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Remediation and revitalisation of industrial areas - a method of promotion

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Abstract. Mining and industrial activity causes adverse changes in the environment. The shift from industrial to post-industrial society has shaped the appearance of degraded areas. In a post-industrial society, there is a lower demand for production capabilities and higher for services, consumption and recreation. This study discusses projects involving the remediation and revitalisation of post-industrial post-mining areas.

1. Introduction

The environment is subject to constant changes resulting from human activities. As industrial development progressed, these changes became more and more visible. The 20th century saw a rapid pace of industrial development and was of particular importance in this respect; although the quality of life of the population increased, it had an adverse impact on the environment. Industry and such sectors as metallurgy, mining, power and the cement industry in particular, were the biggest contributors to the degradation of the environment. The most apparent devastation of the environment occurred as a result of the mining industry. It caused deformations of the ground surface, which were either continuous, forming extensive subsidence troughs, or discontinuous – in the form of various types of cave-ins and crevices.

The problem of developing such areas acquired a large-scale importance and 1989 is assumed as the starting period of this phenomenon which was caused, among other things, by the restructuring of the Polish economy enforced by very strict and radical economic and social reforms.

As a result, post-industrial areas and facilities emerging in cities became the subject of various economic activities and were studied by architects, urban planners, geographers, historians of material culture, etc.

Post-industrial areas can be divided [1] into three types:

1. areas that constitute production process components (e.g. excavations, landfills),
2. developed production areas (e.g. warehouses, production halls),
3. areas with surface development (e.g. storage yards, roads and undeveloped right-of-way land of industrial plants).

Table 1 presents the number of industrial areas depending on the number of residents and occupied area [2-4].



Table 1. Post-industrial areas in Polish cities [2-4].

Number of residents in thousands	Number of cities in Poland with post-industrial land (%)							average
	100 and more	100-50	50-20	20-10	10-5	5-2	2 and less	
According to Domański [3]	79.2	73.5	65.4	69.0	44.0	49.5	33.3	58.6
According to Huculak [4]	79.4	69.2	55.3	35.7	40.0	28.1	00.0	46.2
Total area of post-industrial land in Polish cities (in thousand ha)								
According to Huculak [4]	10.7	4.6	3.5	0.8	2.4	0.2	0.0	22.2

On average, over 50% of Polish cities feature post-industrial areas of more than 20,000 hectares. In addition to post-industrial urban areas, areas abandoned by mining emerged. These are various types of excavations, landslides, landfills, sedimentation basins, etc. At the same time, post-industrial areas, such as areas of military bases and military training grounds as well as farms, formed outside the cities.

Numerous plots of land designated for the above-mentioned activities have become degraded and devastated (these are not only post-industrial areas).

Statistical data [5] prove (table 2) that the number and area of destroyed and degraded areas is decreasing. However, the pace of these changes is low.

Table 2. Devastated and degraded land and remediated and developed land [5].

Specification	2000	2005	2010	2015	2016
	(in hectares)				
Devastated land and degraded land	71.473	64.978	61.161	63.374	64.651
Areas remediated during the year	2.235	1.861	1.222	1.807	1.449
Areas developed during the year	1.222	1.132	581	852	587

Source: data from the Ministry of Agriculture and Rural Development.

In 2017, the degrees of remediation and development of devastated land and degraded land reached the levels of 2.1% and 0.8%, respectively, of the total area of such land which amounted to 62 thousand hectares.

The remediation of post-mining areas is connected with compensating for losses caused by mining activities, but in a substantial number of cases it may also be an opportunity to increase the attractiveness of former mine areas.

2. Key terms

The term “rekultywacja” (remediation, alternatively: reclamation) is defined in the Act on the Protection of Agricultural and Forest Land of 3 February 1995 [6]. Remediation involves creating or restoring utility values in degraded areas – carrying out a series of measures allowing the further use of the land for other purposes, providing it with new social functions.

The remediation process usually consists of three stages:

1. documentation,
2. general (technical) stage and
3. detailed (biological) stage.

Thanks to remediation, post-industrial land may have its previous land use model changed. The most popular types of land use include forests, agricultural and water types. These are the trends most

frequently followed in remediation, not only in Poland, but also in other European countries. Less popular, but also present land use types include cultural, economic, natural, residential, educational and recreational.

