STRATEGIC ACTION PLAN FOR

FUA CITY MUNICIPALITY CELJE

D.T4.1.3_FUAMoC

Final version

01 2019

Table of Contents

Introduction

Scope and structure of the document

The document represents the deliverable D.T4.1.3 of the GreenerSites project, and describes the concrete action(s) that, according to project experience and approaches, can contribute to increase the effectiveness of management of identified brownfield sites in the territory of FUA City municipality Celje.

This strategic action plan (SAP) is arranged with to improve the management of the "stara Cinkarna" brownfield area and limit the effects of soil contamination in the functional urban area of City Municipality of Celje. The strategic action plan for the functional urban area of Celje will answer the following questions related to the consequences of degraded industrial areas:

- What is the current situation?
- What are our goals?
- How will we achieve our goals?
- How can we measure progress?

It has been issued taking into account:

- the specific outcomes of the pilot actions developed during the project,
- the results of the stakeholders' consultation and the participatory processes activated in the Functional Urban Area (FUA).

The document is composed by four main chapters.

In this first part ("Introduction") a general presentation of the considered area and of the activities that have been carried out during the GreenerSites project (pilot actions) can be found. In addition, the process of involvement and consultation of local key stakeholders will be described, and the methodological approach adopted for selecting the relevant action(s) and drafting this Strategic Action Plan is presented.

In subsequent "Part A" you can find a short summary of the concrete action(s) that has been identified for an effective management of brownfield sites in the considered area. In "Part B", these action(s) and then described in detail, starting from the analysis of the specific problem(s) addressed, describing the objectives of the intervention, the actors, roles and timing of activities, and identifying also the financing sources and concrete implementation steps.

The final chapter contains references to other project deliverables and external documents, that can be useful for a deepening of the topics dealt with in the document.

The context: Functional Urban Area and related Pilot Site(s)

The functional urban area of the Municipality of Celje is heavily burdened with the environmental consequences of the former industry. Already in 1873, Celje got a zinc smelter, and later Zelezarna Štore, Emo, Etol, Aero began to operate. These were factories in the field of chemistry and metallurgy, which, on the one hand, gave bread to many locals and significantly influenced the development of the municipality; on the other hand, they left heavy metals and other pollutants behind and polluted the environment for future generations. Traffic also caused significant impact on environment, as two main roads run through the densely populated area of the wider city center.

In the functional urban area of the Municipality of Celje, the most important environmental problem is soil contaminated with heavy metals (mainly cadmium, lead and zinc) (the consequence of air deposition of pollutants, industrial waste and the movement of contaminated earth excavations). Geo-statistical analyses carried out within the GreenerSites project have shown that pollution is most pronounced in the area of "stara Cinkarna" and around the city of Celje (mainly in the direction east-west).

The area of stara Cinkarna (a pilot zone within the GreenerSites project) is an environmentally degraded area due to the consequences of the former metallurgical-chemical industry, including the disposal of industrial waste (Halda Rajmovka). There is pollution of soil and groundwater present, especially with heavy metals.

The implemented Pilot Activities

D.T3.3.1. Detailed analysis of all pollutants in the pilot region and D.T3.3.1. Innovative monitoring system

In the framework of pilot activities, a detailed pollution investigation was carried out in the pilot region. To this end, the municipality commissioned two studies:

> A) MONITORING OF THE QUANTITATIVE AND CHEMICAL STATE OF THE UNDERGROUND WATER IN THE STARA CINKARNE CELJE AREA (IRGO Consulting d.o.o., Report No 44 / 18-1. phase and No of Reports IC 424/18, dated 19/11/2019)

In order to obtain data on the chemical and hydrological status of groundwater in the pilot area stara Cinkarna following investigations have been carried out:

The first phase of hydrogeological investigations (DT 3.3.3), including the establishment (design) of a network of 5 piezometers for monitoring the chemical and quantitative state of groundwater. Permeability tests (filling and pumping tests) and a chemical analysis of groundwater were carried out on all 5 piezometers.

Figure 1: The image shows the location of the piezometers at the pilot area

According to the results of chemical monitoring of groundwater in the area under consideration, groundwater has exceeded the limit values according to Soil Remediation Circular 2013 for the following parameters: arsenic, barium, zinc, cadmium, chromium, cis-1,2-dichloroethene, trans- 1,2-dichloroethene and phenanthrene. The concentrations of arsenic, zinc, cadmium and cis-1,2-dichloroethene also exceed the intervention values mentioned in the aforementioned literature.

Within the second phase, measurements of continuous monitoring of levels, temperature and conductivity of groundwater during the period of 1 year were carried out on 5 piezometers and an assessment of the impact of contaminated ground on groundwater was made.

It was found that artificial fill on the surface is built ofvery different materials whose coefficient of permeability change in both the lateral and vertical directions. Under the bulk material there is a layer, which has a permeability of 2.2x10-7 m / s to 2.9x10-6 m/s. It is less permeable in the southern part of the region under consideration, as it contains a lot of clay. The aquifer is located in a homogeneous sand pebble layer, having an average coefficient of permeability of 1.8x10-3 m/s. The hydro-geological basis is less permeable in the southern part of the plot (10-9 m/s) than in the northern (10-7 m/s), which is a consequence of the geological structure of the area.

According to the data of the one-year continuous groundwater monitoring, the direction and speed of the groundwater flow at different levels of water were determined. The direction of the groundwater flow in the area under consideration is relatively constant and generally takes place from the northwest to the south-east, with a flow velocity of 7.63 m / day.

The source of contamination of groundwater with heavy metals is an artificial bulk material, spreaded throughout the whole area under consideration. In this context, the pollutants are probably distributed in the space in accordance with the position of now demolished installations within stara Cinkarna Celje. Thus, the heavily elevated values of zinc and cadmium in groundwater occur mainly in the east, arsenic and iron in the central part and barium and chromium in the western part of the area. Most of the hydrocarbons are most likely to originate in the northern part or perhaps even upstream of the area under consideration.

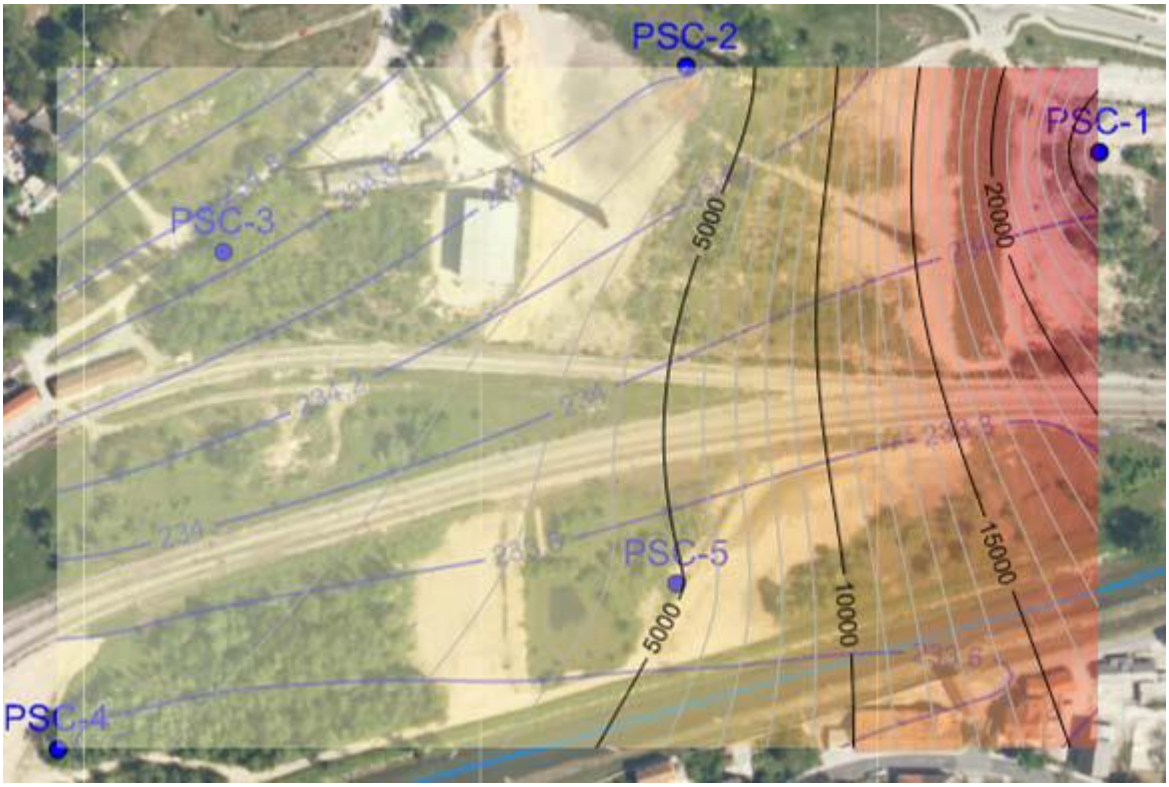


Figure 2: The map (from the GIS test tool) indicates the distribution of zinc [µg / l] at the location of the pilot area and similar distribution of cadmium (their concentration is increasing towards the east)

B) GEOSTATISTICAL ASSESSMENT OF SOIL POLLUTION IN THE MUNICIPALITY OF CELJE (Agricultural Institute of Slovenia, September 2018)

In order to obtain information on soil contamination of heavy metals in the whole area of the FUA, the Municipality of Celje commissioned the implementation of the study Geostatistical Assessment of Soil Pollution in the Municipality of Celje. On the basis of statistical and (geo) statistical analysis of Cd, Pb and Zn content in soil measured in MOC sample sites in 2016, transparent maps of soil contamination with heavy metals in the MOC area were produced by individual assemblies and heavy metals. Air pollution (diffuse pollution) assessment maps and maps of soil pollution generated by the disposal or addition of materials with increased heavy metal content were produced. These maps will serve as a guide for remediation and rehabilitation activities and measures.

