



D.T2.8.1
Pilot action FUA Ljubljana - Ig

Summary 1
03 2017



A. FUNCTIONAL URBAN AREA (FUA) LJUBLJANA - IG

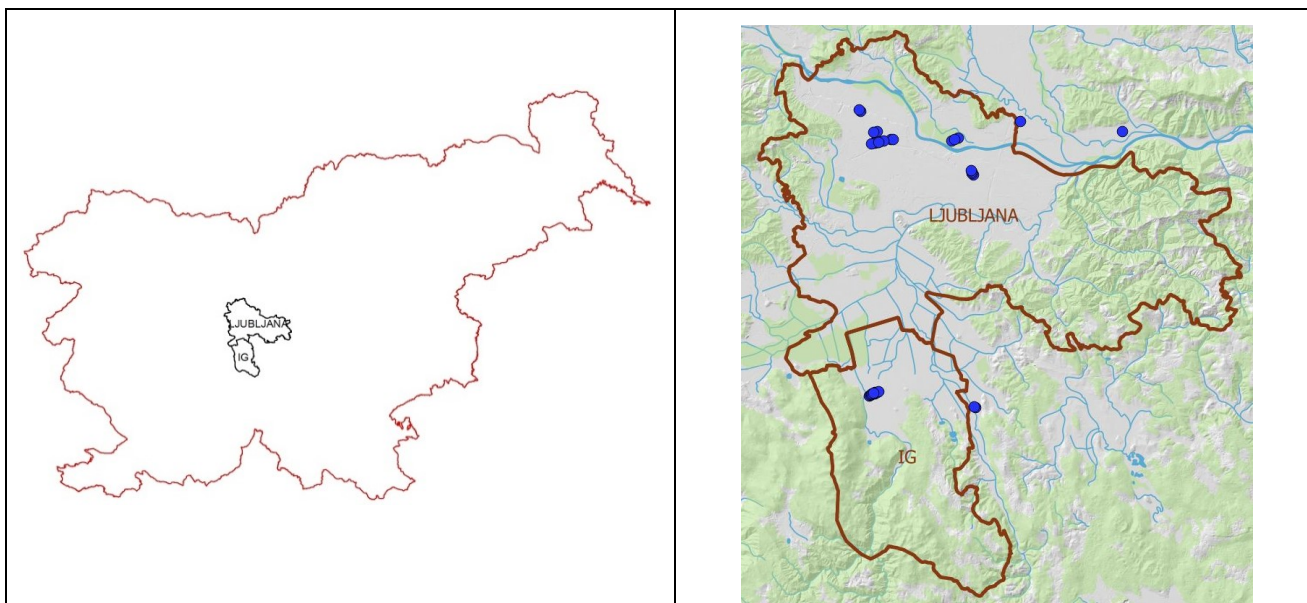


Figure 1. Location of Municipality of Ig and Municipality of Ljubljana City in central Slovenia (Osrednjeslovenska region).


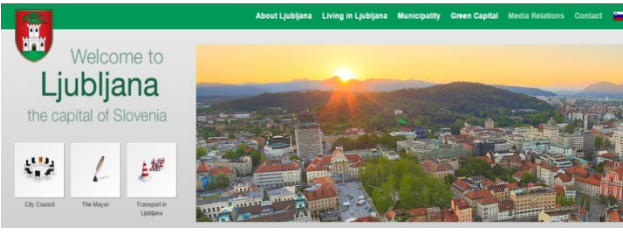
Municipality of Ig	Municipality of Ljubljana City
99 km ² area 25 villages 2,262 house numbers 7,135 inhabitants 8.6 % unemployment 1,380 € gross salary per employee 335 kg communal waste per inhabitant	275 km ² area 38 settlements 40,135 house numbers 288,307 inhabitants 12.6 % unemployment 1,800 € gross salary per employee 498 kg communal waste per inhabitant
	
http://www.obcina-ig.si/	http://www.ljubljana.si/en/
Year 2015, http://www.stat.si/	

Figure 2. A short presentation on Municipalities of Ig and Ljubljana City.