The term “rewitalizacja” (revitalisation), despite its widespread use, was not introduced into Polish law until late 2015. According to the Act on Revitalisation of 9 October 2015, this term means the process of recovering degraded areas from their existing condition, carried out in a comprehensive manner, through integrated actions for the local community, area and economy, focused on these areas, carried out by the stakeholders of revitalisation in accordance to a certain revitalisation programme [7].

In everyday language, revitalisation (Latin *re* – return + *vita* – life = revival) is understood as activities carried out after the remediation process, carried out in accordance with the local land use plan for a certain area, if such a plan exists.

Revitalisation is an extensive concept, encompassing a number of activities aimed at the repurposing and development of degraded areas. These do not necessarily have to be post-mining areas.

Unlike remediation, revitalisation currently does not constitute a legal obligation of the mining company.

When undertaking revitalisation works, the aim is to sustainably develop previously degraded land and create good conditions for the development of other activities, including, for example, in defunct mining areas. Remediation, on the other hand, is aimed at restoring utility and natural values to land devastated and degraded as a result of various human activities. Remediation is often applied to post-mining areas.

Differences between the processes of remediation and revitalisation also concern the territorial scope – remediation takes place up to the boundary of adverse land transformation, and revitalisation usually concerns vast areas, due to the extant mutual connections, and is not limited only to post-mining areas [8].

The remediation and revitalisation of post-mining areas is a significant economic and technical challenge. Especially when it concerns instances of ground subsidence. Due to limited financial resources, the majority of applied measures are *ad hoc* and involve such actions as levelling the terrain, regulating the water relations and soil restoration. Post-mining waste is often used for land levelling, forming unregulated landfills that can adversely affect the chemistry of surface water and groundwater.

Remediation is the last stage of the activities of a mining business, to which the mining company is obliged by the mining license, but the objectives and directions of remediation should be in line with the methods of subsequent land improvement (revitalisation). In view of the quality of the remediation process, it is desirable for the entrepreneur (if being the owner of the land) to take care of further development and revitalisation.

Revitalisation is considered the highest form of restoring utility functions to areas that used to be exploited by industry.

Areas to be revitalised are described according to the degree of degradation as degraded areas, if their utility value (mainly for agricultural or forest use) has decreased, or devastated areas, if they have completely lost their utility value as a result of industrial activity, among other factors [6].

Depending on the cause of degradation, three types of land transformed by human activity are distinguished, together with their infrastructure.

1. "Brownfield" – a polluted site or part thereof with a potential for development [9]. The term is also used to refer to developed areas for which new functions are sought,
2. "Post-industrial land" - degraded, unused or underutilised area, originally intended for economic activities [10]. K. Gasidło [11] defines post-industrial area as an area where industrial production used to take place and distinguishes three types of such areas: I - the area which was used during the production process; II - area of functions auxiliary to industry, e.g.

administrative and research centres, project offices, water intakes and others; III - industrial impact area, affected for instance by pollution,

3. "Post-mining land" (post-mining areas) – a type of post-industrial land. It is created as a result of the mining of minerals using open-pit, underground or borehole methods. The characteristic signs of the mining process formerly taking place in an area are open-pit and underground excavations, ground subsidence, overburden dumps, mining and processing waste, as well as mine infrastructure facilities. Post-mining areas may form post-mining districts (complexes of post-mining areas), meaning that many facilities of former mines, processing plants as well as processing plants with waste dumps, sedimentation basins and technical and construction infrastructure facilities are concentrated in a small area.

All the above-mentioned areas transformed as a result of human activity should be subject to remediation and redevelopment (revitalisation).

