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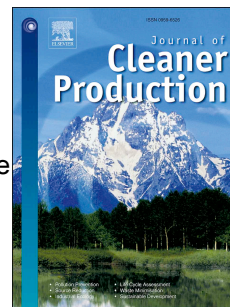
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Sustainable urban development in a city affected by heavy industry and mining? Case study of brownfields in Karvina, Czech Republic

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35
36 **Abstract**

37 Due to recent societal changes ‘brownfield’ sites have gradually become a significant element
38 in planning urban development. Brownfields can occur as a barrier and obstacle to the
39 development of the urban organism but simultaneously they also represent unrealized
40 potential. Brownfields, ex-industrial sites, are greater in those cities whose development was
41 based on heavy industry or mining. In the first part of this paper theoretical concepts linked to
42 the regeneration of brownfields are discussed, the second part is devoted to a case study of
43 Karvina, in the Czech Republic, where the driving forces behind the occurrence of
44 brownfields, their spatial distribution, and their prospects for regeneration are analysed. It was
45 found that 28 brownfield sites on 121 hectares are located in surveyed city with the majority
46 having industrial and mining origins. Majority of local brownfields are owned by a local
47 mining company. The perception of individual sites by the local population was ascertained
48 via a questionnaire survey (n=150). This found that awareness about problems connected to
49 brownfields is quite limited and that local population perceive post-mining brownfields,

50 located in more distant locations, as an opportunity for new industries to create job
51 opportunities in city with significant unemployment problems.

52

53 **Highlights**

54 Brownfield sites and associated impacts on the urban development of post-industrial cities.

55 The popularity of industrial usage for post-mining brownfields.

56 That post-mining landscapes are frequently not perceived as brownfield.

57 Brownfields located in the peripheral locations are usually disregarded.

58 The central role of public administration in brownfields regeneration projects.

59

60 **Keywords**

61 Brownfields; Human Geography; Spatial analysis; Karvina; Czech Republic

62

63 **1. Introduction**

64 According to official statistics, the Czech Republic has experienced an enormous growth in

65 built-up areas in the last two decades. Almost 4 700 hectares of land have newly been covered

66 by different types of constructions, meaning that the same amount of green space has also

67 been irrecoverably lost. Simultaneously, many abandoned sites of various original uses have

68 appeared as a result of recent societal and economic transitions, in both urban and rural areas.

69 The questions arise whether such 'wild' building development at the expense of open

70 landscapes is in line with the proclaimed 'sustainable' development strategies of cities and

71 villages, and whether this form of development threatens the future use of land-based

72 resources. This near-future threat is consistently emphasized by scientists and international

73 organisations, which propose solutions based on more environmentally friendly uses of the

74 landscape. One such direction that could help to reduce such negative development is a

75 systematic and well-planned policy for the regeneration of abandoned sites, for which the

76 term 'brownfields' is usually used. The problem of brownfields has recently raised public

77 debates among representatives of the public administration, private companies, and academia.

78 This issue is increasingly becoming a part of the research agenda of not only geographers

79 (Osman et al., 2015, Frantál et al., 2015a, Kunc et al., 2014a, Hercik et al., 2014) but also of

80 economists (Bartke and Schwarze, 2015, Bartke, 2011; Rydvalová and Žižka, 2006),

81 sociologists (Alexandrescu et al., 2014a, Alexandrescu et al., 2014b), urban planners (Raco

82 and Henderson, 2006), environmental scientists (Carlson et al., 2008), and scientists in

83 technical fields (e.g. Morio et al., 2013). If we focus more on socio-spatially oriented research

84 into brownfields, the following research directions may be stressed: 1) the development of

85 databases with various social, economic, and environmental data on brownfields (e.g., Leigh

86 and Coffin, 2000, Vojvodíková et al., 2011); 2) studies analysing the process of brownfields

87 regeneration and approaches of the public administration in different regions or countries

88 (e.g., Klusáček et al., 2011); 3) studies reacting to the limited financial sources available for

89 the regeneration of brownfields through the development of prioritisations and classifications

90 of these sites (Chrysochoou et al., 2009; Doleželová et al., 2014; Pizzol et al., 2016); 4)

91 studies on the specificities of the spatial development of brownfields within cities (Kunc

92 2014b, Frantál and Nováková, 2014; Novosák et al., 2013); 5) application of GIS tools to

93 brownfields research (e.g. Sun and Jones, 2013); and 6) studies focusing on analyses of

94 specific types of brownfields according to their original use (agricultural – Krejčí et al., 2014,

95 Klusáček et al., 2013, Klusáček 2014, Skála et al., 2013; military - Hercik et al., 2014;

96 cultural – Andres and Grésillon, 2013, Slach et al., 2013 etc.). From the geographer's point of

97 view, it can be stated that the discipline significantly contributes its expertise in spatial

98 coherences and relations between natural and socioeconomic components of the landscape to

99 deepening knowledge of the various spatial aspects of brownfields. Although the significance

100 locational context of brownfields has often been underestimated as it is dynamically reshaped
101 by other driving forces, it can be stated that the spatial dimensions of brownfields and their
102 regeneration are of crucial importance (Frantál, et al. 2013).

103
104 This paper deals with the issue of brownfields in the city of Karvina, a city where due to its
105 mining and industrial history during the last one and a half centuries, and to dynamic
106 socioeconomic changes in the last two decades, many relicts of industrial and mining
107 activities can be found. In the first part of the paper theoretical concepts linked to the
108 regeneration of brownfields are discussed, while the second part is devoted to the case study
109 of Karvina, where the driving forces behind the occurrence of its brownfields, their spatial
110 distribution, and their regeneration prospects are analysed. Attention has also been paid to the
111 perception of individual sites by the local population, as ascertained in a questionnaire survey.
112 Examples of regeneration projects are then presented. In the third part of the paper, selected
113 results of the questionnaire survey focused on the perception of brownfields and regeneration
114 preferences are analysed. The research questions of the paper were defined as 1) what is
115 structure, distribution, specificities and driving forces of occurrence of brownfields in
116 Karvina, and 2) how brownfields in Karvina are perceived by local population.

