



Republic of Serbia

Ministry of Environmental Protection

**Serbian Environmental Protection Agency**



## ENHANCING MANAGEMENT OF CONTAMINATED SITES USING ENVIRONMENTAL MONITORING DATA AND PRELIMINARY RISK ASSESSMENT METHODOLOGY IN SERBIA

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# Land and Soil Resources in Legislative Context

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- Law on Environmental Protection (2004);
- Law on Soil Protection (2015);
- Regulation on systematic monitoring of the condition and quality of soil (2020);
- Regulation on limit values of polluting, harmful and dangerous substances in soil (2019);
- Regulation on the list of activities that may be the cause of soil pollution and degradation, procedure, data content, deadlines and other requirements for land monitoring (2020);
- Regulation on the content of remediation and reclamation projects (2019);
- Rulebook on the content and manner of keeping the Cadaster of Contaminated Sites, as well as type, content and forms, manner and deadlines for delivering the data (2019).



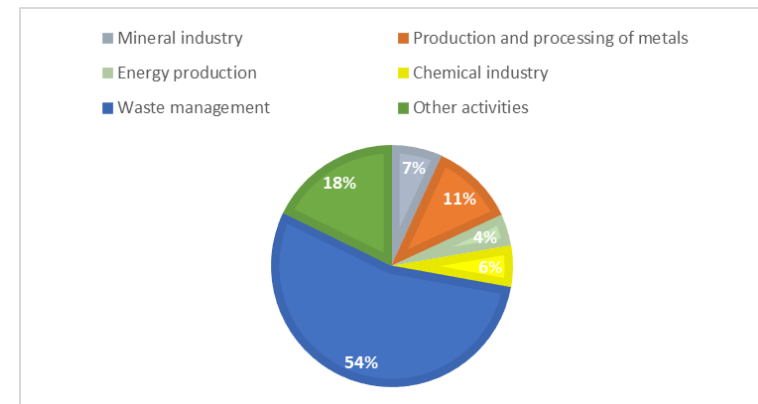
# Cadastre of contaminated sites

## Article 34 - Law on Soil Protection

A database of polluted, endangered and degraded soils

- The main purpose of the Cadastre is to provide systematic data on sources of pollution such as the type, quantities, methods, and location of discharges of pollutants into the soil, in order to implement preventive or remediation measures.
- An integral part of the Environmental Protection Information System administered by the Environmental Protection Agency.
- State organizations, local authorities, and polluters are obliged to provide information about the quality and state of the soil to the Environmental Protection Agency.

- In the territory of the Republic of Serbia, **309** potentially contaminated and contaminated sites were identified and recorded in the Cadaster (State of the Environment Report for 2019, 2020)
- The largest share in the identified sites have waste disposal sites - 54%





# UN Environment/GEF project

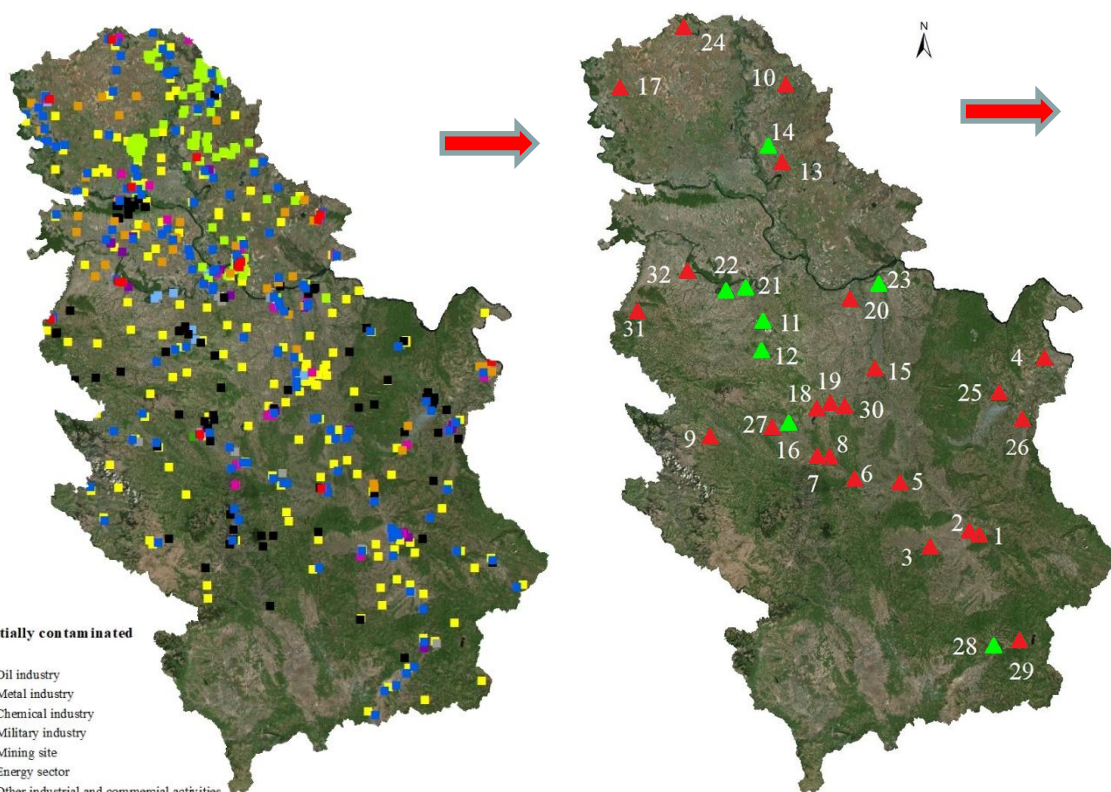
*“Enhanced Cross-sectoral Land Management through Land Use Pressure Reduction and Planning”*