3. Procedures in remediation and revitalisation processes

Remediation is the most important and crucial environmental, social and economic problem. The rational goal of remediation measures is not only to create a stable landscape, consistent with the aesthetics and the surrounding environment, but also to take into account its intended use for future generations. In this sense, the considered remediation (or "reclamation") should take into account the basic objectives which, according to X. Cao [12] include:

- eliminating risks to health and safety (removal of all facilities and structures posing a threat to human health and safety),
- restoring land and water relations (replanting of green areas and stabilisation of residues to reduce mine drainage and water pollution),
- eliminating environmental impact also outside the mine area,
- ensuring a viable, sustainable future for post-mining areas, in terms of environmental, social and economic benefits (development of public areas for recreation, historical purposes, conservation objectives or benefits in the open space or for the construction of public facilities),
- encouraging better use of natural resources.

Mining and land-use are closely linked to a dynamic and integrative process addressed at a range of environmental, production, aesthetic, zoning and economic aspects related to the objectives of remediation planning. This process begins with the opening of a mine and ends when the mine is closed.

Revitalisation is a comprehensive activity aimed at restoring devastated areas for economic use, to the technically possible and economically justifiable extent. The primary problem for undertaking a revitalisation programme is to identify the degraded area and the destructive social, spatial and functional, economic and environmental processes that led to its permanent degradation. The selected indicators should reflect both the nature of the area and the problems that occur there, to the maximum extent possible. The recommended indicators (to designate crisis areas) include[13]:

Social:

- high: unemployment rate, poverty level, crime rate, domestic violence rate,
- low: level of education, number of social organisations (foundations, associations), turnout in elections;

Spatial and functional:

- degradation of the technical condition of buildings, including residential buildings, insufficient equipment in technical and social infrastructure,
- lack of functioning technical solutions enabling effective use of buildings (in terms of energy efficiency and environmental protection),
- lack of access to or low quality of basic services,

- failure to adapt urban-design solutions to the changing functions of the area,
- low level of communication services,
- shortage or poor quality of public areas;

Economic:

- low level of entrepreneurship and poor condition of enterprises;

Environmental:

- failure to comply with environmental quality standards, the accumulation of waste posing a threat to the life or health of people or the state of the environment.

In revitalisation processes, the following mistakes are usually made [14]:

- generating artificial landscapes,
- inappropriate objectives and assumptions made at the planning stage,
- insufficient communication (dialogue) with stakeholders (mainly with the local community),
- blurring of the cultural landscape,
- disturbance of the landscape with low-value facilities and accidental architectural projects,
- the negative image of the place,
- no attention given to designing the facility's surroundings - no stylistic and architectural cohesion,
- no maintenance and development strategy for the facility/area - operational phase,
- no audit of the benefits of the revitalisation/adaptation carried out – the environmental, social and regional contexts.

A very important and often overlooked element of the adaptation process [15] is the audit of benefits resulting from the transformation carried out in the environmental (the improvement of the environment), social (the positive reception of the project by the local community) and regional (a step forward in the development of the region) contexts.

4. Directions of transformation of post-industrial areas and facilities

Closed-down industrial enterprises often leave abandoned areas and post-industrial facilities behind. Post-industrial zones include many types of areas which have been degraded as a result of various utility functions. These include: landfills, excavations and quarries as well as post-industrial areas, which remain within developed areas [16]. The problem, in this case, concerns large industrial districts and cities, cities not associated with industry, and many small and medium-sized towns.

Activities undertaken in order to solve problems of post-industrial areas and facilities can be divided into three main groups [17]:

1. The protection of the cultural heritage related to industry.
2. The improvement of environmental conditions, landscaping and land use.
3. The improvement (development) of post-industrial land and facilities for economic purposes.

Post-industrial land is usually subject to remediation for the purposes of re-use. These are mostly areas of former mines, gasworks, steelworks and other production plants. Their remediation takes place faster than for instance, the remediation of landfill sites.

The main area of interest of revitalisation programmes include city centre areas, as their use would be fully in line with the strategy of sustainable land management and would allow to protect new undeveloped areas for investments. The possibilities of revitalisation in such areas are consistent with the types of the functions being developed [18]:

- housing and gentrification (the process of improving the social structure of the inhabitants of an area through the inflow of a younger population with a higher social status and the physical improvement of the resources located there),
- shopping centres,
- office facilities,
- hotels and restaurants,

- education and science facilities,
- culture facilities,
- sports and recreation facilities,
- industrial facilities and parks,
- green areas.