117 118 **2. Theoretical remarks on the problem of brownfields**

119 The National Strategy for Brownfield Regeneration (CzechInvest, 2008) defines brownfields
120 as properties (lands, buildings) that are underused, neglected, and potentially contaminated.
121 They usually occur as the relicts of former industrial, agricultural, residential, military, or
122 other such activities. The above-mentioned strategy also draws attention to the fact that
123 brownfields cannot be appropriately or effectively used until remediation has been carried out.
124 In spite of the fact that brownfields are defined differently in different EU countries (Alker et
125 al., 2000, Oliver et al., 2005, Thornton et al., 2007, Frantál et al. 2012), there is a common
126 agreement in the Czech Republic over the definition of the term. Nevertheless, this
127 methodological variation regularly gives rise to misunderstandings when cross-national
128 analyses of brownfields are conducted (see Frantál et al., 2015b). As stated in the Search
129 Study for the Location of Brownfields in the Czech Republic developed by the CzechInvest
130 Agency in the period 2005-2007 (CzechInvest, 2008), within the territory of the Czech
131 Republic there are 2 355 brownfields covering 10 326 hectares in total. Based on qualified
132 estimations we propose that the number of sites and associated hectares of land is circa 11 700
133 sites with an area of 38 000 hectares, almost four times higher than the previous estimate. The
134 distribution of these sites within the districts and regions of the Czech Republic is uneven,
135 owing to the different historical and economic developments of individual areas. However,
136 the driving forces behind the occurrence of brownfields in the Czech context are essentially
137 the same across the country. The key processes driving these changes stem from economic
138 transition from central planning towards a market economy at the beginning of the 1990s.
139 Alongside this process, is the shift of the societal paradigm towards a globalised (or
140 Europeanised) post-industrial economy based on a service sector (Dorsey 2003) along highly
141 specialized manufacturing sectors (Turečková, 2014, Domalewski and Baxa, 2015), leaving
142 traditional industrial sites unused. This shift brings increased social risks (Keller, 2011) that
143 have a significant spatial expression, predominantly in densely populated urban areas
144 (Mulíček, et al., 2014) – especially in post-communist cities, where the intensity of the
145 changes is multiplied (Sýkora and Bouzarovski, 2012) - resulting in the displacement and
146 spatial segregation of certain social groups within cities.

147
148 It is obvious that consequences of brownfields are not isolated within, or to, given sites. As
149 stated by Kunc et al. (2014), it is indisputable that the wider hinterland of brownfield sites is

150 notably influenced by such abandoned, neglected, and devastated places, and they interfere
151 with the functioning of the wider urban organism. As evidenced in many studies, the
152 hinterlands of brownfields show greater occurrences of social (e.g., anti-social behaviour,
153 unemployment), economic (decreased market values of land and properties – see Sun and
154 Jones, 2013), environmental (real or perceived contamination), and even psychological (social
155 stigmatisation, fear of crime) impacts. All these coherences strongly affect both local
156 inhabitants and tourists (Navrátil et al., 2013), which make the perception of brownfields
157 quite specific. As Kunc et al. (2011, 2014) demonstrated in their studies on the perception of
158 urban brownfields, differences in the perceptions of brownfields in individual cities in the
159 post-communist context is driven both by the success of the socio-economic transition of
160 given cities in the past two decades and by the educational level of the local population. Kunc
161 et al. (2014) also stress the differing preferences of the population concerning the possibilities
162 for the future use of specific brownfield sites. In cities where a successful economic transition
163 has taken place, housing or green space regeneration is more popular, whilst in cities with
164 economic problems, public support for regeneration projects are focused on new employment
165 possibilities. Specific cases are discussed by Martinat and colleagues (2014, 2015), who
166 focused on the perception of regeneration options for brownfields in cities heavily affected by
167 mining. They point to the vital role of flagship regeneration projects undertaken by the public
168 sector, predominantly in regions with structural problems. The importance of flagship
169 regeneration projects is also discussed by Temelová (2007) in the case of Prague, and in the
170 case of Vienna by De Frantz (2005).

171
172 Another approach to brownfield research is represented by Klusáček et al. (2011), who
173 focused their attention on the attitudes of representatives of the public administration towards
174 the regeneration of brownfields. As illustrated by their research, mayors see the position of
175 local administration in the brownfield regeneration process as being negotiators between the
176 clashing interests of different groups of stakeholders, rather than as initiators. Mayors also
177 emphasized the necessity of involving stakeholders in the regeneration process from its
178 earliest stages and of the close cooperation of individual levels of the public administration. A
179 slightly different approach has been employed by Alexandrescu et al. (2014a), who based
180 their research on an investigation of individual brownfield regeneration projects in the Czech
181 Republic, Poland, and Romania. They pointed to the crucial importance of local sociocultural
182 conditions and to the importance of the organisational embeddedness of institutions engaged
183 in the brownfield regeneration process. Barriers to urban brownfield regeneration from the
184 point of view of the city officials are studied by Tintera et al. (2014) in the case of Estonia,
185 stressing the lack of local knowledge of regeneration possibilities and the absence of
186 brownfield regeneration tools as crucial factors, accompanied by the public opinion that
187 brownfields should be regenerated primarily using private funds.

188

189 **3. Methods and material**

190 The research questions of the paper were defined as 1) what is structure, distribution,
191 specificities and driving forces of occurrence of brownfields in Karvina, and 2) how
192 brownfields in Karvina are perceived by local population.

193

194 The step that has to precede any analysis of the spatial consequences of the occurrence and
195 regeneration of brownfields is the development of databases of these sites. In the absence of a
196 centrally administered database for the city of Karvina, it was necessary to create this
197 database from multiple sources. The above-mentioned CzechInvest Agency database of
198 brownfields was an important source of data. The database was developed by the regional
199 administration of the Moravian-Silesian Region and the Regional Development Agency in

200 Ostrava. Other sources of data included the Integrated Plan for Development of the City of
201 Karvina (2008) and internal materials of the Karvina city administration. The current state of
202 individual sites in this database was verified by field research conducted in early 2014.