- Project Duration: October 2015 – June 2019.
- Capacity Building for Investigation of Contaminated Sites
- Sampling and analysis of specific pollutants ongoing at 32 sites
- Development of Characterisation Plans for abandoned chemical industries
- Application of PRA.MS methodology for preliminary risk assessment to human health and environment
- Development of the Cadaster of Contaminated Sites – upgrade to SEPA’s information system





# UN Environment/GEF project



- Potentially contaminated sites**
- Oil industry
  - Metal industry
  - Chemical industry
  - Military industry
  - Mining site
  - Energy sector
  - Other industrial and commercial activities
  - Commercial and passenger transportation
  - Landfills
  - Dump site
  - Other

	Name of industrial complex	Parameters with exceeded remediation values in soil	Industrial and commercial activities causing soil contamination
1	Ei Nš	<b>Pb</b>	Electronic industry
2	MIN - Niš	<b>Cu, Zn, Pb</b>	Metal working industry
3	Fabrika obojenih metala - Prokuplje	<b>Cr, Cu, Ni, Zn</b>	Metal working industry
4	RTB Bor	As, Cu	Mining operations
5	HI Župa - Kruševac	<b>Hg, Cr, Cu, Ni, Zn, Pb, As</b>	Chemical industry
6	Prva Petoletka - Trstenik	As, Cu, Ni, Cd, Zn	Metal working industry
7	Fabrika vagona Kraljevo	<b>Cr, Cu, Zn, Pb, Ni, As</b>	Metal working industry
8	Magnohrom Kraljevo	As, Ni, Cr, Cu,	Metal working industry
9	Valjaonica Bakra - Sevojno - Užice	Cu, Zn, Cr, Ni	Metal working industry
10	Toza Marković - Kikinda	Zn	Glass, ceramics, stone, soil industry
13	a.d. Radijator - Zrenjanin	<b>PCB</b>	Metal working industry
15	TE Morava - Svilajnac	Ni	Energy industry
17	Fabrika akumulatora Sombor	<b>Pb</b>	Metal working industry
18	Šumadija d.o.o. - Kragujevac	<b>As, Cu, Ni, Zn</b>	Metal working industry
19	Zastava Kamioni - Kragujevac	Cu	Car industry
20	Železara Smederevo	Ni, Pb, Zn	Metal working industry
24	HI Zorka - Subotica	As, Cu, Zn	Chemical industry
25	KTK Koža - Zaječar	<b>Cr, As, Pb</b>	Textile, leather industry
26	IHP Prahovo	As	Chemical industry
27	PKS Latex - Čačak	Ni	Chemical industry
29	Fabrike brusnih ploča - Surdulica	As, Cu, Ni, Zn	Metal working industry
30	21. oktobar - Kragujevac	Cr, Cu, Ni, Zn	Metal working industry
31	HI Viskoza - Loznica	As, Cd, Cu, Pb, Zn	Chemical industry
32	Zorka - Obojena metalurgija - Šabac	<b>PAH, DDE/DDD/DDT, As, Cd, Cr, Cu, Pb, Ni, Zn</b>	Metal working industry



# PRIORITIZATION OF SITES – I PHASE

In order to set priorities for detailed investigations and remediation, all locations have been sorted into 4 groups (I-IV) according to the:

- amount of data on the state of the soil,
- concentrations of pollutants,
- types of pollutants,
- proximity of vulnerable facilities,
- activities on the given locations,
- size of the complex, and
- estimated scope of works.