During the first (preparatory) phase, the following activities were carried out:

1. Data preparation

The results of the analysis of soil contamination in the MOC area include data on heavy metal (Cd, Pb, Zn) pollution at the same sampling sites for soil pollution in Celje for the years 1989 and 2016. The data from the previous analysis (1989) were collected and analysed and a prepared in .csv table for statistical processing.

2. Selection of the statistical program

Geostatistic data processing was done with (geo) statistical program "R" and spatial extrapolation using the kriging method was used in the production of variograms. Based on the statistical and geostatistic analysis of Cd, Pb and Zn content measured in soil in 2016, the study presents methods and maps of soil contamination with heavy metals (Cd, Pb and Zn) in the

municipality of Celje. The following maps and layers of GIS information were produced in the study: maps with a) estimated air pollution with Cd, Pb and Zn; and b) sites of point pollution sites caused by the disposal or addition of materials with increased heavy metal content (Cd, Pb and Zn). The soil contamination maps include an indication of diffuse (air pollution) and contamination with hot spots with heavy metal content.

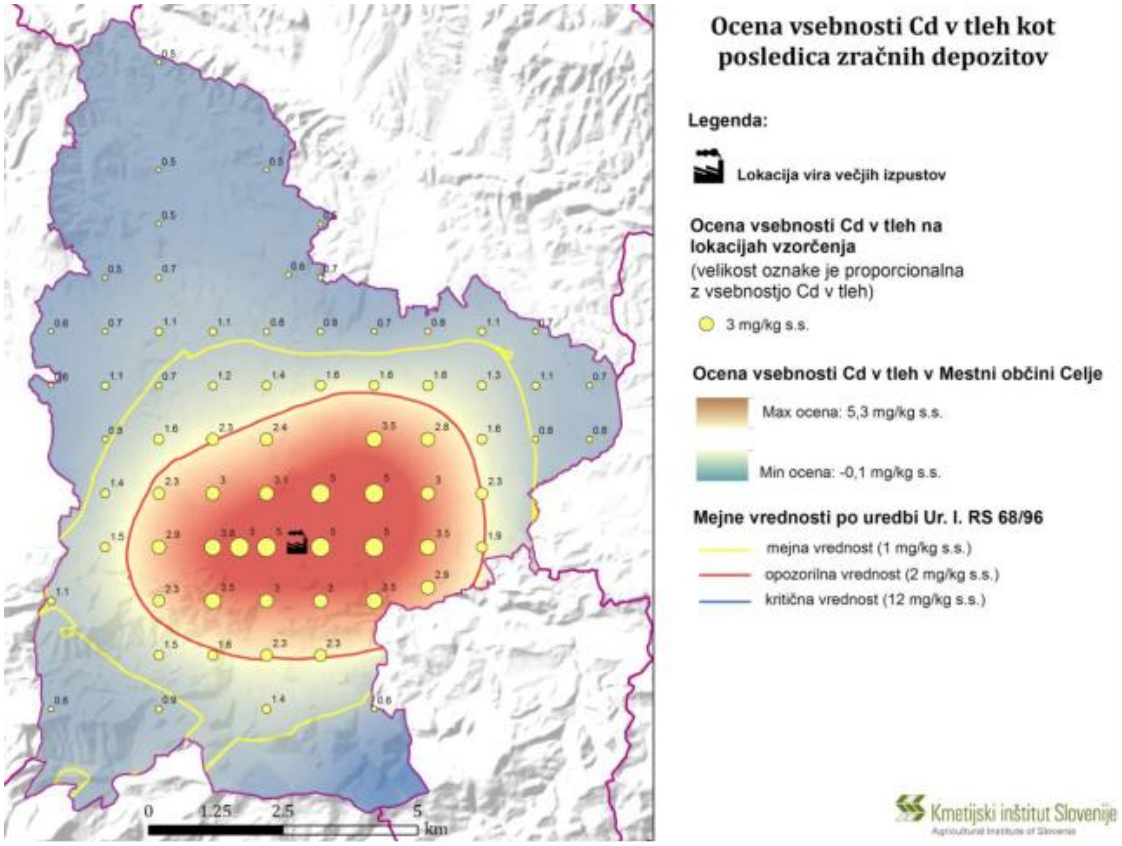
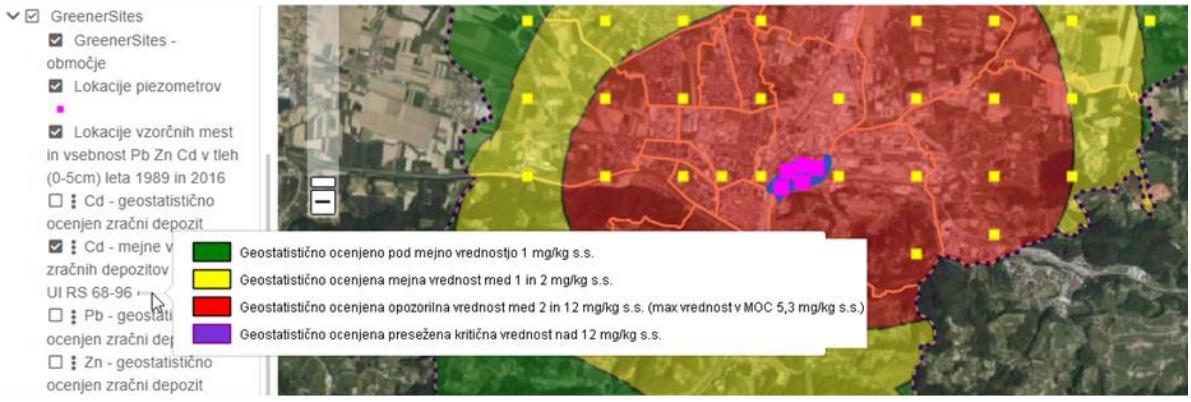


Figure 3: Example of map 1.



Translation of the legend: the test GIS tool information layer visualizes the GreenerSites area (blue), locations of installed piezometers (purple), locations of point pollution sites where the concentration of Pb, Zn and Cd in the ground was measured in 1989 and 2006 (yellow) and areas of limit values of Pb, Zn and Cd air deposits according to the Slovenian law (green, yellow, red)

Figure 4: Example of map 2.

D.T3.3.2. Results of the effectiveness of methods for decontamination of the pilot region

According to the plans in the project application, the project initially envisaged the testing of thermal treatment of contaminated soil. According to the cabinet survey of the method, it was found that the use of this method would be less suitable on the pilot area due to high costs and low feasibility. Therefore, it was decided, in agreement with the project's lead partner, that the thermal treatment of soil should be omitted and soil remediation with immobilization method was tested instead. Additionally, two methods have been tested: the cold recycling method and the method of retaining metals in the soil using substrate. Immobilization method (Oprčkal et al., 2018, summary)

The implementation of the immobilization method is based on the mixing of contaminated soil with a suitable additive, whereby potentially dangerous elements with chemical and physical mechanisms turn into low mobile, poorly soluble and non-toxic chemicals. This prevents the transmission of heavy metals into the environment.

Scientific studies show that calcium paper ash from the paper industry is a suitable immobilizer additive. It consists of hydraulically active minerals that form new mineral phases when in contact with water, which leads to the formation of a bound matrix suitable for immobilization.

As part of this study, a sample of contaminated soil from the area of stara Cinkarna was first sieved, grains larger than 16 mm were crushed, and then the sample was homogenized. As an additive paper ash from VIPAP VIDEM KRŠKO, d.d. was used. A geotechnical composite was prepared from contaminated soil and paper ash in the ratio of dry weight 3: 1. A modified Proctor process according to SIST EN 13286-2: 2010 / AC was carried out to determine the optimum moisture content (19.3%) and the reference maximum dry composite density (1.54 Mg/m3).

Tests have shown that the average single-axis compressive strength of the test samples after 28 days of care is 2.5 ± 3 MPa. Lifting experiments with demineralized water have been carried out in accordance with SIST EN 1744-3: 2002. As, Ba, Cd, Cr, Cu, Hg, Mo, Ni, Pb, Sb, Se, Zn, sulfate, chloride and fluoride parameters, which were measured in the effluent, were below the limit values for inert waste from the Decree on Landfills (Official Gazette of the Republic of Slovenia, No. 36/16).

