fruitful ”wastelands”

… about the project

A study of Warsaw's wastelands was conducted as part of the EU project “Inventory and valuation of selected degraded and polluted areas in Warsaw - natural and social potential of wastelands” implemented by the Capital City of Warsaw in the years 2017-2019. The research was the result of cooperation between specialists from the Institute of Environmental Engineering and the Institute of Horticultural Sciences of the Warsaw University of Life Sciences and the Zarząd Zieleni m. st. Warszawy (Greenery Board of Warsaw). The list of areas subject to the study embraced 25 lands constituting over 10% of the city’s area (ca. 350 ha), which is more than the total area of all urban parks. These included lands located over the Vistula River, post-industrial sites, former forts and railway sites, as well as any and all areas of housing estates (map provided on the last page of the brochure).

Warsaw's wastelands proved to be places that need to be viewed from a different perspective - as greenery resources serving recreational purposes, but also as areas where much can be done in terms of environmental engineering to improve air quality in the city. Above all, however, wasteland greenery should be recognised as a new form of informal urban greenery which can be shaped by citizens in a participatory process and thus perform novel social functions, either temporarily or permanently.

Wastelands:

- clean the soil and air of pollutants;
- are habitats for a variety of plants and animals, including valuable and rare species;
- are intensively used for recreational purposes;
- thanks to their aesthetics are commonly regarded as areas of unrestrained use and natural wealth.

Photo 1. A path in Tarchomin. (photo by B.J. Gawryszewska)

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… soil and air purification

Urban soils are dry and polluted with building material residues, heavy metals and organic compounds. They contain nitrogen and sulphur compounds. Another problem is their salinisation due to street de-icing.

Soil pH, salt concentration, water level as well as concentration of selected heavy metals (copper, zinc, lead, cadmium, chromium, nickel) were examined.

Soil pH ranged from slightly acidic to alkaline, with salt concentration at a level of 0.22-7.98 mS/cm. Soil salinisation was recorded in the soil of Kanał Sielecki [Sielecki Canal] and Odolany Estate 2. The obtained results of heavy metal concentrations showed that the **permissible lead, copper and zinc values were exceeded only in several locations:** in Odolany Estate 2 and Kozia Góra [Kozia Mountain] in the case of lead, in Fort Okęcie [Okęcie Airport] and Kozia Góra in the case of copper, and in Dolna Street and Odolany Estate 1 in the case of zinc. While copper and zinc are microelements that are indispensable for proper growth of plants, in the case of lead even small amounts have a negative impact on organisms. In the present study, traces of lead were found in: Kanał Żerański [Żerański Canal], Górka Kazurka [Kazurka Hill], Wisła Tarchomin Estate and Wisła Siekierki Estate. **The least polluted area of all the studied wastelands was Górka Kazurka**. In the most polluted areas of Odolany 1 and 2, Kozia Górka, Fort Okęcie and Dolna street, no plants should be cultivated or consumed.

Particulate matter (PM) is a mixture of airborne substances with a diameter ranging from 1 nm to 100 µm, both organic and inorganic, solid and liquid. PM includes, among others, street dust, ash from solid fuel combustion, exhaust fumes, toxic organic compounds, heavy metals, road de-icing salts and micro-particles of plant and animal origin. Particulate matter poses a hazard to human health. Only plants have the ability to remove it effectively. According to our present knowledge, **wasteland plants play a key role in reducing the negative impact of PM on human health.**

Carbon dioxide (CO_2) is one of the most important greenhouse gases. By means of gas exchange plants absorb CO_2 from the atmosphere which they subsequently use in the photosynthetic process. By doing so, plants simultaneously release oxygen (O_2). Plants absorbing the greatest amount of CO_2 are those that produce a lot of biomass. Most plant species observed on Warsaw's wastelands meet this criterion. A vast majority are species with rapid growth characteristics, invasive, adapted to adverse climatic conditions such as drought. **In the case of such plants, gas exchange is usually more intensive than in species found in parks**. Thus, they should be viewed as plants that have a positive impact on atmospheric processes, especially in the urban environment where CO_2 emissions are higher. Therefore, wasteland vegetation needs to be preserved.