Functional urban area

Functional urban area (FUA) Ljubljana - Ig consists of suburban hinterland in **Municipality of Ig** and core city area in the **Municipality of Ljubljana City**. They depend among themselves from the social, environmental and financial point of view. However, the interdependence among both parts of FUA is clearly demonstrated by connection to the same drinking water supply system and to the same groundwater natural system.

Groundwater resources are protected by Water protection area, extending from the hinterland in Municipality of Ig to the core city in Municipality of Ljubljana City. In this area, there are 47 water wells in public water supply (3,300 m³/h), 5 wells for beverage industry, 13 wells for industry and tourism, and more than 330 individual wells for heat pumps systems, irrigation and other uses.

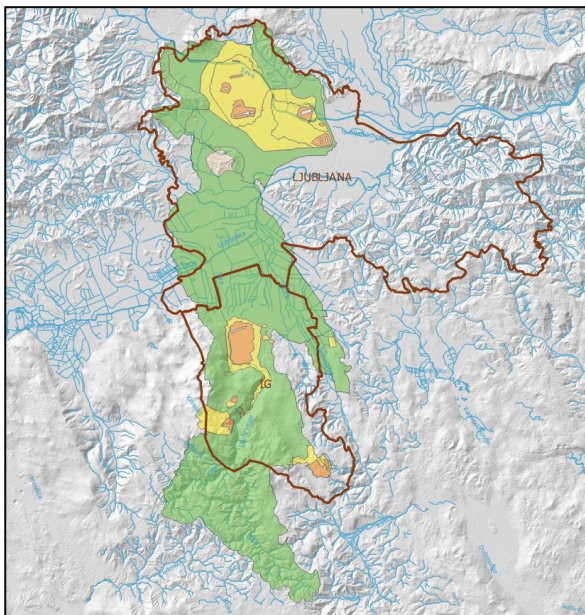


Figure 3 Municipality of Ljubljana City and Municipality of IG. FUA - drinking water protection areas. (GIS tool: QGis).

Core problem and aim of the project

Chemical substances of various anthropogenic sources, on different levels of concentration, have been proven to be presented in groundwater that is the source of drinking water. There are four significant contamination sources on which the AMIIGA project activities will focus. In the hinterland of area, there are contamination plumes from past unappropriated use of pesticides and nitrates in agriculture and from municipal landfill of non-dangerous waste. In the core city there are contamination sources from the industrial part of the city and from sewage system losses.

The aim of implementation of pilot action in Ljubljana is to establish the remediation and other measures that will effectively and efficiently preserve and improve the quality of the groundwater, in order to enable long-term abstracting for drinking water supply and other purposes without treatment processes in the next decades.



Working area

Different contaminations and pollutions were detected in Ljubljana functional area in last two decades (1999 - 2016). Some dispersed contaminations are constantly present, i.e. nitrate (NO₃), atrazine (AT), and desethylatrazine (DAT), trichloroethene (TCE), tetrachloroethene (PCE) and chromium VI (Cr6). Beside these contaminations some occasional or repeated pollutions have been detected in this period (Auersperger, 2017): 2,6-dichlorobenzamide (BAM) and metolachlor (MET), trichloroethene (TCE), repeated contaminations with metazachlor (METZ), benzene, toluene, and increasing dispersed contamination by benzotriazoles and benzensulfonamides.

Continual contaminations and pollutions problems are originating from old contamination sources. These problems are threatening long term safety of water supply, burdening the groundwater protection and management funds and limiting progressive improvement of drinking water quality. Four of those contamination sources that are the most important and that have to be remediated for a functional urban area of Ljubljana - Ig have been selected.