The composite must be arranged in layers along the required area. Each single layer must be trampled with a heavy roller to a reference density until a pile or embankment is made. An insulating layer of thickness up to 0.9 m must be made on top to prevent freezing of the composite. The remediation process may be carried out either in situ or ex situ.

The results of the study showed that the described method is effective for the remediation of contaminated soil from the stara Cinkarna area. The resulting composite is inert and is therefore suitable for the construction of dikes or pits for the purpose of remediation of this degraded area.

1. Cold recycling method (VOC Celje, vzdrževanje in obnova cest, d.o.o. in VOC Komunala, ravnanje z odpadnimi vodami d.o.o., 2018, summary)

The cold recycling method comprises bitumen-cement stabilization, upgraded with an asphalt layer and with green surfaces. It is an impermeable containment barrier, where the cold recycling process does not interfere with critically contaminated soil and requires relatively thin layer of the composite for the construction of a barrier (30-35 cm).

Polluted soil is thus isolated from the environment, pollutant dusting and the passage of surface (meteor) water through the contaminated soil and spread of the pollutants into the groundwater and into the water streams are prevented. The built-in barrier provides an

adequate load capacity for the road with a mean traffic load. Instead of the finished asphalt layer, it is possible to carry out green surfaces over the layer of bitumen-cement stabilization (impervious film, coverage with unpolluted soil, grass).

Cold recycling technology is environmentally friendly for the production of new quality carrier layers, thus eliminating the cost of excavation and consequently disposal of polluted soil and the cost of preparing and transporting new material.

2. Method of retaining metals in soil using a substrate (Rekič et al., 2018, summary)

The remediation method is based on preventing the transition of pollutants into humans and the environment through the greening of the area. To this end, the method of overlaying the contaminated soil with an active substrate, which is prepared from secondary raw materials: compost, mineral soil and zeolite minerals that bind heavy metals, has been tested. The first phase of the experiment was the development and testing of the method, while the second was the installation of a pilot display of remediation in the area of stara Cinkarna.

A pot experiment was carried out for the development of a substrate from a compost of green cut, unpolluted agricultural and forest soil, and zeolite materials that keep heavy metals in the soil and allow the urban landscape to be arranged in the degraded area. Several different substrates with different proportions of mineral and organic components were fabricated and tested. Variations of the substrates were analysed in terms of fertility, metal content in the substrate, metal content in test plants, the effectiveness of metal retention by the method of mixing the soil with clay and compost and depending on the usability of compost for the purposes of use on urban land for less risky types of land use with regard to human health (e.g. greenery of parking lots and other traffic surfaces, greening of other urban green areas).

Laboratory analyses of reference plant samples showed the heavy metal content below the limit of the criterion for the heavy metal content in foods (EC No 1881/2006). According to the results of the accumulation of heavy metals in the reference plants, mixtures of substrates are suitable for remediation of the stare Cinkarna area in ratios (zeolite: mineral component: organic component - 10:40:50 and 10:50:40). Although heavy metals are detected in plants, they are below the legal threshold, which means that such a mineral-organic substrate of one compost would be suitable for use in urban gardens.

A pilot experiment on land remediation at the stara Cinkarna site was also carried out. A geotextile has been laid at the bottom of the enclosed pilot area, which prevents mixing the lower contaminated soil with the piled clean material and also acts as a filter, thereby preventing and decreases ascendent flows and drains and protects the soil. Mineral-organic substrate was deposited on geotextile. For greening or the establishment of green landscaped area of the pilot area the park vegetation (lawns, trees and shrubs) was used.

These methods, in the light of the pilot tests, are shown to be acceptable from the point of view of preventing the spread of pollution, in particular from the point of view of preventing physical contact with contaminated soil and dusting and rinsing pollutants with meteoric water into groundwater.

The tested methods also have their limitations:

- The immobilization composite is frost sensitive and is not intended for large and/or dynamic loads;
- Cold recycling methods and the retention of heavy metals using the substrate do not solve the spread of contamination into groundwater due to the rinsing of pollutants from contaminated soil under the cover (organo-mineral substrate/ bitumen layer) to the groundwater during streaming and raising the level of groundwater and pollution of the river Voglajna when flooding occurs in the contaminated areas.

D.T3.3.4 Technical publication on possible remediation techniques for the treatment of contaminated soil with cost estimates

As part of the activity T3.3.4 a technical publication (a brochure) (DT334 Technical publication of study results) was prepared and printed in 250 copies describing tested remediation methods, including estimates of costs (see Annex 1).

D.T3.3.5 A Protocol for dealing with non-hazardous excavated soil

A protocol for the disposal of polluted but non-hazardous excavated soils in the FUA area and in the area of stara Cinkarna was prepared. The Protocol includes organizational and technical measures for the proper handling of these types of waste. A special emphasis was placed on the study of the possibility of using the pilot site as a landfill for contaminated land excavations since there is no such landfill in Slovenia. The possibilities, limitations, impacts and necessary measures for the establishment of such a landfill were presented.

D.T3.3.6 PP3 Report on Pilot Activities

A report summarizing the pilot activities was prepared by the project partner (CE394_GreenerSites_D.T3.3.6 PP3 PA report FINAL (002)).

Consultation and participatory process

To date, 9 consultations with relevant stakeholders and decision makers have been carried out within the project. The results of these meetings helped to shape the present Strategic Action Plan.

Results of meetings with stakeholders and events within the GreenerSites project:

1. Consultation in Celje 27.11.2017-

The scope of the meeting was to present the outline of the Action Plan (SAP),

Participants: MOC administrators, MOC decision makers (heads of departments and sectors), external experts in the field of soil

2. Consultation in Celje 18.12.2017

Topic: discussion of suitable techniques - checking the feasibility of thermal treatment, immobilization techniques, techniques of artificially prepared soil according to Slovenian legislation

Participants: MOC administrators by fields of work (planners, investment group, environment) and MOC decision makers (heads of departments), external experts in the field of rehabilitation techniques (ZAG, KIS)

3. First round table in Velenje: 15.5. 2018:

Topic: presentation of the results of pilot tests (methods) in the pilot zone of the stara Cinkarna (calcium ash method, cold recycling method, presentation of transfer of pollutants from soil to human), presentation of GIS tools and its use

Participants: Lecturers (ZAG, KIS, VOC), students of the College of Environmental Protection, MOC administrators

4. Second round table in Šentjur 21.5.2018

Topic: Presentation of the results of pilot tests (methods) of remediation in the pilot area of the stara Cinkarna (calcium ash method, cold recycling method, presentation of transfer of pollutants from soil to human), presentation of GIS tools and its use

Participants: Lecturers (ZAG, KIS, VOC), students and professors of the Šentjur School Center, higher professional school (agriculture and landscape), MOC administrators

5. Third round table in Celje 28.5. 2018

Topic: presentation of the brownfield area of the stara Cinkarna, the results of the geostatistical analysis of soil contamination, the impact of soil contamination on people with advice on safe gardening

Participants: representatives of the Faculty of Civil and Geodetic Engineering of the University of Ljubljana, lecturer of the Agricultural Institute of Slovenia, MOC administrators.

6. Additional round table in Celje 5.6.2018

Topic: presentation of the brownfield area of the stara Cinkarna, results of geostatistical analysis of soil contamination, the impact of soil contamination on people with advice on safe gardening

Participants: representatives of local communities and city districts, lecturer of the Agricultural Institute of Slovenia, MOC administrators

7. Local education (training) in Celje 15.6.2018

Topics: presentation of degraded area of stara Cinkarna, results of geostatistical analysis of soil contamination, presentation of the results of pilot experiments (methods) on stara Cinkarna area, spatial planning of pilot area of stara Cinkarna, presentation of the revision of the Environmental Protection Act focusing on the envisaged legal regulation for remediation of old environmental burdens approach and implementation of the process of remediation of the brownfield area,

Participants: lecturers - Pilot experiment operators (ZAG, KIS, VOC), urban planners MOC, representatives of the Ministry of the Environment and Spatial Planning, Faculty of Civil Engineering and Geodesy University of Ljubljana, administrators and decision makers of the MOC

8. Local education in Celje 23.10.2018 (DT 3.13.2)

Topics: presentation of brownfield area of stara Cinkarna, results of geostatistical analysis of soil contamination, presentation of results of pilot experiments (methods) on stara Cinkarna area, presentation of guidelines for SAP preparation, spatial planning of pilot area of stara Cinkarna,

presentation of remediation of old environmental burdens - example of remediation project of illegal dumping site Bukovžlak - 115, co Teharje

Participants: Lecturers - external project promoter, urban planners and GIS MOC service, representatives of the Ministry of the Environment and Spatial Planning, SAP preparation contractors, sectoral administrators and MOC decision makers, external planning companies.

