general shape of an object and minimise surface changes in the area are considered as an optimum. Using a suitable tool in ArcGIS SW enables to generalise shapes without significantly changing the resulting shape of the area and its surface. The tool Simplify Polygon (in the Cartography Tools Toolbox, ArcGIS) was used for this purpose. The resulting simplification of outlines (Fig. 6) is useful particularly for administrative and planning tasks.

To classify the identified PILs into groups (types), the method of genetic classification was used considering share and type of genetic factors (Fig. 7). Naturally, activities which played a decisive role in the formation of PIL represent the genetic factors. The classification criterion was the area representation of areal PIL indicators of different origins (% limit 75, 50, 25, 10) along with a combination of represented area and point indicators. The classification of the identified PIL takes the form of a one-to-four-word denomination with decreasing definition significance when read from left to right, e.g., mining PIL, mining glassworks PIL, wood-processing, food leather manufacturing PIL.

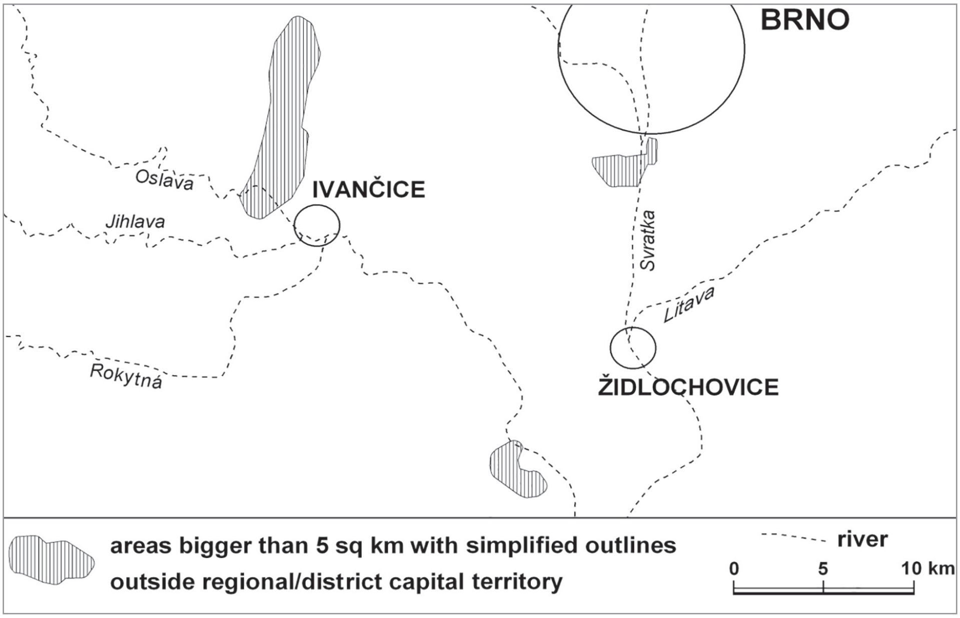

Fig. 6: Post-industrial landscapes identified as areas bigger than 5 km² outside large urbanised zones with outlines geometrically smoothed in GIS

5 Results and discussion

A total of 14 post-industrial landscapes were identified on the territory of the Czech-Austrian border zone (Fig. 8, Table 2). They show a specific geographical distribution in distinct territorial concentrations in the vicinity of regional centres – České Budějovice and Brno. This finding supports the theory that today's regional centres (which used to be important regional hubs in the past as well) conditioned the development of industry and industrial society in their wider surroundings. The decline of the industrial society simply had to be reflected in these surroundings, where contemporary post-industrial landscapes of several types may be identified over industrial heritage.