The revitalisation of areas previously used by industry has a varying impact on the development of urban tourist space. It depends to a large extent on the role that the city authorities attribute to tourism (especially the tourism related to industrial and post-industrial heritage) in urban policy, and thus on the way in which the new urban spaces acquired by the city are assigned tourist functions. Tourism related to historic technological buildings and post-industrial facilities has achieved unprecedented popularity worldwide [19]; in Poland, it is a relatively new phenomenon, which has not yet been included in the catalogue of tourist products offered to domestic and foreign tourists.

5. Examples of post-industrial land development

5.1. The revitalisation of the Battersea power plant in London

Battersea is a district located on the banks of the Thames in the south-western part of London. The energy industry developed there thanks to the Battersea Power Station. In the 1980s it was included in the national heritage of Great Britain as the largest brick building in Europe and it was decommissioned around that time. It is shown in figure 1.



Figure 1. Battersea Power Station before revitalisation. Photo. Ian Tyas / Getty Images.



Figure 2. The revitalisation of Battersea Power Station in London. Photo: Cushman & Wakefield.

Thanks to the revitalisation, 16 ha of the area will be transformed into a multifunctional building complex (figure 2). The investor Cushman & Wakefield intends to develop and hand over for use 35 ha of modern space with a local park. The London branch of Apple is to be located there.

5.2. The revitalisation of the Arcade Providence shopping centre near Boston

The Arcade Providence shopping centre (figure 3) near Boston was one of the oldest of its kind in the U.S. The mall was opened in 1928 and closed in 2008. At that time, a developer became interested in the attractive, historic property and decided to thoroughly modernise the building [20].

As a result of the expansion of online stores in the United States, the interest in shopping centres is declining. The number of facilities closed throughout the country is estimated at about 1200. The developer's innovative project may prove to be an inspiration for the revitalisation of other abandoned shopping malls in the US.



Figure 3.. Arcade shopping centre in the past. Photo by Derek Strahan.

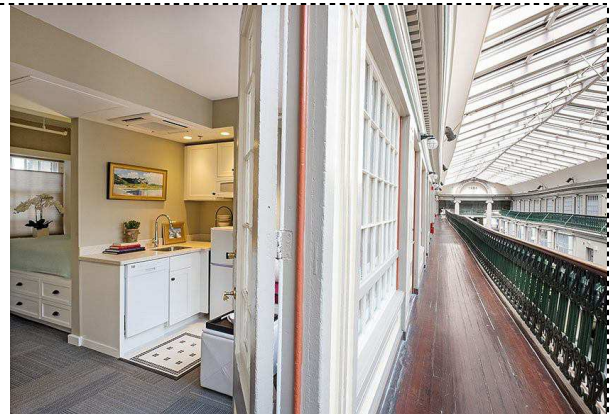


Figure 4.. Shopping mall converted into cheap flats. Photo by arcadeprovidence.com.

The Arcade building was rebuilt according to the revitalisation design of Northeast Collaborative Architects. Shops on the first floor are replaced with 48 small flats with an area of 21 to 42 m² (figure 4).

The revitalisation project of the building combined a recreation and entertainment area located on the ground floor of the building with micro apartments on the first and second floor of the former shopping centre (figure 5).



Figure 5.. The recreational and commercial zone on the ground floor of the building. Photo by Christine Francis.

6. An example method of promoting post-industrial areas

In view of the fact that tourism has been increasing in recent years, it seems possible to attract the public to remediated areas by applying various incentives. Some of the possible options for promoting both developed and undeveloped post-industrial areas may include a combination of geotourism and geocaching. [21]. A box (a "cache") hidden by other participants of the game, is a container protected against moisture, containing the visitors' logbook. The people who prepare these boxes make sure that their location is attractive for those who look for them. A cache is often hidden in places with an interesting history, which the hiding person describes in the profile of the mailbox on the website.

Post-industrial areas can be promoted in a similar way by placing a cache in their vicinity, which encourages people to learn about the history of a certain place. Sometimes it is the only way to reach the general public and draw attention (interests) to places of historical significance.

A telling example of generating publicity around a forgotten post-industrial area is the history of a brick factory, which was promoted by J. Rogóż [22] using the method described above.