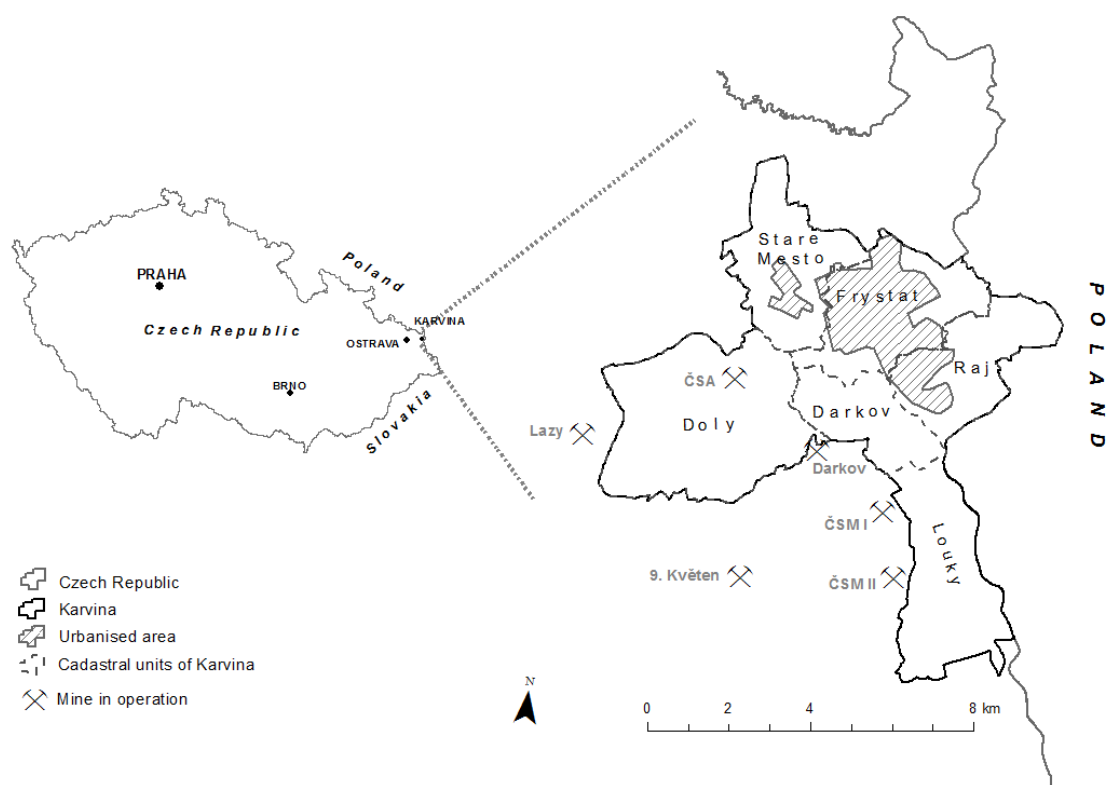
203
204 Information on the extent, ownership, and former and future uses of all identified brownfields
205 was gathered from multiple sources and verified during an interview with a city
206 representative. For general information about the history and recent development of sites the
207 local press was used. Sites were also classified according to the neighbourhoods in which they
208 are located. Selected socioeconomic data of the individual neighbourhoods was also collected
209 and analysed in the context of existing brownfields. In the second research phase, a
210 questionnaire survey was carried out in order to learn more about the opinions of local people
211 concerning brownfields and to identify their preferences for their regeneration and possible
212 future use. During February and March of 2014, residents of Karvina older than 18 were
213 approached in the city streets, and by means of semi-structured interviews 150 completed
214 questionnaires (comprising 16 questions each) were gathered. During this latter research
215 stage, the educational and gender structure of respondents were kept in reasonable balance
216 (see Table 7). As a consequence of directly approaching respondents, there was a very high
217 success rate for questionnaire completion – circa 90 %. To enable deeper insight into
218 individual sites, the identification of pre-conditions and driving forces behind the occurrence
219 of brownfields in Karvina, local publications focusing on specifics of industrial development
220 in the region were utilized (Dohnal 1968, Kijonka a Rebrova 2005, Chmiel 2010).

221
222 **4. Reasons for the occurrence of brownfields in Karvina**
223 Karvina is a city located in Silesia in the eastern part of the Czech Republic, in the immediate
224 vicinity of the Polish border (see Figure 1). The area of the city is 57.5 hectares, with a
225 population of almost 57 000 inhabitants (2014) and the long-term development of mining and
226 heavy industry is the crucial element in the city's urban development. These sectors of the
227 local economy have been configuring the urban structures of the city for more than 150 years.
228 They have influenced the demographic, educational, and social structure and the forms of
229 mass housing such as historical dormitories for miners and later panel housing estates from
230 the 1960-80s, where currently more than 90 % of the city population live. This long-term co-
231 existence of city structures and alongside heavy industries is mirrored in recurring dynamic
232 population expansions and waves of mass migration during mining booms. The peak
233 population was reached in early 1980s at 78 000 people. Relics of urban structures in Karvina
234 can be found dating from the very beginnings of industrialisation at the end of the first half of
235 19th century but the central impulse for urbanisation has been driven by the local mines and
236 factories. Yet the most intense impacts on urban forms date to the socialist period and the
237 massive support for mining and heavy industries from the state. The most radical effects on
238 the urban landscape can be found in the Doly ('Mines') neighbourhood in the western part of
239 the city, where the original city centre of Karvina was once located. This area was heavily
240 undermined and cleared in the 1950s and 1960s, with its population was moved to the east in
241 the area of Frystat, which became the new city centre of Karvina. Significant impacts from
242 mining can be also found in the neighbourhoods of Louky and Darkov in the southern part of
243 the contemporary city of Karvina, where due to undermining many houses were demolished
244 and artificial lakes created.

245
246 After the political changes of 1989 mining activity in the former Czechoslovakia was sharply
247 reduced; mining in the Ostrava-Karvina mining area was affected by these changes. While in
248 the western part of this mining area (Ostrava) the activity had completely disappeared by the
249 middle 1990s. The core of local mining, the only place where black coal has been mined

250 down to the present, shifted eastward to the Karvina area. Currently the mining company
251 (OKD) operates two mines – Karvina Mine (locality CSA in the western part of the city) and
252 Darkov Mine (in the southern part of the city). The two other mines in operation (ČSM Mine
253 and Karvina Mine in the locality of Lazy) are located within neighbouring cities and
254 municipalities (Orlova, Stonava), yet the mining fields are partly located within Karvina as
255 well. Annual production of coal is here around 8,6 million tons (2014) and is consistently
256 decreasing. On the other hand, the OKD mining company has recently attempted to widen its
257 mining fields to areas with better natural conditions for mining, which is happening at the
258 expense of one neighbourhood of Karvina (Stare Mesto). The mining company has been the
259 most important employer not only in Karvina, with circa 11 000 employees, but in the whole
260 Moravian-Silesian Region. Employment in this sector illustrates the importance of industrial
261 activities for the development of the city. In the early 1990s employment in industry formed
262 50,3 % of the economically active population, while according to the last available data from
263 2011, the this has decreased by a half (to 26,5 %), yet the industry still plays an important part
264 in employing the local population. As a consequence of the lack of other employment
265 opportunities in the city, a very high unemployment rate has emerged (14.2 % at the
266 beginning of 2015). The lack of jobs, the high unemployment rate and increased
267 environmental pollution in combination have created the preconditions for outmigration from
268 the city to other cities and regions in the Czech Republic, in the last three decades the
269 population in Karvina has decreased by 27 % in total. Alongside mining metallurgy, metal
270 industry, and engineering have been significant employers in Karvina (the Kavoz, Kovona,
271 Jäkl companies) in the past 100 years, and as recently as the 1990s provided thousands of
272 local people with employment. Today the number of employees in successor companies is
273 much reduced but the sector is still an important employer in the city. Recently lighter
274 industrial activities are gradually arising outside of the traditional industrial areas, in
275 development zones built on greenfields in the northeast part of the city (Stare Mesto), an area
276 which, as already mentioned above, is paradoxically endangered by the further expansion of
277 coal mining (Martinát et al., 2014).