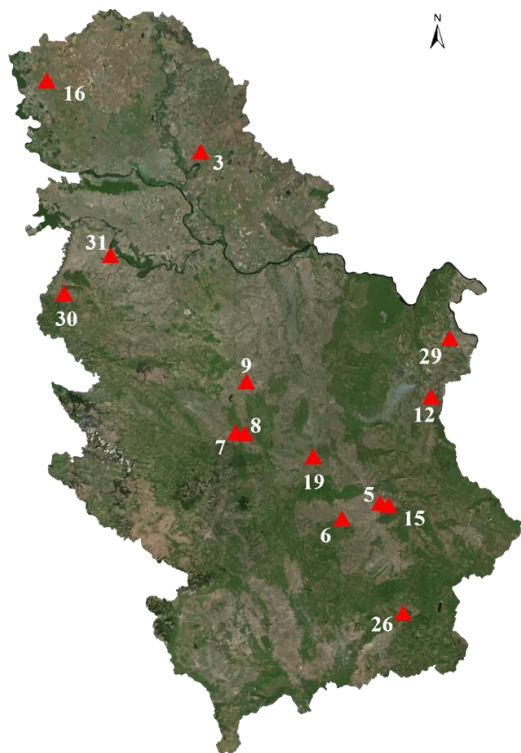
**Group I -**  
Locations where analyzed contaminants did not exceed the remediation values

**Group II -**  
Contains locations for which additional monitoring is proposed

**Group III –**  
Locations where urgent remediation activities are required

**Group IV -**  
Covers large industrial enterprises where certain parts of the complex require remediation

# Locations where contaminated soil was found and requires remediation (14 sites)



Location	exceed RV	
	Inorganic pollutants	Organic pollutants
3. Radijator AD, Zrenjanin	/	PCB
5. Electronics Industry Niš	Pb	/
6. Non-ferrous metal factory, Prokuplje	Cr, Cu, Ni, Zn	C10-C40
7. Fabrika vagona AD, Kraljevo	As, Cu, Ni, Pb	/
8. Magnohrom, Kraljevo	As, Cu, Ni	/
9. Šumadija d.o.o., Kragujevac	As, Cu, Zn, Ni	/
12. Leather and Textile Processing Factory "Koža", Zaječar	As, Cr, Pb	/
15. Mechanical Engineering Industry Niš	As, Cr, Cu, Ni, Pb, Zn	/
16. Battery Factory, Sombor	Pb	C10-C40
19. Chemical Industry "ŽUPA" AD, Kruševac	As, Hg, Cr, Cu, Ni, Pb, Zn	/
26. Paper and packaging factory – Lagoons, Vladičin Han	/	/
29. "Elixir" Mineral Fertilizer Industry Prahovo, Negotin	As	/
30. Viskoza, Loznica	As, Cd, Cu, Pb, Ni, Zn	/
31. "Zorka" non-ferrous metallurgy, Šabac	As, Cd, Cr, Cu, Ni, Pb, Zn	DDE/DDD/DDT, PAH