9.Local consultation in Celje 17.1.2019

Topic: Presentation of the draft SAP, discussion and obtaining opinions on the appropriateness and feasibility of the planned measures and activities.

Participants: representatives of SAP preparation contractor, mayor and mayor's deputy, sector administrators and decision makers MOC.

Methodological approach to select actions

Approach used to select/design the actions that form an action plan is described below:

- All measures are based on the results of pilot activities (tested methods of remediation, soil and groundwater analysis, geostatistical analysis)
- One measure refers to the necessary activities for the remediation and re-urbanization of the stara Cinkarna (pilot area) as the most polluted area in the FUA area
- Reflection on variants of the remedial action of Stare Cinkarna was held within the MOC group (several meetings) and some experts (consultation on the Local Education in Celje on October 23, 2018, personal meetings of SAP preparers with individual experts for the remediation of contaminated soils –(B. Grabnar, Irgo d.o.o.)) - on the various uses of the soil and on various variants of soil remediation.
- Based on these consultations, it was found that:
    - that the political vision regarding the intended use of the soil exists, it is only necessary to realize it within the framework of known and legally defined spatial planning steps,
    - before the final decision on the choice of remediation method used in the stara Cinkarna area, it is reasonable to further explore the wider range of remediation methods on the basis of the data from literature and examples from practice and compare them in several aspects (feasibility, environmental and human health, social acceptability, costs),
    - further analyses of the site's pollution should be carried out for the exact definition and planning of appropriate methods and the course of remediation, and to check the suitability of selected remediation methods in the phase of detail spatial planning of the area,
    - it is necessary to encourage the Ministry of the Environment and Spatial Planning to prepare the Technical Guidelines for the Management of Contaminated Land, including how to examine, assess and manage the risks in such areas. Such

guidelines would help in cases of uncertainty as to whether the remedial action chosen is appropriate or how to proceed with remediation.

- The other two measures concern the issues of the wider FUA area:
    - On the basis of a detailed analysis of soil contamination issues in the FUA area and analyses and studies carried out on this topic, key needs were identified within the MOC project team regarding the upgrading of the GIS system, which mainly relate to the modernization and/or integration of existing data on soil an groundwater pollution, with appropriate attributes that will allow for better spatial planning. For this purpose, the results of soil monitoring and results of the geostatistical analysis were already included. Geostatistical analysis of Cd, Pb and Zn content in soil in the FUA MOC area was converted, processed, and interpreted by GIS tools. Transparent maps of soil contamination with heavy metals in the FUO MOC area by individual assemblies and by heavy metals have been prepared. The maps show airborne contamination with increased content of heavy metals and hot spot pollution caused by the transfer of materials (earths).
    - On a large area of the FUA, it is possible to anticipate excessive soil contamination with heavy metals that during construction activities (the excavation works) results in contaminated waste, for which appropriate management must be ensured. At the same time:
        - In-situ remediation in certain areas is difficult or unfeasible;
        - Registered collectors, processors and intermediaries of this type of waste do not have adequate storage capacities for large quantities of contaminated waste;
        - Export to the rest of the world is a great expense, especially in large quantities. The procedure for obtaining an export license can be lengthy, while temporarily deposited waste can present a serious problem;
        - The state plans to remediate contaminated playgrounds of kindergartens in the area of the FUA and in the preparatory acts imposes the the disposal of contaminated soils to the burden of the municipality.

      On this basis, the need is to establish a site for the collection, processing and possibly incorporation/landfilling of processed wastes. Location variants and waste recovery methods will be considered and evaluated within the spatial planning process and related environmental impact assessment procedures. The description of the measure includes some suggestions for the location of such a center.

Part A. Short Summary of actions

Action 1: Remediation and re-urbanization of the area of the stara Cinkarna area

Action Remediation and re-urbanization of the area of the stara Cinkarna area is intended to reduce the risk to the health of users of the area and inhabitants in the neighbourhood and to limit the spread of pollution to underground and surface waters. It is also intended to ensure sustainable new urban areas. The measure comprises all necessary steps: additional analyses and expert bases, temporary arrangement of the area, determination of suitable land use, preparation of expert bases for the detailed spatial plan, preparation and acceptance of the detailed spatial plan, planning and obtaining permits and approvals, implementation of remediation and re-urbanization and monitoring the success of remediation.

Action 2: Upgrading and publishing the GIS database of soil pollution in the FUA

The measure involves upgrading the existing internal GIS database with additional data on soil contamination and publishing data in the public web browser https://prostor.celje.si/. In the internal GIS database, some data on soil contamination have been collected: results of geostatistical analyses, results of soil contamination measurements at sampling sites in 1989 and 2016, results of measurements in kindergartens. The measure envisages the completion of the GIS database with the results of soil and groundwater pollution in the area of the stara Cinkarna and other new data related to pollution of soil and groundwater in the pilot area or in the FUA.

Action 3: Establishment of a center for the collection and treatment of contaminated terrestrial excavations and the disposal of stabilized waste

The measure is intended to solve the problem of ex-situ treatment and disposal of contaminated earth excavations from the FUA of the Municipality of Celje, where in-situ remediation is not possible or reasonable. The measure provides for the establishment of a collection and treatment center for contaminated terrestrial excavations and the disposal of processed and stabilized soil excavations. The measure covers activities from the search for a location for the establishment of a center, spatial planning, design, environmental impact assessment up to the implementation of the center and its operation.

Part B. Detailed description of concrete actions

Action 1 – Remediation and re-urbanization of the area of the stara Cinkarna area

Content of specific action

The measure is aimed at remediation and re-urbanization of the stara Cinkarna area (see map in Annex 2), which is an environmentally degraded area due to historical industrial use. From 1874 to 1990, the area was used by the metallurgical and chemical industry Cinkarna Celje. For several decades, the production of zinc ore and zinc smelting was carried out here. Parallel to the smelting, new industrial facilities were built in this area, which were intended to support basic production (Project ReSites, 2017), e.g. distillation and refinement of zinc, production of lithophone, electroplating, galvanizing, production of printing plates, production of building materials, production of growing substrates, sodium hydrosulphide and chromium galonium (Boson d.o.o., 2011).

In the area of stara Cinkarna there is also a historical illegal waste disposal site “halda rajmovke”, that lies between the railway line Celje - Maribor and Voglajna. All industrial waste from Cinkarna was deposited here until the closure of the landfill. Bottom ash which is known as "leš", was dominated. Solid wastes were deposited in bulk most likely without any spatial separation of the different types of waste. The tar was deposited in the tar pit by dug into the ground. The tar pits were later buried (Project ReSites, 2017). Precise locations of tar pit are not known, but a scent is present that recalls on them. In the past, the so-called "leš" was used as a fill material in the wider Celje area (Project ReSites, 2017).

Short problem description

Soil contamination

Soils in the area of stara Cinkarna are extremely heavily polluted with copper, zinc, cadmium and lead. Critical emission values are exceeded also by a factor 100. Some measured values exceed even the upper limit values for waste that can be deposited in hazardous waste landfills. In some cases, critical emission values are also exceeded for arsenic and chromium (ReSites project, 2017, Boson d.o.o., 2011 and Vogler, Leštan, 2009). Pollution with mineral oils and asbestos waste is also present (Grilc and Venturini, 2005). Barrels containing arsenic are supposed to be buried in the area (12 barrels, the exact location is not known; the information was not confirmed on the field, Uršič et al., 2007).

Pollution of groundwater

The potential for depletion of detected critical contaminants from the soil by precipitation and groundwater is high (Uršič et al., 2007). The report on the first chemical analyses of groundwater in the area of the stara Cinkarna from 2018 (Ratej, Krajnc, Narat et al., 2018) shows high level of groundwater pollution. The concentrations of zinc, arsenic, cadmium, barium, chromium, cis-

1,2-dichloroethene, trans-1,2-dichloroethene and phenanthrene are mainly raised. The values of the measured pollutants vary greatly according to the sampling point, which indicates a highly heterogeneous distribution of deposited metallurgical and other industrial waste in the area under consideration (Ratej, Krajnc, Narat et al., 2018). More detailed results of groundwater analyses are presented in chapter Introduction, Implemented pilot activities, D.T3.3.1 Detailed analysis of all pollutants in the pilot region and DT3 .3.3 Innovative monitoring system.

Surface water contamination

Depending on the level of groundwater contamination and the prevailing direction of groundwater, it could be concluded that the pollutants also pass into the surface waters of Voglajna and Hudinja, but the monitoring of the quality of the water body VT Hudinja Nova Cerkev - confluence with Voglajna (SI1688VT2) at the measuring point Celje in recent years shows no indications of excessive heavy metal contamination (ARSO, 2017 and 2018) (as opposed to the period 2002-2013, when exceeding of the limit values of certain heavy metals, especially zinc, was observed).