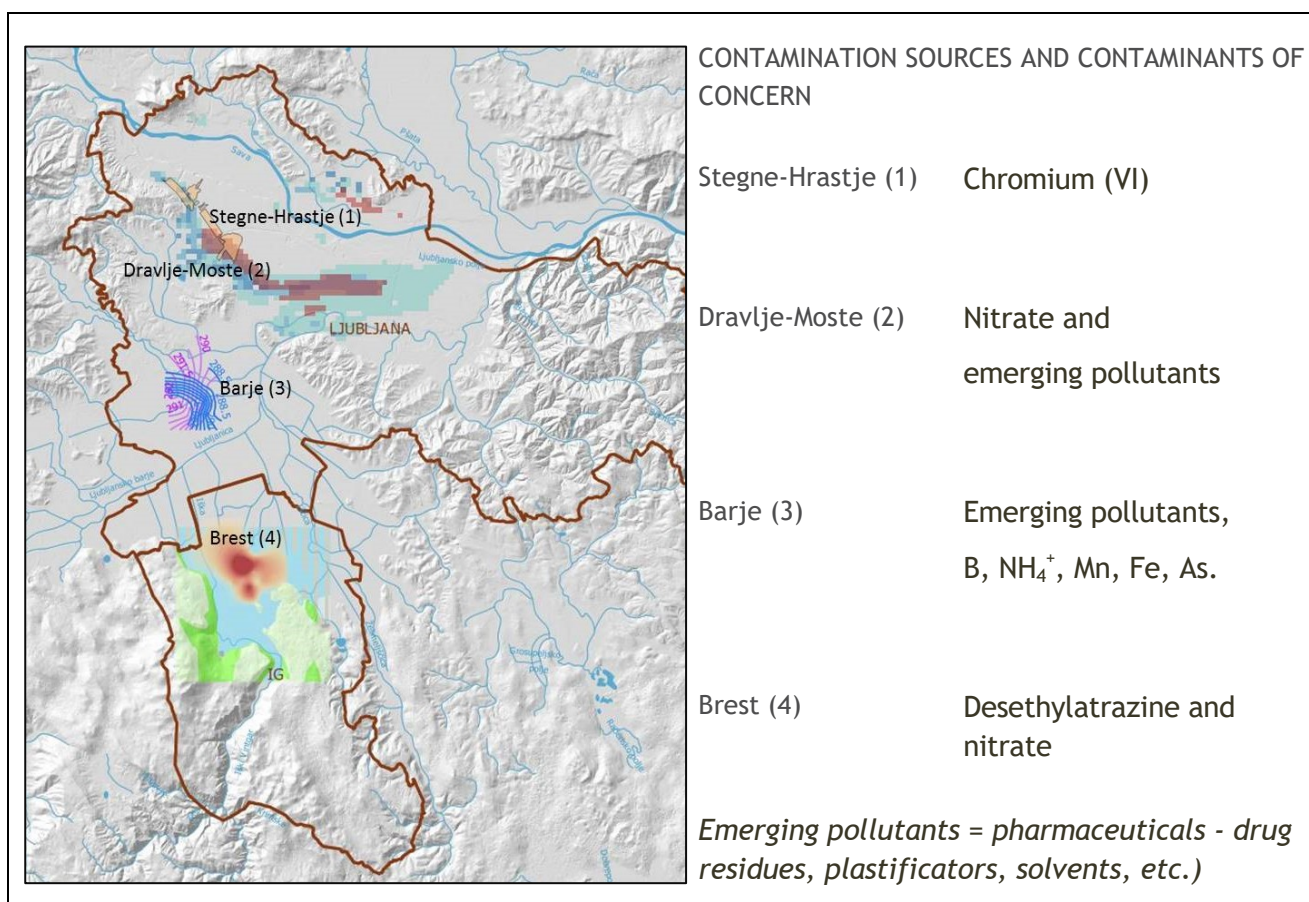


Figure 4 Four contamination sources: Stegne-Hrastje (1) industrial sources, Dravlje-Moste (2) sewage contamination source, Barje (3) municipal landfill, Brest (4) agricultural contamination source. (GIS tool: QGis).



Receptor of significant contaminants is a groundwater which is abstracted by wells and distributed also to public water supply. It is protected by Water protection areas and also by Natura 2000 whereas groundwater constitute habitat in groundwater dependent ecosystems on Ljubljansko barje. There are some specific concerns that will be set out and for which targets will be define in the frame AMIIGA project for the management plan. They are actually presented in Table 1 as a starting point for further reconciliation. They will be thoroughly reconsidered within further common activities of overall AMIIGA project, activities of WP2, and local project activities.