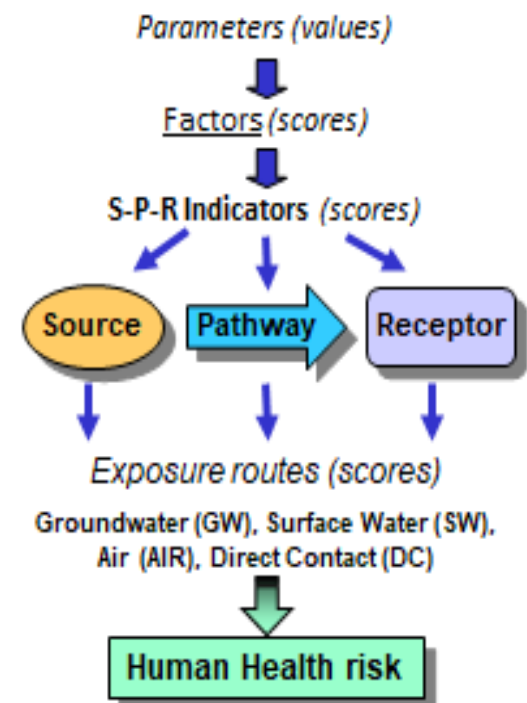
# PRIORITISATION OF SITES – II PHASE PRELIMINARY RISK ASSESSMENT

**GROUP 3** - AS 14 LOCATIONS ARE IDENTIFIED AS LOCATIONS WITH HIGHEST PRIORITY FOR SOIL REMEDIATION PROGRAMS, IT WAS NECESSARY TO ALSO COMPARE THEM FROM THE ASPECT OF RISK TO HUMAN HEALTH.

PRELIMINARY RISK ASSESSMENT MODEL FOR THE IDENTIFICATION AND ASSESSMENT OF PROBLEM AREAS FOR SOIL CONTAMINATION IN EUROPE – **PRA.MS MODEL**

*EEA, 2005, "Towards an EEA Europe-wide assessment of areas under risk for soil contamination"*

**CONTAMINATED SITES PRIORITIZATION BASED ON THE RELATIVE RISK TO HUMAN HEALTH**







# DATA REQUIRED FOR THE PRA.MS MODEL

The PRA.MS model calculates relative risk according to the scores assigned to the values of the relevant parameters for each location and, the application was developed in Access2000 and Visual Basic for Access.

- toxicity of contaminants (risk phrases),
- site area,
- disposal type, engineered containments,
- known releases of contaminants to SW,
- lithology of the unsaturated zone,
- aquifer depth,
- slope,
- mean annual temperature/wind velocity/precipitation,
- distances to nearest well, residential area, and surface water,
- groundwater and surface water use,
- land use at and off site,
- site accessibility,
- waste mass and volume,
- source area and volume,
- known release of contaminants to GW and AIR,
- thickness and presence of the impermeable layer as well as
- information on flooding return.

# RESULTS

No	SiteID	Relative risk an uncertintny factor values and risk classes				Ranked exposure pathways			
		Total risk value	Risk class (PRA.MS)	Total uncertainty value	Uncertainty factor class (PRA.MS)	1st	2nd	3rd	4th
1	Fp-VH	41.7	HIGH RISK CLASS	5.3	LOW UNCERTAINTY CLASS	SW	DC	GW	AIR
2	Vi-LO	41.0	HIGH RISK CLASS	5.3		SW	DC	GW	AIR
3	HiZ-KS	40.0	HIGH RISK CLASS	5.2		SW	DC	GW	AIR
4	Z-SA	32.6	MEDIUM RISK CLASS	4.2		SW	DC	AIR	GW
5	Fom-PK	32.4	MEDIUM RISK CLASS	6.9		SW	DC	GW	AIR
6	Fv-KV	31.8	MEDIUM RISK CLASS	6.9		DC	SW	GW	AIR
7	El-NI	31.4	MEDIUM RISK CLASS	7.5		DC	SW	AIR	GW
8	Mgh-KV	30.7	MEDIUM RISK CLASS	6.1		SW	DC	GW	AIR
9	Rd-ZR	29.6	MEDIUM RISK CLASS	10.3		DC	SW	GW	AIR
10	Sum-KG	28.5	MEDIUM RISK CLASS	7.1		SW	GW	DC	AIR
11	Ih-NG	27.6	MEDIUM RISK CLASS	10.0		DC	SW	AIR	GW
12	Fa-SO	26.1	MEDIUM RISK CLASS	10.6		DC	GW	SW	AIR
13	Mi-NI	24.8	MEDIUM RISK CLASS	8.1		DC	GW	SW	AIR
14	KTK-ZA	24.4	MEDIUM RISK CLASS	7.4		DC	GW	SW	AIR

TOTAL RISK VALUE

UNCERTAINTY  
FACTOR

EXPOSURE  
PATHWAYS



## DISCUSSION

The priority list compiled based on the PRA.MS methodology can be further used for:

- Planning the further site investigation strategies;
- Enhancing the site monitoring;
- Risk communication in the process of site management;
- Decision-making purposes and allocation of resources for remediation projects.



Thank you for your  
attention!

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