Regardless of the trend of reducing the pollution of the Hudinja watercourse with heavy metals, according to the results of some research (Šelih, 2016), the pollution of river sediments in Voglajna (after the confluence with Hudinja) occurs in the area of the stara Cinkarna. In particular, pollution with zinc (exceeded the critical values in the Decree on Limit, Warning and Critical Emission Values of Hazardous Substances in Soils, Official Gazette of RS, No. 68/96), lead and arsenic (exceeded the alert values) was observed. The measured values of copper were also increased (exceeded thresholds). The decrease in pollution levels is evident downstream, as shown by analysed samples at the confluence of the Savinja and Voglajna and even more downstream in Savinja). It is interesting that in Voglajna, along the stara Cinkarna, there is also a barium contamination, for which no limit values are defined in the Slovenian regulation, but the measured pollution concentration is significantly higher than Dutch intervention value (Dutch target and intervention Values, 2000).

No monitoring of water for the freshwater fish life is carried out on Voglajna and Hudinja, and publicly available data on the content of pollutants in aquatic organisms (fish) are also not available.

The risk to human health

The risk assessment for human health due to soil contamination in the area of the stara Cinkarna was not carried out. The risk of the transfer of potentially dangerous substances from the soil to the human organism is specific to the type of use of soil.

With regard to the actual use of soil in the area under consideration, most of the area is classified as built or related areas (13.9 ha) (predominantly in the S part of the area). 3.2 ha of land is classified as agricultural land in overgrazing, 1.9 ha is classified as untreated agricultural land, 1.5 ha is permanent meadow, 0.9 ha is water and 0.7 ha are trees and shrubs.

Depending on the actual use of the soil, it can be estimated that the greatest risk of transmission of pollution is associated with dusting and inhalation of contaminated dust particles. In this respect, the sources of dust are mainly unpaved and unprotected soils, which are mainly present in the north-eastern part area under consideration (uncultivated and unfinished built-up land) and in the southern part of the area (untreated agricultural land).

Polluted dust can be transmitted to the areas of nearby houses (north and northwest of the pilot area). Results of research on the pollution of road and house dust with heavy metals (Žibret and Šajn, 2013) show that the pilot area, including the nearby inhabited houses, is classified as an internal pollution zone, where the implementation of measures for the decrease of transfer of pollutants with dust into humans is very necessary.

Contaminated dust can also be deposited in several nearby gardens (located in the courtyards of residential houses north and northwest of the pilot area). Research on cadmium content in vegetables in the area of the Municipality of Celje (Karo Bešter, 2013) showed that soil contamination in gardens with cadmium, lead and zinc is most present in the city center and near the pilot area. Vegetables where the content of cadmium in edible parts of plants exceeds the regulatory threshold (Commission Regulation ..., 2006) can be an important contribution to the overall dietary exposure of cadmium.

Heavy metals can cross into the body of inhabitants through the dirty hands, which is especially characteristic of children (when playing on unfinished or non-scrubbed soil) and garden gardeners (during handling with of contaminated soil).

We have also checked the possibility of introducing pollutants from the area into people via contaminated water (due to abstractions). In the area under consideration, there is no drinking water coverage for the public water supply system or water protection areas for the capture of drinking water. According to the ARSO data, one water permit for collection of water from a well for other purposes (allowed to take up to 90 m3 a year) has been granted in the area of consideration.

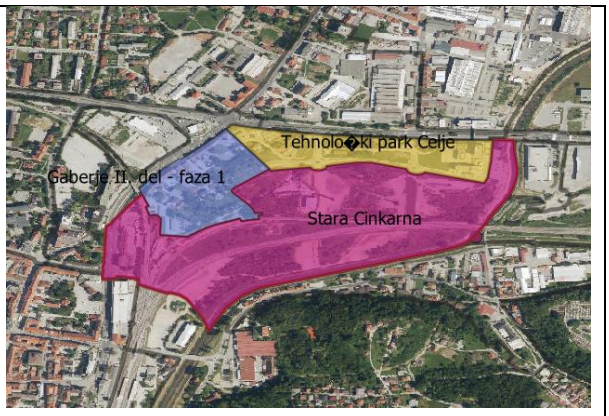
The possibility of transferring pollutants to humans is also through the consumption of fish from Voglajna and Hudinja, but data on the content of pollutants in fish in these two rivers is not available.

Foreseen land use

According to the current Celje Spatial Plan (Spatial Components of the Long-term Plan of the Municipality of Celje for the Period from 1986 to 2000 and the Spatial Components of the Medium-Term Social Plan of the Municipality of Celje for the Period from 1986 to 1990 for the Area of the Municipality of Celje (Official Gazette SRS, no. 40/86, 4/88, OJ RS No. 86/2001)), the area under consideration is classified as building land. According to the draft of the new municipal spatial plan, after its adoption, the area will be classified as a central activity (CD).

In the past, the detailed spatial plan (hereinafter referred to as OPPN) proposal for the Gaberje II area was prepared, which also included the pilot area of stara Cinkarna (the purple area on the picture on the right below). OPPN was not adopted but it is considered as a expert basis and a still valid political vision of spatial development of the area.

SHEMATIČNI PRIKAZ OBMOČJA Z MEJO OPPN IN OZNAKO KAREJEV



More detailed use of the area of the stara Cinkarna according to the OPPN proposal (areas 6, 7, 8 and B in the picture on the left above) is presented in the table below.

No. area	area	Predominant proposed use
6	area center	administrative regional, administrative local, tourist - hotel, cultural - library, business, commercial, residential, student dormitories, garage
7	area of the international university	educational center, cca. 3000 students, garage, railway station
8	area technology park	high tech companies, science park, university and business innovation center, university spin off, large companies spin off, research and development, laboratories
B	Area B	Phase 1: embankment, landfill for excavated soil Phase 2: business, service, recreational, museum, garage

Objective of specific action
The result of the measure will be remediation of soil and groundwater and re-urbanization of the area. The objectives of the measure are: • reducing the risk to the health of users of the area and inhabitants in the neighbourhood, • limitation of the dissemination of pollution to ground and surface waters, • sustainable provision of new urban areas. • ensuring the financial, environmental and technical feasibility of the selected remediation solution.
Partners involved and description of participation process
The measure will be implemented by the Municipality of Celje as the owner of the land with various subcontractors for individual activities and steps (to carry out analyses and expert bases, to temporarily arrange the area, to prepare spatial acts and environmental reports, to prepare a plan for remediation of soil and groundwater, to carry out remediation, to carry out works, to carry out monitoring). In the event that the state adopts the planned Environmental Protection Act, which will allow for the co-financing of the rehabilitation of old burdens by the state, part of the costs for remediation of the site can be covered by the state.
Planning of activities (timeline)
Short term (in two years): 1. Implementation of additional analyses and expert bases 2. Temporary arrangement of the site 3. Obtaining technical guidelines or guidelines on the required extent and type of remediation In the medium term (2-5 years) 4. Determination of suitable land use 5. Preparation of expert bases for detailed municipal spatial plan and preparation and acceptance of OPPN Long-term (5-10 years and over) 6. Designing and obtaining permits and approvals 7. Remediation and re-urbanization of the area 8. Monitoring the success of the area remediation

Financing		
Activities	**Financial scope**	**Resources**
1. Implementation of additional analyses and expert bases	30.000 EUR	MOC EU funds (Interrreg Central Europe)
2. Temporary arrangement of the site	0,40 EUR/m2 (greening with grass)	MOC
3. Obtaining technical guidelines or guidelines on the required extent and type of remediation	/	Ministry for environment and spatial planning as part of its regular operation
4. Determination of suitable land use	/	MOC as part of Municipal spatial plan proposal (hereinafter referred to as OPN)
5. Preparation of expert bases for OPPN and preparation and acceptance of OPPN	60.000 EUR (feasibility study) 30.000 EUR (additional geological and hydrogeological analyses, soil contamination analyses) 50.000 EUR (a plan for remediation of soil and groundwater) 30.000 EUR (OPPN preparation)	MOC
6. Designing and obtaining permits and approvals	5.000 EUR (risk analysis for groundwater) 50.000 EUR (preparation of project documentation for the implementation of remediation and construction of facilities) 15.000 EUR (EIA) 10.000 EUR (IED permit)	MOC, state resources (in case of adoption of a new environmental protection act)

	15.000 EUR (STS certificate for building product)	
7. Remediation and re-urbanization of the area	100 EUR/m^2 (immobilization with ash) 60 EUR/m^2 (cold recycling) 341 EUR/m^2 (organo-mineralni substrat) Sourceof data: an evaluation from a technical publication on pilot activities 140-230 EUR/ are ; 22-88 EUR/t (fitoremediation) 460 EUR/are (escavations and landfilling) 263-438 EUR/t (vitrification) 66-240 EUR/t (flushing) Vir: Khalid S. et al, 2017 in Matić, 2016 1 MIO EUR (investment in a vertical premeable membrane for groundwater purification *) Vir: Battelle Memorial Institute, 2012 Reurbanization - there is no estimate, depending on the design of the objects	MOC, state resources (in case of adoption of a new environmental protection act)
8. Monitoring the performance of area remediation	10.000 EUR/year (monitoring of groundwater quality)	MOC

	Additional costs for the maintenance of groundwater cleaning equipment (no estimates)	

*Example of investment costs for the construction of two barriers – one with length of 160 m and depth of 10-13 m and a second with length of 120 m and depth of 4-6 m

Progress of implementation

1. Execution of additional analyses and expert bases

Performing a historical analysis of archives with the aim of locating former industrial plants and activities and producing a problem map (as a basis for locating further geological and hydrogeological research and pollution of the PA).