Photo 2: Wasteland vegetation as a filter and barrier for PM. (photo: A. Przybysz)
Photo 3: Accumulation of PM on robinia pseudoacacia. (photo A. Przybysz)

... rare plant species

Forty one types of plant communities were distinguished in the studied areas, more than half of which were various types of trees in different stages of succession. The lands that have been neglected for several years resemble young forests. However, succession following discontinuation of land use does not lead to the formation of natural plant communities, which is due to the short period of time but also the lack of available tree and shrub species, and above all undergrowth. On the habitats naturally occupied by oak-hornbeam-lime forests, tree communities including poplars, birches and invasive species, mainly ash-leaf maple, can be observed.

The findings in the Vistula river valley were much more positive, although also in this area invasive species have favourable conditions to spread abundantly. Non-forest communities, mainly golden rod as well as meadows in partly used areas are slightly less numerous. **The number of vascular plant species exceeds 100 and is comparable to the number of varieties found in developed parks**. Species typical of forest habitats cannot be found on wastelands, but there are plants characteristic of older meadows, such as the spiny restharrow.

Several species of rare and protected plants were reported in the studied area:

- watercress;
- broad-leaved helleborine;
- spiny restharrow;
- pendulous sedge.

Photo 4. Pendulous sedge – a species considered extinct in Poland, found on Odolany wastelands. Findings published on the website - https://atlas-roslin.pl/gatunki/Carex_melanostachya.htm . (photo: P. Sikorski)

Photos 5 and 6. Rarer species identified on the studied wastelands - broad-leaved helleborine and spiny restharrow (protected species). More protected plant species coming from former allotment gardens, e.g. honeysuckle and Siberian iris, were seen. (photo: P. Sikorski)

Photo 7: Leaf area index measurements with the SunScan device. (photo: P. Sikorski)
Photo 8. Watercress - a species from the Red List of Threatened Species. (photo: P. Sikorski)

... precious birds

Birds are considered to be the most valuable landscape quality indicators. **Due to the fact that many urban habitats are deprived of bird breeding sites, wastelands become ideal places to fulfil this need**. Wastelands with the richest diversity of birds embrace areas near the Vistula River - Wisła Żoliborz and Wisła Tarchomin Estates, followed by areas of Wisła Żerań, Młociny estate, Las Bemowo [Bemowo Forest], Fort Bemowo [Bemowo Airport], Wisła Siekierki Estate, Sadyba Psi Nieużytek Estate. Apart from the sites in the vicinity of the Vistula River, there are relatively rich forest areas in Warsaw's neighbourhoods of Bemowo and Sadyba. All of them are humid or water habitats.

The number of birds subject to the inventory taken within the present study exceeded 14,000 individual plants and 100 species including, among others, the common merganser, hedge sparrow, middle-spotted woodpecker, black and green woodpecker, willow tit and mandarin duck.

Photo 9. Common merganser. (photo: J. Matusiak)
Photo 10. Thrush nightingale. (photo: J. Matusiak)
Photo 11. Hedge sparrow. (photo: J. Matusiak)
Photo 12. Middle-spotted woodpecker. (photo: J. Matusiak)
Photo 13. Willow tit. (photo: J. Matusiak)
Photo 14. Mandarin duck family. (photo: J. Matusiak)

… beneficial insects

Ground beetles may be an excellent indicator of the state of the environment. For that reason, an inventory of these insects on Warsaw's wastelands was performed, with many species of ground beetles observed including visually attractive varieties such as Carabus auronitens. Coastal forests along the Vistula River were proved to be particularly rich in ground beetles. This stresses the important ecological function of both the river and its banks. Most of the species found on the wastelands in question can fly, which allows them to reach also distant, isolated areas. As far as safeguarding species diversity and the ecological role of these areas are concerned, preservation of wastelands' diversity is of utmost importance as it also impacts maintenance of their tourist and recreational functions.