6.1. Tarnów - brick factories

At the beginning of the 20th century there were five brick factories operating in Tarnów:

1. Rudy – it is estimated that it was established before 1865. The plant ceased its activity before the Second World War. The excavations left overgrown wastelands, remainders of buildings in the form of: outbuildings, administrative and storage facilities and drying rooms.
2. Konstancja – one of the larger and more popular brickyards operating in Tarnów in the 20th century. It was closed in September 1987. The historic architecture was demolished. Only a few devastated buildings and a chimney remain.
3. Kantoria – established in 1902-1906. It produced bricks and tiles for many years, for various owners. Production was discontinued in 1980. A chimney and an unprotected and unused excavated tank remained after the plant.
4. Tarnowianka - located in the vicinity of the Konstancja plant. Construction works were completed in 1908. In the 1950s the brickyard was modernised and operated until the 1990s, when the clay deposits were exhausted. At present, no remains of the buildings have been preserved; new halls have been built in their place, and the town's southern ring road runs through the former excavation areas.
5. Mieszczanka –probably established around 1912. The name derives from the fact that the brickyard was a municipal factory. In 1951, Mieszczanka became a part of Krakowskie Zakłady Ceramiki Budowlanej. It was modernised and operated continuously, despite the exhaustion of raw materials in its excavations, until 1989, when the operation was discontinued.

In the area of the former cement industry areas there remain a post-mining pit (figure 6), overgrown wastelands, devastated buildings (figure 7) and a chimney (figure 8).

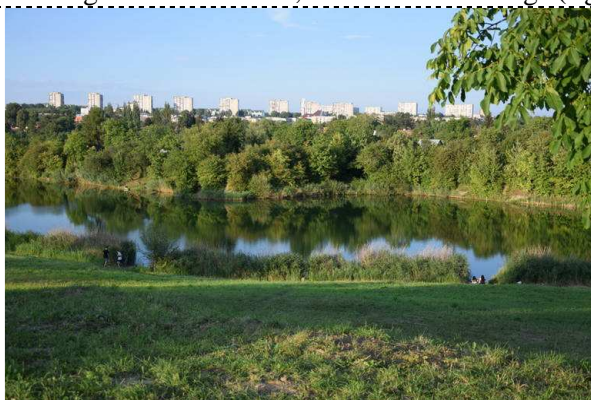


Figure 6.. Kantoria post-mining pit. Photo by P. Chwał.



Figure 7.. Other buildings – Kantoria. Fig. S. Siekierski.

Plans for redeveloping the water reservoir of the former Kantoria brickyard assume the construction of an open amphitheatre for outdoor events (figure 9), arranging a beach and providing access to the reservoir for water sports enthusiasts. It is also planned to build an amphitheatre with a floating stage and a promenade along its banks. The project [23] also provides for the creation of an educational path, an outdoor gym and swimming pools and wading pools.



Figure 8. The chimney of the Konstancja brick factory. Photo by J. Rogóż.

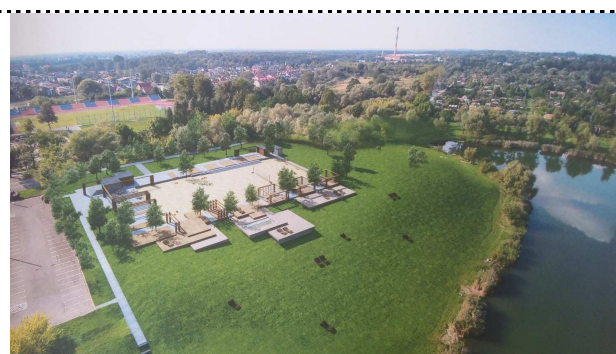



Figure 9. The planned appearance of the surroundings of Kantoria after the reconstruction. Photo: visualisation/ archive of the Tarnów City Hall.

6.2. Setting up caches

In designing caches meant to preserve the memory of the former brickyards, a convenient location was chosen. The locations of caches  are indicated on the map of Tarnów (figure 10). It was decided that most caches would be located close to trees. The caches had the form of "breakfast boxes", i.e. tightly closed plastic containers.