Table 1. Receptors and specific subjects in protection of groundwater.

Name and identification	Subject of protection	Specific concern/target for AMIIGA
<i>Groundwater in alluvial aquifer of Ljubljansko polje</i>	<i>Drinking water catchment area Water protection area “WPA” of Ljubljansko polje Hrastje well field</i>	<i>Remediation concept for prevention of Cr (VI) concentration levels: below < 50 µg/L in plumes below < 10 µg/L in water wells</i>
<i>Groundwater in alluvial aquifer of Ljubljansko polje</i>	<i>Drinking water catchment area Water protection area “WPA” of Ljubljansko polje Hrastje well field</i>	<i>Remediation concept for nitrate concentration levels: below < 25 µg/L on hot spots (outliers) below < 18 µg/L in groundwater body and abstraction wells</i>
<i>Groundwater in alluvial aquifers of Ljubljansko barje: First gravel layer “ppp” Upper aquifer “zv”</i>	<i>Drinking water catchment area Water protection area “WPA” of Ljubljansko polje</i>	<i>Remediation concept to control natural attenuation capacities and prevent progress of contamination from B, NH₄⁺, Fe, Mn, As and emerging pollutants (pharmaceuticals - drug residues, plastificators, solvents, etc.) from the landfil</i>
<i>Groundwater of Ljubljansko barje aquifers: Iška alluvial fan aquifers: “Iška-zg” and “Iška-sp” Carbonate (dolomite/limestone) aquifer in the basement of Iška alluvial fan aquifers</i>	<i>Well field Brest Water protection area “WPA” of Ljubljansko barje Springs (ecosystems Natura 2000)</i>	<i>Remediation concept for desethylatrazine (DAT): Preventing to draw DAT contamination plume to abstraction wells Progressive weakening of DAT contamination plume Enabling use of groundwater from dolomitic aquifer and VD Brest-3a well</i>



Management plan for four contamination sources in Ljubljana - Ig FUA will be prepared in three main steps: Framework and background for the management plan, Draft management plan, and Final reconciliation of management plan. Setting up efficient, acceptable and feasible measures requires a definition of reliable targets, target values and milestones. In order to accomplish these tasks, the following activities are foreseen:

- Advanced conceptual models for four contamination sources, based on:
 - Detailed status assessment of four contamination sources (urbanization-industry-landfill-agriculture), actualized by data from monitoring period 2011-2016, and by results of additional sampling campaign.
 - Detailed mass balance of contaminants for actual status and comparison with the development and changes in last six years period.
 - Trend analysis of time series data - statistical and environmental trends and forecasts. Specific evaluation and forecasts will be presented for low concentration contaminants, especially for new emerging compounds.
 - Assessment of natural attenuation capacities, focusing on chemical redox and microbiological degradation on landfill site. Assessment of the effect of dilution, adsorption and dispersion on urban, agriculture and industrial site.
 - GIS database layers will be designed to support management planning.
- The risk assessment from water supply safety perspective, focused to improvement of Water Safety Plan and water protection measures:
 - Numerical hydrogeological transport and surface-groundwater interactions model will be updated.
 - Scenarios, that could the most endanger drinking water supply, will be modelled.
- Feasibility study of measures (remedial, mitigation, monitoring), which will be selected within pre-investment analysis of 12 measures for four significant different pollution sources:
 - active and continuous identification and remediation of point contamination sources in the industrial site Stegne - Hrastje
 - progressive decrement of nitrate on outlying concentration sites in the area of sewage system losses plume in Dravlje - Moste area; control of emerging pollutants;
 - natural attenuation monitoring at municipal landfill Barje; establishment of points of compliance on the southern area of city towards passage of groundwater flow from Ljubljansko barje to Ljubljansko polje;
 - adaptation of pumping regime in Brest waterworks, preventing to draw DAT contamination plume to abstraction wells, progressive weakening of DAT



contamination plume, and enabling use of groundwater from dolomitic aquifer and VD Brest-3a well.

- Development of Groundwater management plan for four contamination sources in Ljubljana - Ig FUA.