Moreover, the research showed a vast number of different communities of ground beetles inhabiting individual wastelands, which indicated a great diversity between those areas, from open sandy sites to old forests, and from dry areas to extremely humid ones.

The disappearance of pollinating insects has become a worldwide problem. This phenomenon can also be observed in Poland. Due to the need to protect wild pollinating insects, bumblebees were selected to constitute another indicator of the natural potential of urban wastelands.

In our study, 19 out of 30 species of bumblebees observed in Poland over the last decades were found on the wastelands in question. All of these varieties are under legal protection.

Therefore, it needs to be concluded that extensively used urban wastelands (e.g. mowed occasionally, thus favouring the blossoming of host plants) contribute to the preservation of valuable bumblebee species.


15


16


17


18


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Photo 15. Carabus auronitens. (photo: A. Schwerk)
Photo 16. Harpalus rufipes. (photo: A. Schwerk)
Photo 17. Bombus sylvarum. (photo: B. Zajdel)
Photo 18. Bombus campestris. (photo: B. Zajdel)
Photo 19. Flower meadow in Warsaw. (photo: B. Zajdel)

wastelands are used intensively!

Two basic types of use were reported on the studied areas:

- bottom-up (signs of territoriality and traces of use);
- top-down (use related to administrative and management activities).

Smaller areas tend to show higher intensity of land use. This may mean, among other things, that the larger the area, the “wilder” it is and thus more conducive to experiencing urban nature. **Higher intensity of use usually expresses greater dwellers’ desire for various forms of recreation - not only contact with nature but also sport, integration, gardening, creative activities, etc**. The most intensively used areas included Górka Kazurka [Kazurka Hill], Targ Ursus [Ursus Market], the area of Skra swimming pools near Pole Mokotowskie [Mokotów Field], as well as Dolna Street, i.e. lands in the vicinity of housing estates and a large park. The most rarely used areas were Potoki Street, Wisła Żerań, Młociny Estate and Wisła Siekierki - sites with limited accessibility, located near industrial facilities.

Photo 20. Bench and bridge on Kozia Górka. (photo: B.J. Gawryszewska)
Photo 21. Anglers at Dolna Street. (photo: B.J. Gawryszewska)
Photo 22. Picnic site with a hearth over the Vistula River in Tarchomin. (photo: B.J. Gawryszewska

what do we like about wastelands?

As part of the research project, interviews with wasteland users, both professionals (architects and landscape architects) and those not dealing with the issue of wastelands on a professional basis, were performed. Twenty in-depth interviews and one focus group interview (with 6 officials and representatives of non-governmental organisations) were conducted, the results of which are as follows:

- wasteland users find the distance between wasteland and their place of residence important. However, there was one exception. The areas located near the Vistula River were perceived as so attractive that they were worth visiting even though the distance was considerable;
- small design operations are conducive to viewing wastelands as aesthetic. All respondents emphasised improved aesthetics, perception and comfort of use as a result of constructing paths with natural surface, equipping an area with small architecture, rubbish bins. The respondents also warned against "overinvestment", especially against disturbance of flora;
- users expect wastelands to remain unchanged. They do not want them to lose their status quo. They allow for the said small design operations as well as raise the issue of rubbish. the need for improved accessibility and the sense of security (contacts with the homeless and animals, e.g. ticks, stray dogs, were reported as potentially dangerous);
- wasteland users like a variety of landscapes, i.e. different shapes and colours of nature, water, small architectural forms. **Natural diversity, complemented by cultural themes and equipment improving accessibility, met with the greatest approval.** A particular case was the area of Pole Mokotowskie [Mokotów Field], i.e. the site where the former swimming pools of Skra had been located. Despite litter, inaccessibility and degradation of its infrastructure, this area was viewed as fascinating thanks to the combination of untamed nature controlling the area and peculiar forms of ruins of the old recreational facilities;
- last but not least, users pay attention to the natural value of wastelands, both in terms of biodiversity and curbing climate change, as well as improving air quality in the city.