Continue monitoring of groundwater pollution.

Measurements of chemical and ecological status of the river Voglajna (upstream and downstream).

2. Temporary arrangement of the site

Prevention of dusting (planting uncovered surfaces) must be ensured. Users of the site and potential visitors should be warned about the existing pollution, the related threats and the appropriate behaviour (information boards, informing the nearby inhabitants).

3. Acquisition of technical guidelines or guidelines on the required extent and type of remediation

Within this activity, information on the depth of soil remediation has to be obtained from government decision makers and expert (need of groundwater purification, acceptability of overlay methods, other requirements regarding the implementation of remediation and the necessary expert bases).

4. Determination of suitable land use

The Municipality of Celje is preparing a Municipal Spatial Plan (currently in the draft phase). The vision of the spatial development of the area under consideration is focused on the re-urbanization and expansion of the urban space for administrative, tourist, commercial, residential and educational purposes. When planning the land use of the pilot area n, the high level of pollution and the flood risk of the area along the Voglajna should be considered. Foreseen land use may change if it turns out that the currently proposed use (based on the existing expert basis) would require financially demanding modes of remediation.

As part of the preparation of the Municipal Spatial Plan, the guidelines for the detailed spatial plan for considered area (OPPN) has to be prepared, including the requirement to prepare the plan of the remediation of soil and groundwater in the area under consideration.

5. Preparation of professional bases for OPPN and preparation and acceptance of OPPN

a. Perform feasibility studies for soil and groundwater remediation

The feasibility study is carried out with a more detailed examination of the feasibility of remediation from a technological, economic, environmental and financial point of view and should include, in particular:

- a set of possible alternative remediation technologies (pilot tested and others) with defined performance locations,
- a plan for the implementation of activities within the framework of an individual alternative,
- analysis of technical and time feasibility, economic viability, environmental impacts and risk analysis for individual alternative remediation technologies,
- comparing technologies and proposing the most suitable alternative.

b. Execution of additional necessary geological and hydrogeological investigations and detailed analyses of soil and groundwater contamination on the basis of the constructed problem chart (result of step 1)

c. Preparation of the plan for remediation of soil and groundwater

In preparing the soil remediation plan, the results of the feasibility study (point 5a above) and the results of the remediation pilot tests of the GreenerSites project should be taken into consideration.

In the event that the feasibility study demonstrates that methods tested in the pilot area are feasible, the preparation of the rehabilitation plan shall take into account the suitability of each tested method of remediation with regard to the intended use of the soil, foreseen interventions and the degree of soil contamination:

- Recommended method of remediation in more polluted parts of the area and in the development of earth excavations (road and communal networks, facilities) - Immobilization method with paper ash (Oprčkal et al., 2018). The European Commission (2006) recognizes the method of immobilisation for the management of contaminated soil as BAT (best available technology).

Prior to the implementation of the remediation process, which according to the Waste Regulations (Official Gazette of the Republic of Slovenia, No. 69/15) represents the process of processing waste R5, for the processing at a specific location, the environmental permit for waste recovery should be obtained. If the processing capacity is over 10 t per day, environmental protection consent (environmental impact assessment) and environmental protection permit for the operation of the plant, which can cause large scale pollution, must be obtained. After the recovery process, excavated soil loses the waste status. In order to obtain and market the use of the obtained construction product (geotechnical composite), the Slovenian Technical Approval must be developed.

- Recommended method of remediation in less contaminated parts of the area and construction of hardened surfaces (roads, parking lots) and green areas where no excavations are needed - Cold recycling (Apotekar, 2018)

The cold recycling method is useful for the following arrangements:

• park arrangements for the greening of areas with grass or low flying plants that do not have deep roots,

• building land for recreational purposes, e.g. soccer stadium,

• building land for the purpose of parking spaces, installation of small mobile buildings, tents,

• building land for the purposes of a warehouse or conveyor belt, a logistics center.

- Recommended method of remediation in less contaminated areas and for human health of less risky type of soil use - Substrate for retention of heavy metals in soil (Rekič et al., 2018)

The remediation method is based on the preparation of a substrate from a compost of a green cut, unpolluted agricultural and forest soil, and zeolite materials that keep heavy metals in the soil and enable the regulation of the urban landscape in the degraded area.

- Remediation of groundwater

By the phase or at the latest in the preparation phase of the OPPN, an expert basis for the implementation of groundwater remediation must be provided. The aim of the expert basis is to provide an environmentally and socially acceptable and cost-effective solution to prevent the spread of pollution from contaminated soil into underground and surface water.

d. Preparation and adoption of OPPN

The OPPN shall be prepared taking into account all the implemented expert bases. The preparation of the OPPN in principle follows the existing vision of land use for the area (see Brief description of the problem, Foreseen Land Use). A spatial vision can change if it turns out that the currently proposed use would require financially demanding ways of remediation.

5. Designing and obtaining permits and approvals

It is reasonable to plan investments in the area under consideration (construction of facilities in accordance with OPPN) as comprehensive as possible, therefore the good cooperation between the MOC and other potential investors is crucial. It is also reasonable to plan transport and communal infrastructure as much as possible in parallel with the facilities and to carry out a preliminary procedure or an environmental impact assessment in accordance with the Regulation on Environmental Interventions for which an Environmental Impact Assessment (Official Gazette of the Republic of Slovenia, No. 51/14, 57/15 and 26/17) for a meaningful comprehensive intervention. In particular, it is important that the impact assessment is carried out for investments that will be co-financed from EU funds. In this way, the utility infrastructure characteristics will meet the needs of the foreseen facilities and activities, the project documentation will meet the requirements for co-financing from the EU funds, and the investors will not need to implement several EIAs for individual interventions.

If the area is planned to be remediated in phases, it is mandatory to include the implementation of groundwater remediation for the entire area of treatment in the first phase of planning the arrangements in the area under consideration (in accordance with the adopted remediation plan and OPPN). The main investor is MOC, in cooperation with the state and private investors, and with the help of EU funds.

Expected required activities:

• Risk analysis for groundwater contamination

• Preparation of project documentation for the implementation of remediation and construction of facilities

• EIA for the processing of hazardous waste and urban planning

• IED permit for the processing of hazardous waste

• Obtaining STS

• Acquiring water consent

6. **Remediation and re-urbanization of the area**

Soil remediation is carried out as part of the construction of interventions in accordance with the OPPN, the remediation plan and the project documentation. The institution and investor of the remediation is the investor of the facility (facility) that is being implemented.

7. Monitoring the success of the area remediation

Continue the continuous measurement of groundwater contamination. Periodic soil analysis to verify potential impact on soil contamination due to dust deposits from other contaminated parts of the municipality.

Challenges and risks:

• The vision of spatial development of the area has not yet been confirmed, the possibility of changing political support

• large area, high depth of pollution, heterogeneity of dikes and type of pollution, lack of more precise data on pollution

• social (non) acceptance of individual types of remediation,

• the limited and unreliable financial resources and the lack of EU and national resources, the risks associated with the success of obtaining EU funds,

• flooding of part of the area,

• legitimacy - lack of criteria and guidelines for remediation and the consequent unreliability of the admissibility of the measures applied to national authorities.

Action 2 – Upgrading and publishing the GIS database of soil pollution in the FUA

Content of specific action
Within the GreenerSites project, an internal GIS database of soil contamination in the FUA was established. In the internal GIS database, some data on soil contamination have already been collected: results of geostatistical analyses, results of soil contamination measurements at sample sites in 1989 and 2016, results of measurements in kindergartens. The MOC also has and maintains a public data viewer (https://prostor.celje.si/), which currently enables the public to review data on roadblocks, parking lots, green spaces, spatial plan, display of the state of the space and comments for better regulation of the city infrastructure.
Short problem description
A GIS database should be upgraded with additional available data on soil and groundwater pollution (e.g. data on soil and groundwater contamination in the area of the stara Cinkarna). A decision on the extent and method of presenting soil contamination data to the public in FUA should be made and the duly processed data should be included in the existing public data viewer.
Objective of specific action
The objective of the measure is to upgrade an internal GIS database with missing data on soil contamination in the FUA area with a view to making it more usable for employees within the MOC. The measure also aims to publicize data on soil contamination and on measures to reduce the burden on the inhabitants with heavy metals with the objective to inform and raising public awareness on this issue.
Partners involved and description of participation process
Action leader would be Municipality of Celje (Department of GIS). In the upgrading of the GIS database, it will cooperate with subcontractors who obtained data (KIS, IRGO,…). When deciding on the nature and form of public release of soil pollution data, consultations will also be held with representatives of local communities and urban districts.