278
279 **Figure 1.** Location of Karvina in the context of the Czech Republic



280
281 Source: authors' own processing
282

283 5. Spatial patterns of brownfields in Karvina

284 Within the city of Karvina, the research phase of this article identified 28 sites occupying a
285 total area of 121 hectares that could be called brownfields. Within the Karvina area effects of
286 coal mining such as terrain decreases as a consequence of undermining, hydrological changes
287 in the area, artificial lakes, slag heaps and other impacts have created wider devastated areas
288 that are not taken into consideration in the set of analysed sites because of their specifics.
289 Such wider devastated sites are located in the neighbourhoods of Doly, Darkov, and Louky,
290 and are much larger than the brownfields identified. Nevertheless, for the purposes of this
291 research, due unclear delineation, they have not been taken into account. If we accept this
292 presumption, then the above-mentioned 28 brownfields cover in total 2.1 % of the area of the
293 city. As is clearly illustrated in Table 1, the distribution of brownfields within the individual
294 neighbourhoods of Karvina is strongly uneven.
295

296 **Table 1.** Brownfields in individual neighbourhoods of the city of Karvina

neighbourhood	number of brownfields (2014)	area of brownfields (2014, ha)	share of area of neighbourhood (%)	share of total brownfield area in the city (%)	area and population (2011) (population; km ²)	
Darkov	1	3	0.6	2.5	301	541.8
Doly	8	50.78	3.1	42.0	325	1643.4
Frystat	2	0.7	0.3	0.6	1547	256.1
Hranice	5	13.21	5.1	10.9	8152	259.5
Louky	3	3.43	0.3	2.8	407	991.7
Nove Mesto	4	26.1	10.9	21.6	17163	240.1

Raj	2	18.8	2.4	15.5	16088	771.3
Stare Mesto	3	4.97	0.6	4.1	810	849.9
Mizerov	0	0	0	0	12077	198.3

297 Source: brownfield database of the CzechInvest Agency; brownfield database of the
 298 Moravian-Silesian Region; Integrated Plan for Development of the City of Karvina (2008);
 299 internal materials of the city of Karvina; authors' own field research

300
 301 Brownfields within the city of Karvina can predominantly be found in the neighbourhood
 302 Doly, which is located in the western part of the studied area. The neighbourhood is typified
 303 by wide post-mining areas with a small population remaining, and covers the former, now
 304 demolished, city centre of the original historical settlement of Karvina. Within the Doly
 305 neighbourhood brownfields occupy an area of almost 51 hectares. The majority of these sites
 306 are post-industrial either former coal mines or a similar use, with a rich history going back to
 307 the middle 19th century. Here are the areas of former mines (Jindrich, Gabriela, Barbora and
 308 others), former dormitories for miners (U Frantisky, U Barbory), and facilities of mines still in
 309 operation, whose functionality is limited or completely abandoned for example the bus station
 310 by the CSA Mines and the coking plant located by the CSA Mine). As is apparent from Table
 311 2, in this neighbourhood the population (325 in 2011) has recently, as a consequence of its
 312 peripherality and desolation, been reduced by 75 % in the last two decades. The remaining
 313 population are mainly socially marginalized and poor, whilst the mining company (OKD) is
 314 the largest owner of land and buildings. The area is typical of mining landscapes in its surface
 315 manifestations of mining activities as well as in its decreases of terrain as a result of
 316 undermining, the occurrence of many artificial lakes, and general changes to hydrological
 317 conditions.

318
 319 Another neighbourhood of Karvina with a strong brownfield presence, covering more than
 320 one fifth of the total area of brownfields in the city, is the area of Nove Mesto. As the name
 321 indicates (Nove Mesto = New City), this neighbourhood was formed from built-up areas
 322 developed in the second half of the 20th century, mainly by prefabricated housing estates.
 323 Almost one third of the total population of Karvina (approx. 17 000 people) is concentrated in
 324 Nove Mesto, this being the largest section of Karvina by population. The Kovona company
 325 with its substantial industrial operations focusing on metal industries used to be located here
 326 during the communist era. After the privatization of the Kovona national company keeping
 327 the same name in the 1990s, many industrial operations were limited and several buildings
 328 abandoned. One part of the area called the Industrial Park, on Zavodni Street, is the only part
 329 of this facility presently used. Other examples of brownfields in Nove Mesto are a former
 330 concrete mixing plant and a plant for producing prefabricated panels dating from the
 331 development of the local housing estates. Yet another example of a brownfield is the former
 332 House of Culture, where social events for the local population were formerly organized but
 333 which is now abandoned.

334
 335 More than ten percent of the total area of brownfields in Karvina is located in the Raj (18.8
 336 hectares) and Hranice (13.3 hectares) neighbourhoods. Within Hranice are several post-
 337 industrial sites that were part of the Jäkl Company and a former district construction
 338 company. Other brownfields are left over from housing; Vagonka, originally villas for
 339 officials from the Jäkl iron works in the 1920s, later housing for poor people, were
 340 demolished in 2011. Other types of brownfields can be found in Raj, located in the south-
 341 eastern part of the city. The largest registered brownfield within Karvina (at 15.5 hectares)
 342 was identified here; it is the premises of a former military air defence base named Cerny les
 343 and several farms. In the central part of present-day Karvina, thus the Frystat neighbourhood,

344 there are also some abandoned buildings with specific historical and architectural value such
 345 as Janackuv mlyn a mill and, Larischovy konirny formerly stables.