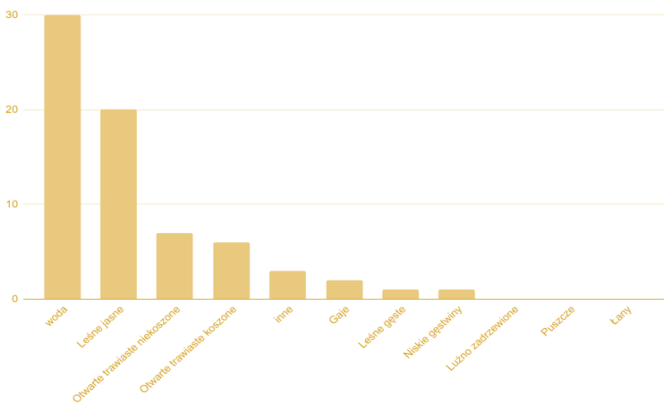
Photo 23: One of the respondents' favourite views - Vistula River area in Tarchomin. (photo: B.J. Gawryszewska)

…favourite sceneries

The Visitor-Employed Photography technique which is based on photographs taken by visitors in places they find most attractive was employed to determine aesthetic preferences for the landscape of the studied wastelands. Over 23,000 photographic data provided by the respondents were grouped into 53 types of repetitive, photographed landscape images, with the following eleven types of "sceneries" selected:

- water sceneries (river, pond);
- mowed grass plants (low herbaceous plants);
- open unmowed grass areas (higher herbaceous plants);
- fields (one herbaceous species on a large area, mostly Canadian goldenrod and reed);
- low thickets (dense shrubs, young trees, and herbaceous plants);
- groves (herbaceous plants, small trees and shrubs);
- loosely wooded sceneries (herbaceous plants, no understory, tall trees
- light forest sceneries (low understory, tall trees);
- dense forest sceneries (dense understory, densely growing tall trees);
- "large forests" (dense understory, densely growing tall trees, lots of dead wood);
- other (fields of crops, railway sidings, etc.).

The most frequently photographed - preferable views - were water and waterside areas, followed by forest sceneries with scattered trees, with sunlight reaching the undergrowth ("light forest"), unmowed meadows and herbs and mowed grasslands. The graph below contains comprehensive findings.



Photos 24-27. The most popular sceneries: water, light forest, unmowed grass, mowed grass.
(photo: B.J. Gawryszewska)

Photo 28: MUSE device (portable brain sensing headband) on the researcher's head. (photo: B.J. Gawryszewska)
Photo 29: DJI S1000+ unmanned aircraft. (photo: J. Chormański)
Photo 30. Optris PI 640 thermal imager (photo: J. Chormański)

The present research was carried out with the application of novel specialised technologies.

Portable MUSE brain sensing headbands were used in mental status evaluation to monitor brain waves of respondents resting on wastelands. Such devices are designed to sense states of relaxation and alertness. **The obtained results showed that some (partially developed) wastelands may become leisure areas ensuring the same level of relaxation as urban parks.**

Whereas environmental studies, e.g. measurements of surface temperature distribution, were conducted with the use of unmanned aerial vehicles (drones) equipped with thermal, multispectral or RGB cameras, thereby enabling evaluation of various parameters of plant condition and consequently of the environment - chlorophyll content and leaf area index (LAI) allowing for determination of gas exchange intensity. The research involving a total of 17 areas (the number was limited due to the ban on the use of drones in some locations, e.g. near Okęcie and Bemowo airports) allowed us, among others, to confirm **increased water retention capacity of the studied wastelands, even on highlands, decreased temperature (of the urban heat island) as well as significant intensity of carbon dioxide absorption.**

The conducted research enabled us to develop a model of an algorithm for the selection of a transformation scenario of any wasteland which could be used in an urban green space system. The model in question includes four scenarios which take into account the proximity of residential areas, natural value and intensity of land use. These embrace: an ecological park, an ecological park with the possibility of use by the local community, a social park and a natural urban park. The fifth scenario was selected as a result of allocating individual areas to individual scenarios by providing only two possible answers - YES or NO - to the questions about the natural value, intensity of use and the need to preserve the informal character of a given green area (the natural value was considered to be the top priority). It means an area which does not constitute a natural or social value, but before it is designated for a new investment (e.g. intensively developed urban park), it can be left unused so as to allow uncontrolled vegetation growth for a period of 15-20 years, thereby constituting a natural biological filter (whose effectiveness will depend on the density of plants growing on it).

wasteland or... social park?