The identified and genetically classified PIL (Fig. 9) by using GIS technologies were subjected to two further classifications with the objective to determine their status from the viewpoint of future development. The identified and genetically classified PIL have undergone basic geographic research. It focused on both the collection of background material on PIL's natural properties and the identification of their basic economic and social parameters. A cartographic and photographic documentation was provided. Interviews with representatives of the territorial administration of municipalities located in the territory of PIL were realised in order to get acquainted with the problems of the territory and the views of the local administration on their solution. From the results of field research, the collection of detailed archive data on PIL territory and discussions with local

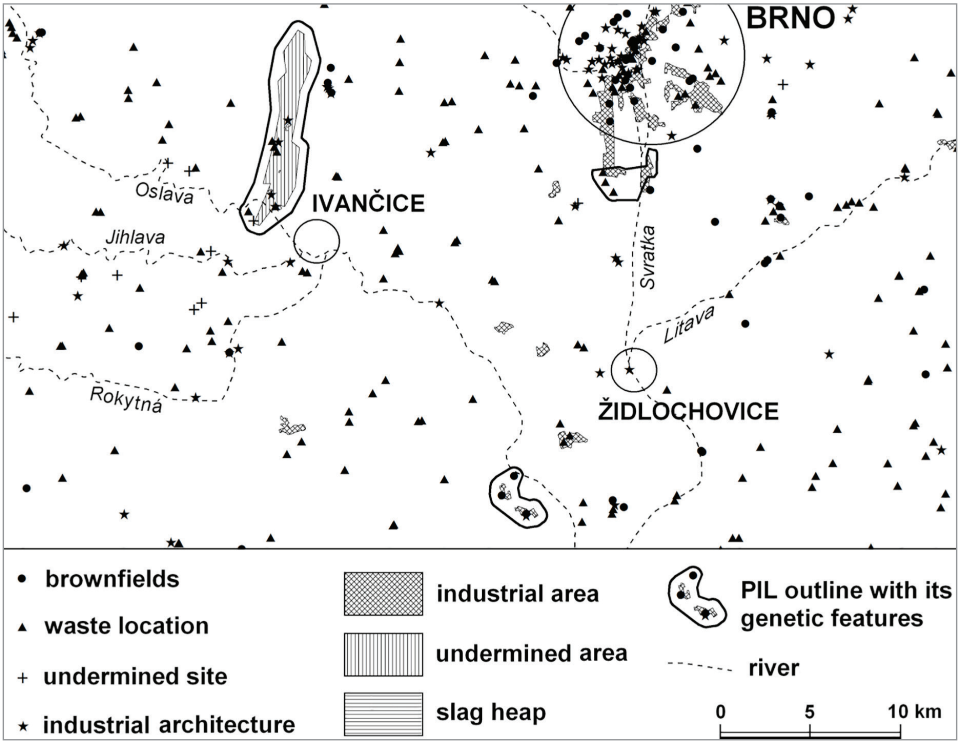

Fig. 7: Post-industrial landscapes identified in the sample area. Inside PIL outlines PIL indicators are presented

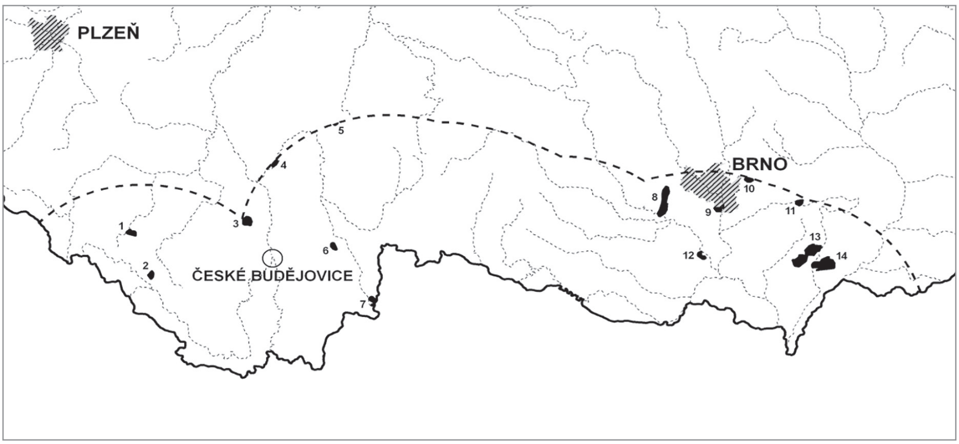

Fig. 8: Territorial distribution of post-industrial landscapes identified in the border zone with Austria

administrative representatives, the classification of identified PIL into groups was based on their (1) ‘environmental value’ (an expected status or a role in the border zone) and (2) an implementation of the initial intervention or the measure necessary to trigger future development.