346

347 **Table 2.** Selected demographic characteristics of city parts of Karvina

neighbourhood	population density (2011, population /km ²)	population change (2001-2011, in %)	population change (1991-2011, in %)	change in the number of houses (2001-2011, in %)	age index (2011, 65+/0-14)	economically active population (2011, in %)
Darkov	56	-25.9	-74.8	-19.0	191.7	45.2
Doly	20	-59.9	-75.0	-54.0	84.9	37.2
Frystat	604	8.5	13.0	9.8	169.0	43.8
Hranice	3 141	-9.4	-18.8	17.8	125.4	45.9
Louky	41	-10.2	-39.1	-6.2	204.8	46.9
Nove Mesto	7 150	-11.6	-11.4	1.0	111.6	41.9
Raj	2 086	-14.1	-14.5	7.6	153.5	46.7
Stare Mesto	95	-5.3	0.0	6.8	142.7	45.7
Mizerov	6 090	-14.0	-18.5	0.4	137.8	47.1
Karvina	989	-12.7	-16.9	1.2	132.0	45.1

348 Source: Czech Statistical Office (Census 1991, 2001, 2011 – www.czso.cz)

349

350 Brownfield regeneration projects will always be closely linked to the needs of the local
 351 population. As visible in Table 2 and noted above, Karvina is a city that has experienced
 352 sharp population decreases in last two decades, losing 13 % of population in the last decade.
 353 Despite these population decreases, the number of houses is consistently rising; except in
 354 neighbourhoods heavily affected by ongoing mining Doly, Darkov, Louky. It is obvious that
 355 the distribution of demographic features among individual city parts also strongly differs. The
 356 exception to this trend is in the central part of the city (Frystat), where the population is
 357 growing, if we focus more on the age structure using an age index (see Table 2), we can
 358 clearly see that the very old, small neighbourhoods heavily affected by mining are populated
 359 by elderly people (Darkov, Louky) while the relatively younger city parts (Nove Mesto,
 360 Hranice) have a dominance of housing estates from the time of communism. Such a
 361 demographic development poses huge problems for the future as concerns services and
 362 facilities for elderly people. It seems that this trend should be considered in thinking about
 363 regeneration projects, especially in cities with such demographic profiles.

364

365 Tables 3-6 provide details on the different aspects of the Karvina brownfields according to a
 366 range of criteria. As emerged from the analyses conducted regarding the size of brownfields,
 367 the most frequent size category is between 1-3 hectares, whilst the largest total area, more
 368 than 20% is covered by brownfields sized between 5-10 hectares. The most frequent previous
 369 use of present-day brownfields both by number and by area is industrial (Table 4). Such a
 370 result is not very surprising although due to the absence of undermined areas within the
 371 database noted above, post-mining brownfields form about one third of the total area of
 372 Karvina brownfields, in particular in the Darkov and Doly neighbourhoods. In the context of
 373 the recent dramatic decline in agricultural activity in the Czech Republic it is not surprising
 374 that agricultural brownfields also form an important part of the database. In the case of
 375 Karvina, we refer to former farms in the Louky and Raj neighbourhoods and to abandoned
 376 greenhouses in Stare Mesto. The architecturally valuable Larischovy konirny (stables) in

377 Frystat fall into the same category. A former use in the service sector was identified in four
 378 cases (Table 4), nevertheless the classification of several sites is uncertain and some specific
 379 sites are hard to classify, such as the bus station by CSA Mine, an abandoned church of St.
 380 Barbora in the undermined part of Louky, or an abandoned water tower in Hranice. Whilst the
 381 previous use of the brownfields may remain uncertain that same cannot be said for questions
 382 of ownership. The majority of sites are owned by private owners, in the case of ex-mining
 383 areas and buildings, this is predominantly the mining company OKD itself. Those
 384 brownfields under public ownership were identified in just two cases, the Larischovy konirny
 385 stables in Frystat and the Vagonka estate in Hranice. A mixed type of brownfield ownership
 386 was identified only in the areas around the former Barbora Mine in Doly.
 387

388 **Table 3.** Brownfields in Karvina according to their size

size	< 1 ha	1-3 ha	3-5 ha	5-10 ha	> 10 ha
number of sites	3	11	6	5	4
area of sites (ha)	1.5	20.5	21.9	25.7	51.4
share of total area (%)	1.2	16.9	18.1	21.2	42.5

389 Source: authors' own research and processing

390
391 **Table 4.** Categories of brownfields in Karvina according to previous use

previous use	culture	housing	mining	industry	services	military	agriculture
number of sites	1	3	5	9	5	1	4
area of sites (ha)	1	9.7	37.9	42.2	7.14	15.5	7.6
share of total area (%)	0.8	8.0	31.3	34.9	5.9	12.8	6.3

392 Source: authors' own research and processing

393
394 **Table 5.** Categories of brownfields in Karvina according to ownership

type of ownership	mixed	private	public
number of sites	3	23	2
area of sites (ha)	19.9	97.1	4
share of total area (%)	16.4	80.2	3.4

395 Source: authors' own research and processing

396
397 The categories of brownfields in Karvina according to the intensity of their contemporary use
 398 are shown in Table 6. It can be observed that a partial use of studied sites was identified in
 399 one third of brownfields. This type of site was previously used for activities other than solely
 400 mining activities, for example other industries or agriculture. It can be observed that the reuse
 401 of post-mining brownfields is highly specific and problematic regarding both environmental
 402 risks such as undermining, contamination, hydrological changes and their peripheral location.
 403 This assumption about environmental problems is supported by analyses of the database. It is
 404 in post-mining brownfields in Karvina where contamination is most frequently supposed (see
 405 Table 6).
 406

407 **Table 6.** Categories of brownfields in Karvina according to contemporary use and
 408 contamination

contemporary use	partially used	unused	contamination	supposed	not supposed
number of sites	9	19	number of sites	10	18
area of sites	36.9	84.1	area of sites	60.3	60.7

(ha)			(ha)		
share of total area of sites (%)	30.5	69.5	share of total area of sites (%)	49.8	51.2