In order to make the caches more attractive, the first finders could obtain pins with photographs of the brickyard and their most characteristic elements, i.e. chimneys, from each cache. During the inspection of the area, it turned out that one of the brickyards already has its own cache.

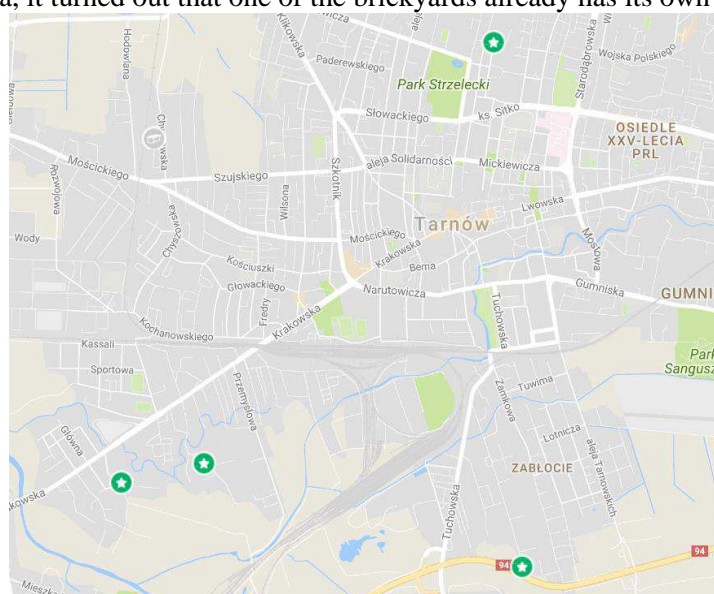


Figure 10. Location of the author's cache in the field [24].

6.3. Feedback from caches

Table 3 contains data on geocaches with their numbers in the Geocaching portal.

Below are examples of comments made by Geocaching users addressed to the author's caches (original spelling).

Kantoria:

Commentary by Euphoria_: "Luckily, the author is online and called with a hint. Kantoria. A beautiful story, beautiful remains Thanks for the cache and {FTF}" [FTF- first to find- author's note]

Mieszczanka:

Commentary by Euphoria_: “Fast bus ride from Kantoria to Mieszczanka. A nicely prepared cache. Thank you for the story of Mieszczanka and for the third, great pin.”

Table 3. Statistics of caches visits [22].

Cache name	Geocaching number	Number of people searching (as at 4 July 2018)
Rudy	GC7QJ57	5
Mieszczanka	GC7QBEC	8
Tarnowianka	GC7QBE6	5
Kantoria	GC7qBDQ	8

7. Summary

The presented examples regarding post-industrial areas show that attractive revitalisation can be achieved in a non-standard way. The potential of the land in question is used for this purpose, both in terms of its utility and economy. It receives new functions thanks to the revitalisation process. Both in Poland and across the world, industrial heritage is becoming a showcase of certain regions and a tourist attraction.

Post-industrial areas require a comprehensive approach during the revitalisation process. In many cases, their revitalisation reduces the negative impact caused by the disappearance of jobs, minimising social frustration.

It is a new approach to promote revitalised areas. This is a kind of response to the emerging trend of industrial heritage tourism.

By engaging in geocaching, tourists have the opportunity to reach places and facilities that are not mentioned in traditional tourist guides or included in the offers of travel agencies.

Due to the fact that the geocaching network covers almost the whole of Poland, the tourist has the opportunity to start and finish a sightseeing tour at almost any place and time, choosing the most interesting sites on the way.

Geocaching is currently a niche phenomenon, which, however, has the potential to become more widely known. Thanks to this, the previously hidden industrial heritage, with only minor investments, could become a real tourist attraction. Geocaching is a young but very interesting form of tourism. Users are attracted by the need for conspiracy and the aura of mystery that accompanies the search. Geocachers gather in social media and on the geocaching.com website. New applications are created, participants in the game are awarded badges, regular events are held to familiarise the participants with a given topic (city/region). People interested in geocaching are usually highly-educated individuals who have been involved in this activity for years [25]. For some people it is a passion to which they dedicate most of their free time, and consider the presence of geocaches in an area the decisive factor when choosing their holiday destination.

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