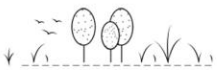
AREA

IS THE AREA ENVIRONMENTALLY VALUABLE?

Is it a riparian area? A peat bog? Rushes?
Is it included in the list of natural habitats of the Ecophysiographic Study of the Capital City of Warsaw?
Is there any data proving presence of protected species? (in the case of areas that have not been studied, it is necessary to perform an inventory)
Is the site located in the vicinity of a water reservoir of at least 1 ha?

At least one answer should be "yes" so as to follow the YES *path*

YES



ENVIRONMENTALLY VALUABLE AREA

Is the site used intensively?

CHECK:
Is at least 4.4% of the site total area in use?

YES **NO**

SCENARIO I

ECOLOGICAL PARK

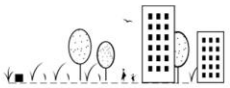
Park with access only from the observation towers and outdoor facilities (paths running away from precious biotopes).

SCENARIO II

ECOLOGICAL PARK with the possibility of bottom-up use

Park providing users with the opportunity to relax in a natural environment, equipped in such a way so as to enable bottom-up creation of leisure space, however designed with the assumption to stay only in designated areas.

NO



AREA WITH OTHER PREVAILING VALUES

Is there a need for an informal green space in the vicinity of the site?

CHECK:
Is the site located no further than 500 m away from areas with a population of no fewer than 100 people? Are there any housing investments planned within 500 m?
Does the site have the potential to decrease the local temperature by min. 5 °C (has an area of at least 1 ha and is at the same time wooded)?
Is it the only area of informal greenery within 500 m?
Is it an important ventilation corridor, a link between other valuable areas?

YES **NO**

AREA OF SOCIAL VALUE

Is the site used intensively?

CHECK:
Is at least 4.4% of the site total area in use?

YES **NO**

SCENARIO III

SOCIAL PARK

Park enabling unrestrained bottom-up use and selection of leisure space.

SCENARIO IV

NATURAL PARK

Space similar to an urban park, but with emphasis on natural values.

SCENARIO V

NATURAL BIOFILTER

An investment area that should be left untouched for 15-20 years as a natural biofilter, then might be designated for an investment, e.g. intensively developed urban park.

The greater the foliage and density of vegetation, the more effective the biofilter is.

SCENARIO I

"STAY ON THE PATH AND RESPECT NATURE"

PROGRAMME:

"STAY ON THE PATH"

Environmental education in the form of information boards and programme of educational events.

EQUIPMENT:

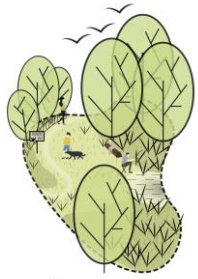
Ground or mineral surfaces, no furniture or equipment provoking a desire to stay.

LOCATION OF EQUIPMENT:

Location of paths and information boards on the periphery of precious biotopes.

COSTS:

Surfaces
Information boards
Environmental education programme



SCENARIO II

"USE DESIGNATED SITES ONLY"

PROGRAMME:

Environmental education in the form of information boards and programme of educational events.
Guard rails, designated picnic and fishing sites.

EQUIPMENT:

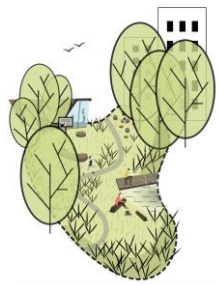
Ground or mineral surfaces, valuable biotopes enclosed by guard rails, seats and rubbish bins made from natural materials available on the site (e.g. fallen trunks, stones).