Planning of activities (timeline)

Short-term (2 years):

1. Incorporation of new data on soil contamination in the FUA into the internal GIS database (e.g. data on soil and groundwater pollution in the area of the stara Cinkarna area), inclusion of description of measures to reduce transfer of heavy metals into inhabitants due to gardening and other activities)

2. Preparation of soil contamination data for inclusion in the public viewer

Conducting a consultation on the scope and method of presented data with representatives of local communities and urban districts.

In the medium and long term:

3. Maintenance of the GIS database (internal and public)

Financing

Activities	Financial scope	Resources
1. Incorporation of the missing data on soil contamination in the FUA into the internal GIS database	10.000 EUR/year	MOC, EU funds (Interrreg Central Europe)
2. Preparation of soil contamination data for inclusion in the public viewer	5.000 EUR/year	MOC, EU funds (Interrreg Central Europe)
3. Maintenance of the GIS database (internal and public)	5.000 EUR/year	MOC

Progress of implementation

1. Inclusion of missing soil contamination data in the FUA into an internal GIS database

Data on soil and groundwater pollution in the stara Cinkarna area and description of measures to reduce the transfer of heavy metals into inhabitants due to gardening and other activities should be included in the existing internal GIS database. The GIS database is regularly updated with newly acquired data.

2. Preparation of soil contamination data for inclusion in the public viewer

Within the MOC administration and after consultation with representatives of local communities and town districts, a decision on the types and form of data on soil contamination in the FUA area of the public viewer is taken. Due to the societal sensitivity of the problem, it is necessary

to pay great attention to this. MOC advocates the case of a greater openness of the GIS database (direct publication of pollution results), however the publication of all available data must be accompanied by appropriate interpretation and with an overview of the measures envisaged to solve the problems. In the public viewer, instructions should also be included on measures that can be taken by individuals themselves to reduce exposure to pollution.

3. Maintenance of the GIS database (internal and public)

In the long term, the maintenance of the internal database and public viewer should be ensured and their adaptation (for example, legislative changes, measures implemented, adding new available pollution data).

Challenges and risks

The challenges and risks associated with the publication of soil contamination data are linked to the social aspect and the sensitivity of the problem due to its impact on human health and the legitimate public concern associated with it. There is a risk that data may be used as a mean of non-constructive political clashes in the event of inadequate interpretation. The planned measure addresses these challenges as it requires an adequate interpretation of the data, inclusion of an overview of the measures envisaged for solving the problem, the publication of instructions on the measures that citizens can carry out themselves to reduce the exposure to pollution and the coordination of the content of the measure with stakeholders (representatives of local communities and town districts).

The challenge is also related with needed long- term engagement of MOC for providing supplements and maintenance of the internal and public database.

Action 3 – Establishment of a center for the collection and treatment of contaminated soil excavations and the disposal of stabilized soil excavations

Content of specific action
According to the results of analyses of soil contamination and geostatistical analyses, there is a high level of soil contamination in the area of the FUA, especially in the vicinity of the area of the stara Cinkarna and the city centre in the East-West direction, as well as in certain other parts of the municipality (i.e. hot spots). In the case of construction and other interventions in the soil, a polluted soil excavation is created, which represents a polluted waste. Due to high costs of exporting such waste and insufficient capacities of existing collectors or processors, and at the same time limited possibilities for processing on-site, the location of the landfill or waste management center should be provided. At the same time, the state plans to remediate contaminated playgrounds of kindergartens in the area of the FUA and imposes the responsibility for the disposal of contaminated soils to the municipality. Due to all this, there is a growing need for the establishment of a collection, treatment and disposal centre for contaminated soil excavations (hereinafter referred to as management center for the contaminated soil excavations).
Short problem description
In the process of setting up a management center for the contaminated soil excavations, it is first necessary to find the appropriate location. Two options that are worth exploring are: a) the establishment of a center and a special disposal area for processed and stabilized soil excavations within existing Regional Waste Management Center Celje b) the establishment of a center in the area of abandoned mineral mining (clay, stone); performing remediation of dugouts using artificially prepared soil. Further steps are taken depending on the selected location and the method of disposing of processed soils., As part of the preparation of the OPN, the appropriate land use is determined for the location and the preparation of the OPPN is foreseen, if necessary. The envisaged arrangements are also assessed within the framework of a strategic environmental assessment. At the stage of more detailed planning of the center, appropriate environmental protection approvals (EIA, OVD) must be obtained.
Objective of specific action
The aim of the measure is to provide legally, environmentally and socially acceptable and cost-effective ex-situ solution for the collection, processing and disposal of processed contaminated soil excavations that cannot be processed at the site of origin and in this way facilitate and accelerate the implementation of construction works and soil remediation on contaminated parts of the FUA.

Partners involved and description of participation process
The implementation of the measure is conducted by the Municipality of Celje. In the event of a location in the RCERO area, Simbio d.o.o. (public waste management company) will be involved. For individual activities within the measure, MOC hires relevant subcontractors.

Planning of activities (timeline)
Short-term (up to 2 years) 1. Determination of the location of the management center for contaminated soil excavations. In the medium term (2-5 years) 2. Purchase of land (in case it is not owned by MOC) 3. Determination of appropriate land use and implementation of the SEA 4. Preparation of OPPN Long-term (5-10 years and over) 5. Design, EIA and acquisition of IED permit 6. Establishment and operation of the center

Financing

Activities	Financial scope	Resources
1. Determination of the location of the management center for contaminated soil excavations	10-15.000 EUR	MOC, EU funds (Interrreg Central Europe)
2. Purchase of land (in case it is not owned by MOC)	Not available, depending on the location	MOC
3. Determination of appropriate land use and implementation of the SEA	/	MOC v okviru priprave OPN
4. OPPN Preparation	30-50.000 EUR	MOC
5. Designing, EIA and acquisition of IED permit	100 - 200.000 EUR	MOC
6. Establishment and operation of the center	Not available, depending on the expected capacity and method of processing and chosen contractor	MOC, Simbio d.o.o. in the case of a RCERO site; in other cases, in cooperation with external contractors

Progress of implementation
1. Determination of the location of the management center for the contaminated soil excavations. A study of variants will be carried out in which potential locations of the management center for the contaminated soil excavations will be recorded. Locations will be compared and assessed from an economic, technical, social and environmental point of view. For the two best-rated variants, all the necessary planning and implementation steps will be foreseen and described. The best rated variant will be proposed for implementation. 2. Determination of appropriate land use and implementation of the SEA In the event that the selected variant of the site does not yet have adequate land use, the proposed land use change will be proposed during the preparation of the OPN for the proposed variant. The environmental acceptability of the location for the center will be checked during the SEA for the OPN. In the case of spatial placement of the landfill, the provisions of the landfill regulations concerning spatial planning of landfills should be taken into account. 3. Preparation of OPPN Preparation of expert bases for OPPN for the establishment of a management center for contaminated soil excavations. Depending on the sensitivity of the location, scope and level of consideration of the site within the SEA for OPN, it is also possible to expect that SEA can be requested also in the framework of the preparation of the OPPN. In the preparation phase of the OPPN, the conceptual design of the center and the technical bases will be provided: geotechnical, geological, hydrogeological and chemical analyses, remediation plan in the case of abandoned mines, etc. The extent and types of research required will depend on the type of location and the extent and type of envisaged arrangements foreseen in the OPPN. When designing a center, the starting points defined in D.T3.3.5. Protocol on the Management of Non-hazardous soil excavation should be considered. 4. Designing, EIA and acquisition of OVD The design plan of center will be prepared and the implementation of the EIA will be needed in the case of exceeding the thresholds in the regulation on the types of interventions for which the EIA must be carried out. An environmental permit must be obtained for the operation of the landfill / facility for waste treatment. At this stage, a precise waste management plan preparation is of crucial importance. When designing a landfill, the requirements of the landfill regulations must be respected. In case of the remediation of mineral dugouts, the requirements of the regulation on the introduction of waste into the soil and other regulations in the field of waste management should be considered. It is necessary to provide the use of best available techniques. On the basis of the application and complete documentation, a building permit will be obtained. 5. Establishment and operation of the center The construction of a center will be carried out in accordance with the building permit. A valid operational license will be obtained. Operational monitoring of emissions into the environment

should be carried out during operation as it will be foreseen in in the building permit and the EIA. It is necessary to ensure monitoring and keeping records of all waste streams on the center.

Challenges and risks:

- difficulties in determining the appropriate location of the center due to spatial, environmental, technical and traffic restrictions,
- possible challenges in acquiring land (interest for sale, financial volume),
- the complexity of obtaining licenses,
- social acceptability in spatial planning and operation - NIMBY effect,
- financial constraints.

References and annexes

Here below you can find a list of additional material developed within the GreenerSites project, plus relevant external bibliography, related to the concerned Pilot Site(s) and/or connected to the proposed Action Plan.

Web links relate to the date of consultation.