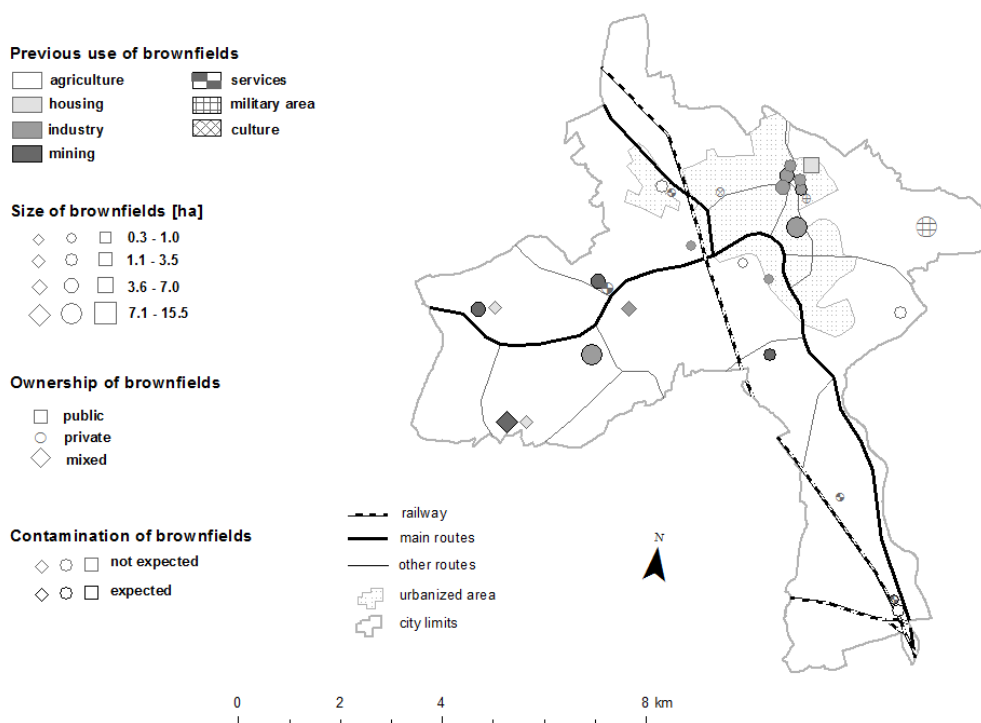
409 Source: authors' own research and processing

410

411 Figure 2 presents the spatial distribution of individual types of brownfields in Karvina, as
 412 regards their location within the city, size, previous use, type of ownership, and contamination
 413 status. It might be observed that while in the built-up areas of Karvina sites of industrial origin
 414 prevail such as engineering, metal industry, metallurgy, food industry, the post-mining
 415 brownfields are located in the western part of the city (Doly), where settled areas are highly
 416 limited. Agricultural brownfields can primarily be found on the outskirts of the city.

417

418 **Figure 2.** Location and basic characteristics of brownfields identified in Karvina



419

420 Source: authors' own research and processing

421

422 6. Perception of brownfields

423 An integral part of efforts to make brownfields viable parts of cities again is to customise
 424 regeneration plans to the needs of the local population. Such tailored solutions can have a
 425 better chance of attracting the population to reuse sites brownfields that that been neglected or
 426 abandoned for years or even decades. Surveys of the perceptions of brownfields and on
 427 preferences for individual regeneration plans create a suitable platform for deepening our
 428 knowledge of regeneration options, possibilities, and their acceptance by groups of
 429 stakeholders. Bearing in mind the limited space of this paper, only the key results from the
 430 larger survey are presented. The basic segmentation of groups of respondents (n=150) can be
 431 seen in Table 7.

432

433 **Table 7.** Basic segmentation criteria of respondents

	gender
male	27 %
female	73 %
	age
18-29 years	24 %
30-44 years	28 %
45-59 years	42 %
60-70 years	3 %
above 71 years	3 %
	education
elementary	8 %
secondary without final graduation	33 %
secondary with final graduation	45 %
university	14 %

434 Source: authors' own processing (n=150)

435

436 The first question of the survey was to discern familiarity of the local population with the
 437 term 'brownfield' which is quite limited, with just one third (32 %) of respondents answering
 438 affirmatively. Almost half the respondents were unable to find the proper answer. This might
 439 be caused by the poor educational structure of the Karvina population, according to 2011
 440 census data only 7.4 % of the local population has attained a university education. Yet in
 441 comparison to analyses carried out on this topic in 2010 (Kunc et al., 2011) nearby city
 442 Ostrava with a comparable relationship with industry less than one fifth of respondents were
 443 able to answer positively. Increasing awareness among the population of the term brownfield
 444 may be linked with gradually growing discussions in mainstream media on this topic in recent
 445 years, when several flagship regeneration projects have been completed such as Vaňkovka
 446 shopping mall in Brno, Karolina shopping mall in Ostrava and the Golden Angel project in
 447 Prague.