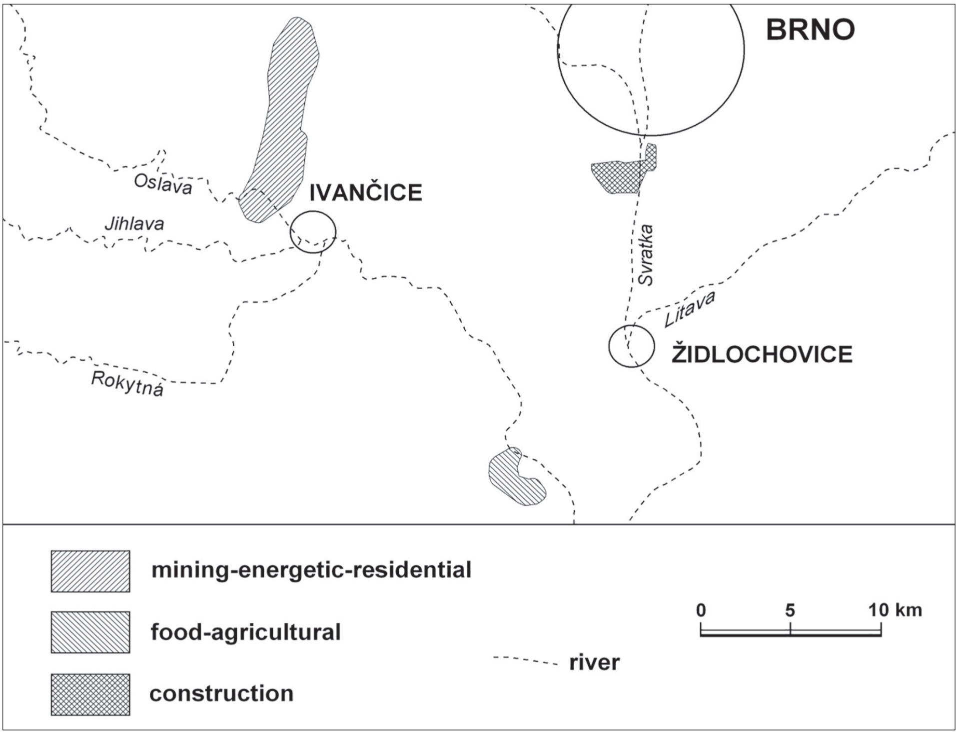

Fig. 9: Examples of PIL genetic classes in the area to the south of Brno

The ‘environmental value’ represents their current significance for the quality of the environment (both the natural and social) in the given place as well as in a wider (national) context. The presence of PIL indicators based on their physical nature (mining deposits, dumps, industrial architecture, human-made landforms, etc.), along with the expected positive or negative impact of these objects on the environment within the given PIL were the classification criteria, rather than classification based on their origin (economic sectors in the past). Their verbal denomination is a compromise with respect to the processes which take place in the PIL (Fig. 10, see Table 2). A total of six types of PIL were identified based on their ‘environmental value’.

Another classification procedure was then used for each PIL to outline basic initial measures for the area’s future management based on its genesis and the character of existing indicators, including the value (Fig. 11). The selection of initial measures resulted both from needs of the local administration within individual PIL and from outcomes of

No	PIL name	Genetic type	Environmental value based on	Initial measure
1	Vimpersko/Winterberg	textil-wood-food	history development possibility	revitalising
2	Volarsko/Wallern	wood-food-leader	history development possibility	revitalising
3	Mydlovarsko/Midlowar	mining	possible risks	security against accidents
4	Bechyňsko/Bechin	textile-food-iron	history education possibility	revitalising after cleaning
5	Ratibořskohorsko	mining	history education possibility	controlled management
6	Třeboňsko/Wittingau	food	history development possibility	revitalising after cleaning
7	Halámecko	mining	recreation education possibility	supported naturalising
8	Rosicko-Oslavansko/ Rosssitz-Osslawan	mining-energetic-residential	history development possibility	controlled management
9	Modřicko/Medritz	construction	running development	investments
10	Mokersko/Molirau	mining	ecological education possibility	supported naturalising
11	Bučovicko/Butschowitz	wood	development possibility	revitalising after cleaning
12	Pohořelicko/Pohrlitz	food-agricultural	development possibility	investments
13	Šardicko/Scharditz	mining	well-working agriculture	controlled management
14	Dubňansko/Dubnian	mining-glass	well-working agriculture	controlled management