Project deliverables and material

Deliverable D.T1.2.1- Analysis of the status of degraded areas in the functional urban area of the Municipality of Celje, 2017

Deliverable D.T. 3.3.3 - Ratej, J., Krajnc, T., Narat, D., Pečolar, T. Narat, J., Report on the implementation of piezometers and the first chemical analyzes of groundwater in the area of the stara Cinkarna Celje, IRGO Consulting d.o.o., Ljubljana 2018

Deliverable D.T. 3.3.1 - Ratej , J., Krajnc, T., Kocjančič, M., Report on the monitoring of the quantitative and chemical status of groundwater in the area of stara Cinkarna Celje, IRGO Consulting d.o.o., Ljubljana 2018

Deliverable D.T. 3.3.1 - Rekič, K., Bergant, J., Vrščaj, B., Geostatistic assessment of soil contamination in the Municipality of Celje, Ljubljana, September 2018

Rezultat D.T. 3.3.2 - Oprčkal, P., Mladenovič, A., Legat, A., Report no. P 254 / 18-420-1 on the implementation of an attempt to remedy the soil from the stara Cinkarna area with the immobilization method, ZAG, Material Department, Laboratory for stone, aggregate and recycled materials

Rezultat D.T. 3.3.2 - Apotekar, U., An attempt to remediate contaminated soil in the pilot area "stara Cinkarna - Cold recycling method, Final report - PID, VOC Celje d.o.o., 28.5.2018

Rezultat D.T. 3.3.2 - Rekič, K., Šinkovec, M., Vrščaj, B., Pot experiment with substrate of compost and mineral soil and development of methodology for establishing a pilot display of soil remediation in the stara Cinkarna area, Agricultural Institute of Slovenia, Final report, October 2018

Rezultat D.T. 3.3.5 - Grabner, B., Protocol for handling with contaminated excavations in the area of the stara Cinkarna and in the FUA area, 2018

External bibliography and links

Voglar, G. E., Leštan, Domen, Solidification / stabilization with cement as a method of remediation of contaminated soil in the area of the stara Cinkarna, Report on the results of the project, February 2009Boson d.o.o., Environmental Report for the Municipal Detailed Spatial Plan for the City Center Gaberje II. Del, March 2011

Grilc, V., Venturini, S., Geotechnical Report and Chemical Analysis Report, Chemical Institute Ljubljana and INI doo, October 2005

Uršič, A., Uršič, S., Gobec, M., Grcić, E., Expert bases for the rehabilitation of the stara Cinkarna area, Environmental risk assessment, ZZV Celje, February 2007

ARSO, 2017, Assessment of the status of watercourses in 2017 - chemical parameters

http://www.arso.gov.si/vode/reke/publikacije%20in%20poro%c4%8dila/Ocena%20stanja%20vodotokov%20v%20letu%202017%20-%20kemijski%20parametri.pdf

ARSO, 2018, Data on water quality, Rivers - data display for 2018http://www.arso.gov.si/vode/podatki/arhiv/kakovost_arhiv2018.html

Žibret, G., Šajn, R., The content of metals in house, attic and road dust in the Celje area and a proposal for measures to improve the situation. Monography: Environmental pollution and natural resources as the limiting factor of development in Slovenia - Celje basin as a model approach for degraded areas, edited by Grabner, B., Ribarič Lesnik, C., p. 58-73. Celje, 2013Eržen, I., Zaletel Kragelj, L., Overview of the health conditions in the Celje basin in connection with the excessive soil contamination. Monography: Environmental pollution and natural resources as the limiting factor of development in Slovenia - Celje basin as a model approach for degraded areas, edited by Grabner, B., Ribarič Lesnik, C., p. 58-73. Celje, 2013

ARSO, 2018, Data on water quality, Rivers - data display for 2018

ARSO, 2017, Ocena kemijskega stanja podzemnih voda za leto 2017, xls preglednica

ARSO, 2017, Kakovost zraka v Sloveniji v letu 2016

http://www.arso.gov.si/zrak/kakovost%20zraka/poro%c4%8dila%20in%20publikacije/Porocilo_2016.pdf

Khalid, S., Shahid,M., Niazi, N.K., Murtaza, B., Bibi, I. et al.. A comparison of technologies for remediation of heavy metal contaminated soils. Journal of Geochemical Exploration, Elsevier, 2016, 182, pp.247 - 268. <10.1016/j.gexplo.2016.11.021>. <hal-01577861v2>

https://www.sciencedirect.com/science/article/pii/S0375674216303818

Hashim, M.A., Mukhopadhyay, S., Sahu, J.N., Sengupta, B., Remediation technologies for heavy metal contaminated groundwater, Journa of Environmental management 92 (2011) 2355-2388, june 2011

Nacionalni inštitut za javno zdravje (NIJZ), Priporočila za izvajanje gradbenih del pri rokovanju z onesnaženim materialom, april 2018

Vrščaj, B., Bergant, J., Kralj, T., Karo Bešter, P., Seifert, A., Šinkovec, M. 2015. Ukrepi za remediacijo onesnaženih tal na vrtovih in območjih vrtičkarstva in ukrepi za zmanjšanje

prehoda težkih kovin iz tal vrtov v vrtnine v Mestni občini Celje. Končno poročilo. Ljubljana, Slovenija, Kmetijski inštitut Slovenije, Oddelek za kmetijsko ekologijo in naravne vire, Center za tla in okolje.

Grčman, H., Zupan, M., 2018. Strokovno svetovanje, izdelava strokovnih izhodišč pri pripravi projektne dokumentacije za izvedbo sanacije igrišča vrtca in izvajanje terenskih meritev v vrtcih Mestne občine Celje v letu 2018, Univerza v Ljubljani, Biotehniška fakulteta, Oddelek za agronomijo, Infrastrukturni center za pedologijo in varstvo okolja

MOC, 2018. Tabela Vrtci Celje – zbirne vrednosti meritev tal.

Lampič, B., Cigale, D, Kušar, S., Potočnik Slavič, I., Foški, M., Zavodnik Lamovšek, A., Barborič, B., Meža, S., Radovan, D., 2017. Celovita metodologija za popis in analizo degradiranih območij, izvedba pilotnega popisa in vzpostavitev ažurnega registra, FF, FGG in Geodetski inštitut, Ljubljana.

Ministrstvo za okolje in prostor, Medijsko središče, Novica, 2014. Ministrstvo za okolje in prostor o problematiki onesnaženja v Celju.

http://www.mop.gov.si/si/medijsko_sredisce/novica/5779/

European Comission, Press release database, 2014. Okolje: Evropska komisija toži Slovenijo zaradi onesnaževanja, ki izvira iz odlagališč odpadkov

http://europa.eu/rapid/press-release_IP-14-51_sl.htm

VO-KA Celje, 2018, Poročilo o izvajanju oskrbe s pitno vodo ter odvajanju in čiščenju odpadne vode v letu 2017

http://www.vo-ka-celje.si/cache/documents/56c5d36c9394aa857ae0f69a/Porocilo_o_izvajanju_oskrbe_s_pitno_vodo_ter_odvajanju_in_ciscenju_odpadne_vode_v_letu_2017.pdf

Vsebnost težkih kovin v tleh, Kmetijski inštitut Slovenije, 2018

http://www.kis.si/f/img/File/OKENV/PDF/Preglednica.VsebnostTKvTleh.ukrepi.pdf

CDM Smith, 2017, Povzetek okoljskega poročila za lokacije Cinkarna Celje, Za Travnik, Bukovžlak

http://www.cinkarna.si/si/files/default/objave_si/leto2017/Povzetek%20okoljskega%20poro%c4%8dila%20CDM%20Smith%20za%20lokacije%20Cinkarna%20Celje,%20Za%20Travnik,%20Bukov%c5%belak.pdf

Matić, H., 2016. Pregled sanacije tal v zgornji Mežiški dolini, Diplomsko delo, Visoka šola za varstvo okolja Velenje

http://webcache.googleusercontent.com/search?q=cache:8hGWUwHWPs8J:www.vsvo.si/images/pdf/2016093027_346-2016.pdf+&cd=6&hl=sl&ct=clnk&gl=si&client=firefox-b

Battelle Memorial Institute, 2012. Permeable reactive barrier cost and performance report, Final technical report, TR-NAVFAC-ESC-EV-1207

https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=9&cad=rja&uact=8&ved=2ahUKEwjwgPGB35fgAhXPxYUKHY8sDecQFjAIegQIAhAC&url=https%3A%2F%2Fclu-in.org%2Fdownload%2Ftechfocus%2Fprb%2FPRB-tr-navfac-esc-ev-1207-c%26p-2012.pdf&usg=AOvVaw1neUDNG68sbY9iudY8aV2a

Web links

More information on the concerned area and/or on the proposed Action(s) can be found in the following web links:

- https://prostor.celje.si/ - The spatial portal of the Municipality of Celje is a collection of interactive maps with specific themes.

Annexes

Annex 1: Brochure Results of tested remediation methods for the contaminated area in the pilot area of the stara Cinkarna

Annex 2: Map with the display of the pilot area, M1: 10,000