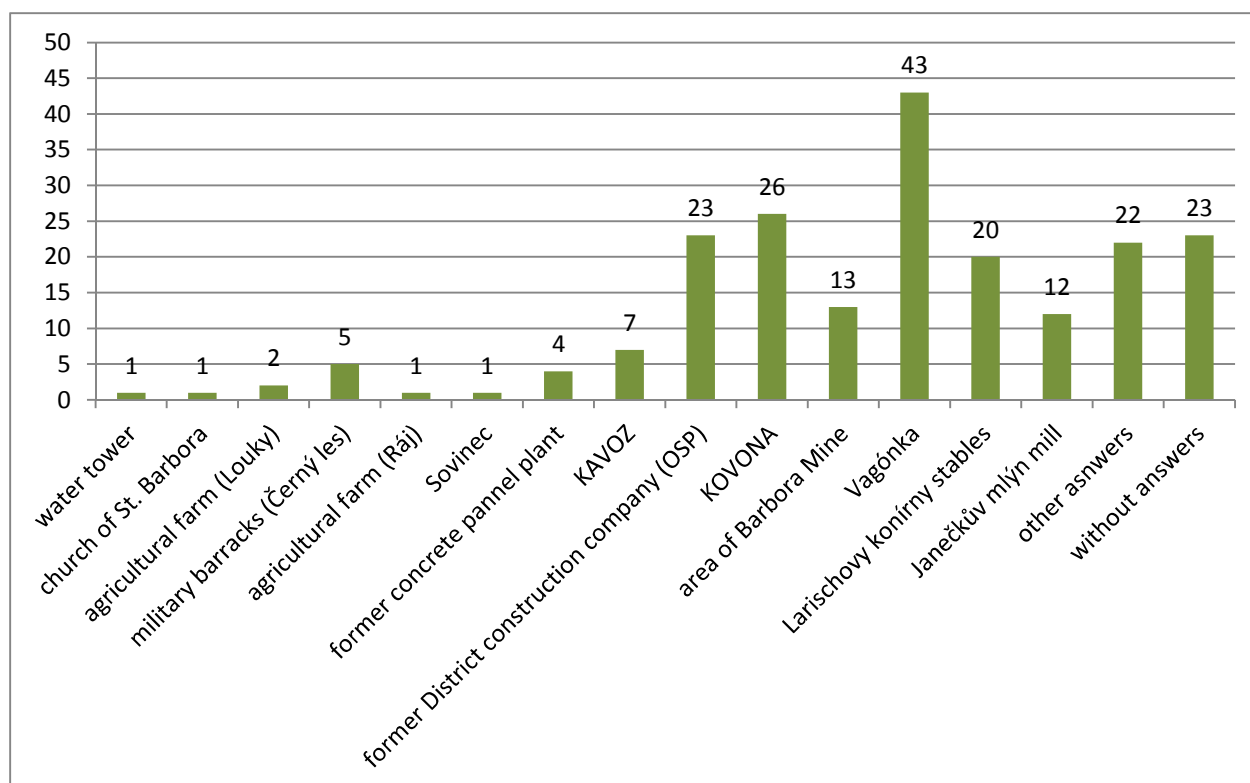
448

449 The second question aimed at identifying the specific localities within the city of Karvina that
 450 respondents associate with brownfields. The correct definition of the term had been provided
 451 after the first question. The question was formulated as an open one and the results were
 452 surprising (see Figure 3). Respondents noted fourteen different sites in total. One third
 453 mentioned Vagonka, a presently demolished site formerly used as housing for the poor; one
 454 fifth of respondents named the premises of the former Kovona Company (metal industries)
 455 and the building of the former District Construction Company. Post-mining sites were not
 456 mentioned despite the heritage of the industry in the city, only 9 % of all respondents
 457 mentioned former mines (the Barbora Mine in Doly) and other post-mining brownfields were
 458 not mentioned at all. The large frequency of mentions of the Vagonka site is probably due to
 459 the fact of its recent (2011) demolition and former status as a residence for disadvantaged
 460 people; it had become a 'hot' issue in Karvina's media. The other factors explaining the
 461 popularity of Vagonka is the location of the post-mining brownfields outside of settled areas
 462 of the city in the western and southern parts of the city. This wider area is scarcely inhabited
 463 and thus largely out of sight of the inhabitants of Karvina, making the urgency of regeneration
 464 for these sites much less, in contrast to the two most frequently referenced localities.

465

466 **Figure 3.** Overview of answers to the question: "Which location comes to your mind in
 467 Karvina in connection with the term brownfield?"

468



469
470
471

Source: authors' own research and processing (n=150)

472 The next question focused on options for reusing post-mining brownfields, which were
473 supposed to be the most known between respondents. This was partly confounded by the lack
474 of awareness of post-mining brownfields as discussed above. Individual regeneration options
475 were shown and explained to respondents in the form of a list. Respondents then evaluated
476 individual options (see Table 8) with the numbers 1 to 5 (1 = the highest importance and 5 =
477 the lowest importance). For every proposed possibility the average was calculated as the
478 arithmetic mean. The closer the final value of each choice was to 1, the more preferred the
479 given regeneration option was. As is clearly visible in Table 8, the most preferred option for
480 regeneration of post-mining brownfields was new areas for industry. This result can be
481 explained in the context of current social problems, high unemployment, and a lack of jobs
482 that are typical for contemporary Karvina. People would like to see industrial activities in
483 those locations where they were used to commute for work for decades, in locations with
484 good transport accessibility but at a distance from settled areas. The second best option for
485 people was to regenerate post-mining brownfields into green space, which would seem to be
486 the easiest solution. The least preferred option was housing, not surprising, since cities like
487 Karvina are experiencing strong declines in their population and face problems with
488 unoccupied flats rather than a shortage.

489
490 **Table 8.** Potential regeneration options for post-mining brownfields in Karvina as stated by
491 local population

regeneration options	evaluation
for industry	2.12
for urban greenery	2.4
for leisure time and sport activities	2.67
for services	3.55
for housing	3.98

492 Source: authors' own research and processing (n=150), (1 = the highest importance and 5 =
493 the lowest importance)

494
495 It seems that majority of the population of Karvina have adapted to life in proximity of
496 mining activities and the resulting terrain to certain extent. Although the landscape in the
497 western and southern parts of the city is heavily affected by mining, almost two thirds of
498 respondents of our survey agreed with opinion that further expansion of 'mining can't worsen
499 the current situation'. This might also be expression of resignation of local population who
500 have lost their confidence that the situation might be improved in near future. Lack of other
501 job opportunities for less qualified people means that mining is perceived as the most stable
502 job regardless of the anticipated exhaustion of the reserves in the next two decades.
503 Environmental and health consequences are underestimated or are not seriously taken into
504 account. Representatives of local city administration are supporters of further expansion of
505 mining in the area, even at the expense of residential areas.

506
507 Questions regarding the urgency of regeneration of local brownfields showed a different set of
508 possibilities. It is apparent that the population of Karvina perceives the existence of
509 brownfields within the area of the city as an issue that poses problems for future urban
510 development if not regenerated. Two thirds of respondents consider brownfields a problem of
511 at least medium importance. The same share of respondents (65 %) regard the existence of
512 brownfields as a sign of the decline of the city. This result perhaps reflects that industrial (and
513 mining) activities have significantly influenced all elements of life in city for decades and it is
514 this period which is usually connected in the minds of local residents to the times when the
515 city had the greatest renown and the brownfields highlight is decline.

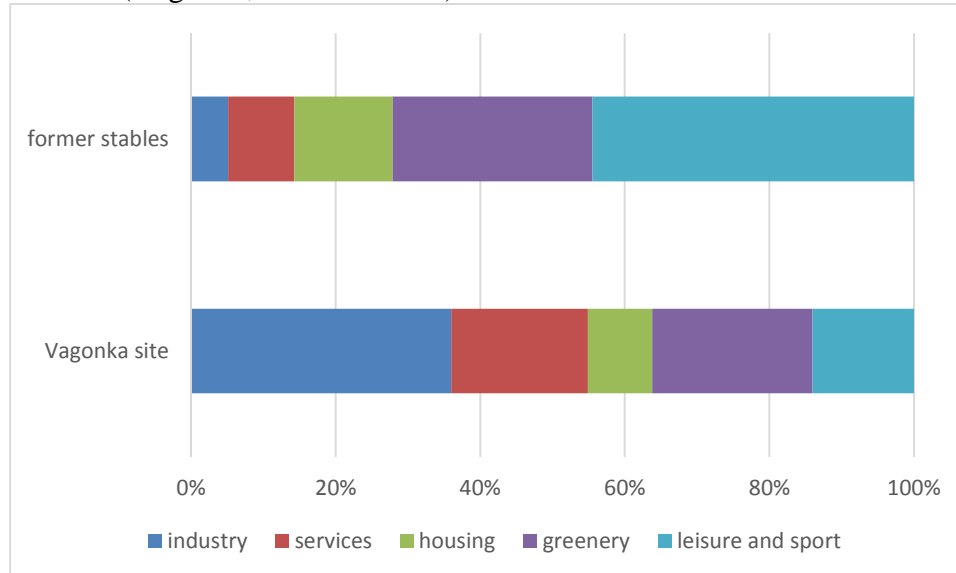
516
517 Moving to the survey results connected to financial sources for brownfield regeneration
518 projects, it can be confidently stated that a majority of respondents (77 %) are convinced that
519 a mix of private and public money is the most suitable way to accelerate brownfield
520 regeneration. Such opinion reflects that the majority of brownfields in Karvina are owned by
521 private companies, only two sites are owned by the public administration, and it seems that
522 the local population believe public bodies should be significantly involved in brownfield
523 regeneration projects. The assumption of the necessity of private money taking a role in the
524 regeneration process supports the results of a question focusing on the satisfaction of the
525 population with the policy of local officials regarding brownfields. A majority of respondents
526 (57 %) consider this policy to be insufficient. An interview with a representative of the city
527 revealed that the possibilities for the public administration to invest money in regenerations
528 are quite limited and also possibilities to interventions in case of private properties is strongly
529 reduced due to legislation settings. This suggests both a gap between the expectations that
530 citizens have of the local state and its capabilities, as well as a failure to communicate those
531 limitations effectively.