Tab. 2: Classification of PIL in the Czech-Austrian border zone

the field research. In many cases, more than one important measure was offered, the priority was given to what seemed to be the most important in terms of local wishes. Where a successful development occurs, there is a need for investments, mainly due to the deterioration or lack of capacity of the technical infrastructure (communication, sewerage, electricity, water and gas distribution network). The opposite is the case after vast mining of raw materials. Former quarries represent a territory for a spontaneous ‘return of nature’ usually associated with the succession of rare species of organisms. A social support for this process is primarily to prevent further devastation of this area, for example by waste deposits. In another area type affected by mining, the primary task is to secure former mines against the risk of leakage of harmful substances or against their physical collapse

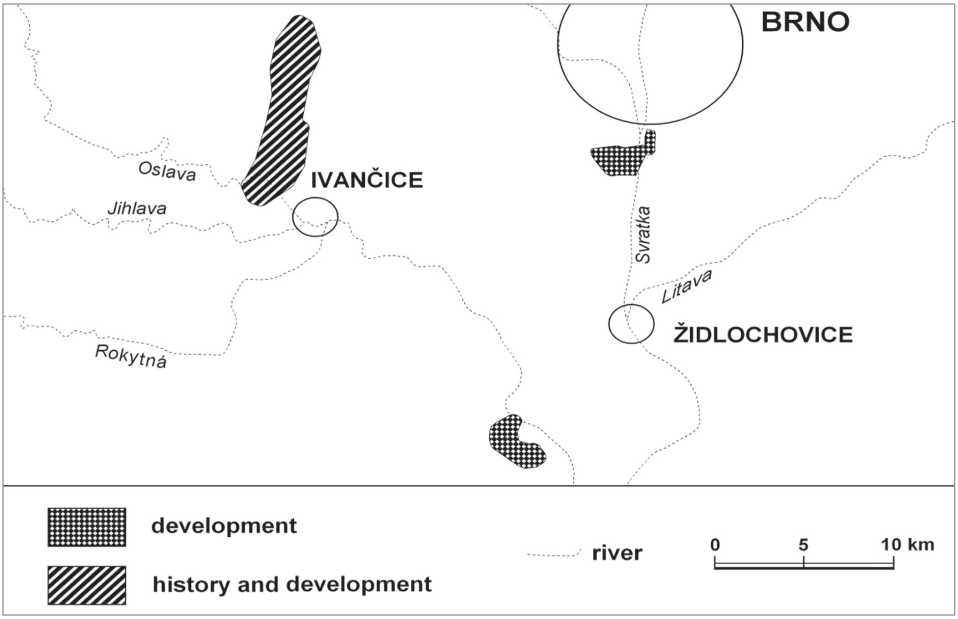

Fig. 10: Examples of PIL environmental value classes in the area to the south of Brno