LOCATION OF EQUIPMENT:

Based on preferred sceneries

COSTS:

Surfaces
Information boards
Environmental education programme



SCENARIO III

„USE THE AREA AND JOIN IN PARK CREATION|

PROGRAMME:

Free choice of picnic, walking or fishing sites.

Social animation programme encouraging residents and social organisations to active contribution to the creation of the area (e.g. cultivation of a community garden, etc.).

EQUIPMENT:

Social animation pavilion (meeting places, local community sites, etc.), main walking routes equipped with mineral surfaces, rubbish bins, information boards, storage places for materials found on the site which could be used by visitors for building purposes (e.g. for building seats, community gardens, fuel for bonfires, etc.), picnic shelters on the most frequented routes, seats made of natural materials (wood, stone), bridges for anglers, etc.

LOCATION OF EQUIPMENT:

Based on preferred sceneries

COSTS:

Pavilion, surfaces
Information boards
Shelters and seats
Social animation programme

SCENARIO IV

"ENJOY THE PARK, ENJOY THE NATURE"

PROGRAMME:

Programme of an urban park providing users with the opportunity to admire nature (environmentally valuable areas).

EQUIPMENT:

Equipment typical of modern parks with recreational areas, sports fields, cycling routes and skate-parks, with surfaces characteristic of modern parks and modern urban furniture, community gardens and environmental education sites.
Plantings of park plants (tree avenues, flower beds with native plants, areas left for uncontrolled vegetation).

LOCATION OF EQUIPMENT:

All over the area.

COSTS:

Investment in a park covering a plot of land reduced by the area designated for uncontrolled vegetation.

SCENARIO V

"A PLACE TO THE BENEFIT OF THE CLIMATE"

PROGRAMME:

None

EQUIPMENT:

None

LOCATION OF EQUIPMENT:

None

COSTS:

None

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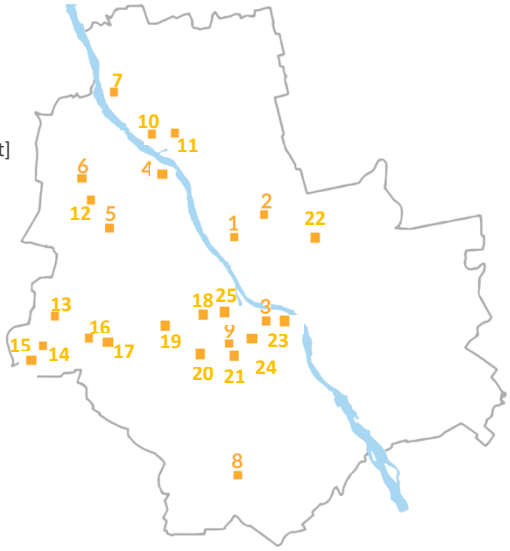
no. POIS.02.05.00-00-0207/16 of 21.07.2017

Zarząd Zieleni m.st. Warszawy

Szkoła Główna Gospodarstwa Wiejskiego w Warszawie

1 Kanał Olszynka [Olszynka Canal]
2 Siarczana Street
3 Wisła Siekierki Estate
4 Wisła Żoliborz Estate
5 Lasek Bemowski [Bemowo Forest]
6 Młociny Estate
7 Wisła Tarchomin Estate
8 Górka Kazurka [Kazurka Hill]
9 Kanał Sielecki [Sielecki Canal]
10 Wisła Żerań Estate
11 Kanał Żerański [Żerański Canal]
12 Fort Bema [Bema Airport]
13 area of Cmentarz Wolski [Wola Cemetery]



14 Glinianka Schneidra pond
15 Ursus Market
16 Odolany Estate 1
17 Odolany Estate 2
18 Fort Okęcie [Okęcie Airport]
19 Pole Mokotowskie [Mokotów Field] (former swimming pool area of ”Skra”)
20 Dolna Street
21 Potoki Street
22 Kozia Górka[Kozia Mountain]
23 Sadyba Psi Nieużytek Estate
24 Sadyba Pond 2
25 Kopiec Powstania Warszawskiego [Warsaw Uprising Mould]

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