532
533 A comparison of the results regarding perceptions of possible alternative re-use options for
534 two contrasting sites in the city is revealing. One site located on the margins of city,
535 Vagonka, and one site located in central parts of the city, a former stable. In the case of the
536 Vagonka site re-use for industry and the creation of new jobs, is the most popular, whilst in
537 the case of former stables other functions such as leisure and sport attract more support. Such
538 results correspond to specific functions of different parts of city. This suggestions limitations
539 to re-purposing sites, as it hard for the local population to imagine alternative re-uses of given
540 sites, since they have been used to certain functions from these sites for decades. Public
541 bodies and NGOs will have to work at educational activities to change the attitudes of the

542 local population concerning alternative re-use, or even interim use, of brownfields. In part this
 543 is because there is only a limited tradition of public participation in planning decisions, which
 544 perhaps limits the citizen's imagination of their own city.

545

546 **Figure 4.** Comparison of perceptions of individual re-use options of two brownfield sites in
 547 Karvina (Vagonka, former stables)



548

549 Source: authors' own research and processing (n=150)

550

551 7. Concluding remarks

552 This paper aimed to spatially analyse brownfields in the area of the city of Karvina as an
 553 example of city heavily affected by coal mining and industry, and thereby discuss the
 554 perceptions of the local population about their city. A database of brownfields with 28
 555 individual brownfields covering 121 hectares in total was developed based on various
 556 secondary sources and on field research. An analysis of the developed database was carried
 557 out and the whole set of brownfields were categorized and evaluated in relation to their status
 558 regarding; previous use, contemporary use, size, ownership, and supposed contamination
 559 status. Due to natural and historical conditions post-mining brownfields are primarily located
 560 in peripheral locations within the western and southern parts of the city (the Doly, Louky and
 561 Darkov neighbourhoods), whilst industrial brownfields can be more found in proximity to a
 562 belt of housing estates built up during the socialist era (the Nove Mesto and Hranice
 563 neighbourhoods). Specific to the centrally located parts of Karvina (Frystat) are brownfields
 564 with historical and architectural value (the Janackuv mlyn mill, the Larischovy konirny
 565 stables) about which specific re-use options were formulated by respondents of survey.

566

567 The database and survey evidence signals the relevance of the assumption that urban
 568 brownfields significantly influence urban development and city structures in a given city.
 569 Such sites are of intense interest to local people. Geographical proximity plays crucial role in
 570 the perception of the urgency of regeneration of any given brownfield. This finding is the
 571 mostly visible in case of post-mining brownfields in Karvina. Karvina is city which is
 572 predominantly known in relation to the mining industry but since these sites are located in
 573 distant locations from the residential areas of the city, the urgency of their regeneration is
 574 perceived as being reduced. Post-mining brownfields are here traditionally perceived as
 575 places for production activities as reflected by this being the most preferred option for their
 576 use by respondents surveyed, which complicates their alternative re-use. The probability of
 577 using these sites for industrial activities is, despite extensive plans, is very low in light of the

578 existence of other available space in other zones within the city limits and the environmental
579 risks present. The combined efforts of the owners, the state and the residents will be needed to
580 find ways to re-use these sites. This could be through incentives from the local state and the
581 increased activities of the local resident to support such a process. Alternatively, an indirect
582 approach is to showcase those examples that considered to be the best practice of regeneration
583 and gather public support through such a route.

584
585 Currently knowledge about the environmental benefits of brownfield regeneration is at a
586 relatively low level. What is lacking is awareness of the social and environmental problems
587 associated with brownfield sites. Policies at the national, regional, and local levels regarding
588 brownfields also show large gaps in how they conceptualise the problem. International
589 experiences, such as with the provisional use of brownfields in cases where hygienic and
590 environmental conditions are not in contradiction, could be also useful (Haase and Rall, 2011;
591 Martinat et al., 2014). In this regard several regeneration projects that have already been
592 executed within the area of the city of Karvina could also be mentioned. Some of them have
593 increased public discussion about their usefulness. While the project focusing on the
594 development of the industrial zone Nova Pole in the Stare Mesto neighbourhood is perceived
595 by the population positively, because of its creation of new jobs, whilst the development of a
596 golf resort on undermined areas in Lipiny (Frystat neighbourhood) has raised debates about
597 whether public support should be used in this kind of project. Among other projects currently
598 in their preparatory phase the Darkov lake project is illustrative. The aim is to build a leisure
599 zone around an artificial lake in the Darkov neighbourhood, which was heavily affected by
600 undermining. As another beneficial project is the “Footprints of Original Karvina”, which
601 aims at building educational trails and cycle paths in areas in the Doly neighbourhood heavily
602 affected by mining, which is enabling at least the partial use of this area. Another project in
603 preparation is the planned industrial zone Nad Barborou, also in Doly. It is necessary to add
604 that in some post-mining brownfield sites with significant environmental issues re-
605 naturalisation is the only option.

606
607 Finally, in the planning, preparation, implementation, and subsequent operation of a
608 regeneration project, it is necessary to provide for the participation of the local community,
609 whose opinion is crucial to the success of any project. New re-use options should be
610 acceptable to the local population in order to make new developments and sites truly viable
611 again.

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