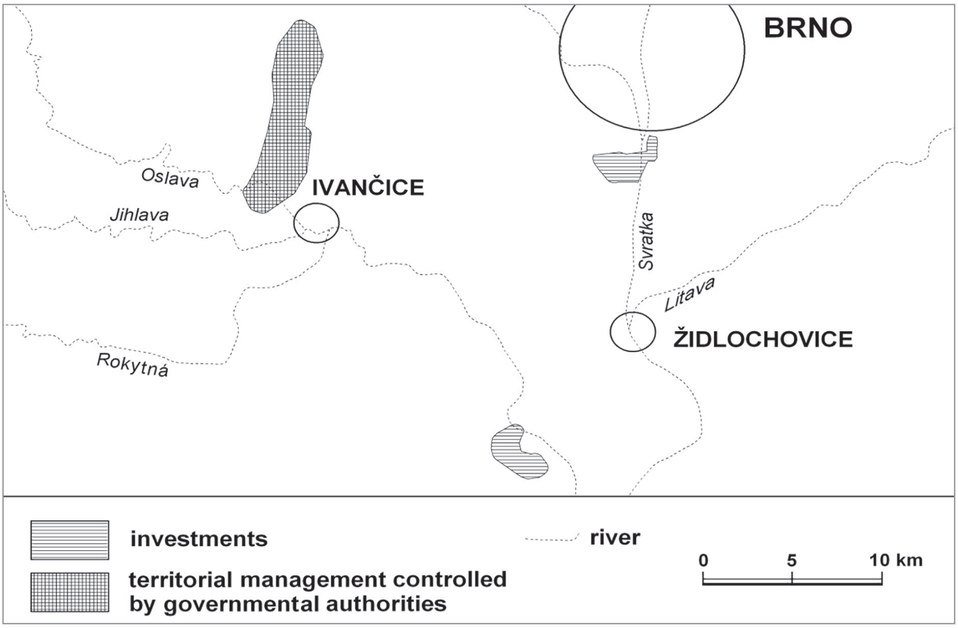

Fig. 11: Examples of basic initial measurements to be applied in PIL in the area to the south of Brno

with unpredictable consequences, inter alia, threatening the lives of the inhabitants. A relatively common task is the revitalisation of the territory, which means the economic transformation of the territory for new activities replacing the original, usually heavy industry or military activities. Such areas can serve for recreation and tourism, sports, modern light industry, often also educational purposes. Sites that are extremely polluted with chemicals and oils, however, require a clean-up in advance. A controlled management is well-suited for areas where, after an industrial expansion period, a return to agricultural use occurs. Here, it is necessary to set such rules of use that will lead to the targeted reduction of traces of former industrial utilising or to local preservation of industrial buildings/areas as historical sights (especially objects, heaps) without endangering the production of quality food or the stay of visitors.

The strength of the PIL's mapping procedure is the fact that the expected aims were fulfilled. This, apart from a clear identification and definition of a PIL, required the use of generally accessible digital geo-data with a single mapping method to conduct genetic classification and typology of PILs according to the representation of indicators (in terms of number and area) in each identified PIL. It is expected that the method can be easily repeated upon using similar data. It became apparent that different PIL indicators always come together. Where one occurs, others tend to occur as well, albeit not always recorded in the used databases. Their presence was proved by a conducted verification survey.

The weakness of the method used is undoubtedly the fact that it draws only on a part of the theoretically possible PIL indicators. At this point, however, it must be noted that most indicators occur jointly in concentrations, which is logical. The downside of the method is knowingly relying on incomplete data on the indicators used (e.g., brownfields), as their owners or managers release only a limited selection of such data for public use. The processors subjectively intervened in the data processing twice: At first, when determining buffer width (500 m) around point and polygon PIL indicators, and secondly when defining the minimum size of a PIL (5 km^2). Expert opinions may differ but the final selection drew on published case studies and inspiration from the past applied in a different context.

6 Conclusion

The resulting work is intended both for the public of the border zone and inhabitants of inland Czechia and Austria, as well as for decision makers on the regional and local levels and investors from both sides of the border. The information may prove inspiring for potential developers and investors, for nature and landscape conservation bodies and for the sphere of architectural and cultural monument protection. The used GIS procedures clearly defined individual PIL, classified them genetically, identified their relation to the environment (positive or negative value) and addressed initial measures, which need to be taken in individual PIL with respect to their characteristics. The measures may range from a proposed complete elimination of the given PIL, its conversion to various industrial or non-industrial purposes to its conservation for educational and museum purposes.

A subsequent stage of the study requires detailed knowledge of each PIL and to propose measures for their future management. Owing to the fact that we provide PIL types and general outlines of measures, the individual PIL characteristics will have to be specified in more detail on the local level (with respect to land use, degree of damage or danger, etc.) and the proposed general measures will need to be modified and perfected to meet their requirements. In any case, the identified PIL are a reality. They represent a development issue owing to their uncertain status and future. They may become an interesting focus of research for several scientific and technical disciplines.

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