



This Project is co-financed by
the European Union and the Republic of Türkiye.

IDENTIFICATION AND REMEDIATION OF CONTAMINATED SITES WITH PERSISTENT ORGANIC POLLUTANTS (POPS)

*Sectoral Training within the scope of the Regulation on Control of Soil
Pollution and Sites Contaminated by Point Sources*

24 OCTOBER 2023

ROBERT RASCHMAN



REPUBLIC OF TÜRKİYE
MINISTRY OF ENVIRONMENT,
URBANIZATION AND CLIMATE CHANGE



Environment and Climate Action
Sector Operational Programme



Persistent
Organic
Pollutants





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International Approaches in Identification of Sectors

International Examples of POPs Contaminated Sites

Robert Raschman



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POPs - Introduction

- Persistent organic pollutants (POPs) are organic substances that:
 - Have an adverse effect on human health and the environment, even in low concentrations
 - Persist in the environment
 - Accumulate in living organisms
- Widely used during the industrial boom after World War II.
- Beneficial in pest and disease control, industry etc. ↔ Unforeseen adverse effects on human health and the environment.



Paul Hermann
Müller
1948 – Nobel
price for DDT

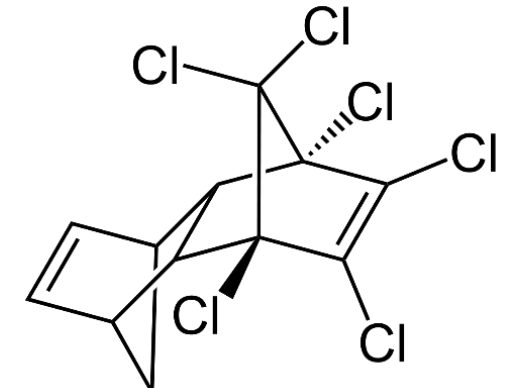


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POPs - Groups

POPs include:

- Pesticides - compounds used mainly in pest and disease control (insecticides) and in crop production (herbicides). Pesticides which can no longer be used for their intended purpose become obsolete.
- Intentionally produced industrial chemicals - such as polychlorinated biphenyls (PCBs), which were widely used in electrical equipment)
- Unintentionally produced chemicals – such as by-products formed during industrial processes, degradation or combustion (such as dioxins and furans).



*Chlorine atoms in Aldrin
molecule*



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POPs – Effect on Human Health and Wildlife

Human Health:

- People are mainly exposed to POPs through contaminated food

- Death
- Cancers
- Allergies
- Hypersensitivity
- Developmental changes
- Damage to the nervous systems
- Disruption of the endocrine, reproductive, and immune systems

Wildlife:

- Diseases and/or abnormalities
- Accumulate in the organisms at the top of food chains, such as white-tailed sea eagles





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POPs – Stockholm Convention (<http://chm.pops.int>)

A. POPs, the production and use of which must be eliminated:



<u>Aldrin</u> ●	<u>Chlordane</u> ●	<u>Chlordecone</u> ●
<u>Decabromodiphenyl ether (commercial mixture, c-decaBDE)</u> ▲	<u>Dicofol</u> ●	<u>Dieldrin</u> ●
<u>Endrin</u> ●	<u>Heptachlor</u> ●	
<u>Hexabromobiphenyl</u> ▲	<u>Hexabromocyclododecane (HBCDD)</u> ▲	<u>Hexabromodiphenyl ether and heptabromodiphenyl ether</u> ▲
<u>Hexachlorobenzene (HCB)</u> ● ▲	<u>Hexachlorobutadiene</u> ▲	<u>Alpha hexachlorocyclohexane</u> ●
<u>Beta hexachlorocyclohexane</u> ●	<u>Lindane</u> ●	<u>Mirex</u> ●
<u>Pentachlorobenzene</u> ● ▲	<u>Pentachlorophenol and its salts and esters</u> ●	<u>Polychlorinated biphenyls (PCB)</u> ▲
<u>Polychlorinated naphthalenes</u> ▲	<u>Perfluorooctanoic acid (PFOA), its salts and PFOA-related compounds</u> ▲	<u>Short-chain chlorinated paraffins (SCCPs)</u> ▲
<u>Technical endosulfan and its related isomers</u> ●	<u>Tetrabromodiphenyl ether and pentabromodiphenyl ether</u> ▲	<u>Toxaphene</u> ●



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B. POPs, the production and use of which must be limited to exceptions and special purposes:

<u>DDT</u> ●	<u>Perfluorooctane sulfonic acid, its salts and perfluorooctane sulfonyl fluoride</u> ● ▲
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C. POPs, unintentional release of which should be minimized and , where feasible, eliminated:

<u>Hexachlorobenzene (HCB)</u> ■	<u>Hexachlorobutadiene (HCBd)</u> ■	<u>Pentachlorobenzene</u> ■	<u>Polychlorinated biphenyls (PCB)</u> ■
<u>Polychlorinated dibenzo-p-dioxins (PCDD)</u> ■		<u>Polychlorinated dibenzofurans (PCDF)</u> ■	<u>Polychlorinated naphthalenes</u> ■
Pesticide ●		Industrial chemical ▲	Unintentional Production ■



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Sectors and Contaminants

- Typical contaminants can be identified for specific sectors
- Number of plants operating in **sectors** that often cause soil and groundwater pollution may indicate answer to the question: „How many sites with a potential for contamination exist in the defined region/country?“
- Properties of the **contaminants** (in particular their toxicity and ability to migrate through the rock environment) play an important role in answering the question: „How many of the contaminated sites are in need of remediation?“
- **However:** The decision on the priority of the site for remediation can only be made on the basis of the completed site survey and Risk Assessment!



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POPs Contaminating Sectors

- Economic sectors presenting risks in terms of environmental contamination by POPs differ in individual countries, depending on their economy profile, the level of development achieved, natural conditions etc.
- Historical use (e.g. obsolete pesticides)
- Life cycle (production – distribution – use – disposal) - In which sectors did any of these activities take place?





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Area of Use	POPs / Way of Use
Agriculture	Pesticides (herbicides and insecticides): Aldrin, Chlordane, DDT, Endrin, Heptachlor, Hexachlorobenzene, Toxaphene , Endosulfan, Chlordecone, Dicofol, Lindane, Pentachlorophenol
Municipal sphere – Diseases control	DDT (malaria), Endosulfan (tsetse flies)
Municipal sphere – Insects and rodents control	Pesticides for control of termites, grasshoppers, ticks, textile pests, rodents etc.: Dieldrin, Endrin, Heptachlor, Endosulfan, alpha/beta Hexachlorocyclohexane, Lindane



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Area of Use	POPs / Way of Use
Municipal sphere - POPs contained in consumer goods	Mirex (fire retardant), Decabromodiphenyl Ether (additive in plastics, textile, coatings etc.), Hexabromobiphenyl (fire retardant), Hexabromocyclododecane (polystyrene foam), Pentachlorobenzene (fire retardant), Perfluorooctanoic acid (PFOA) and related compounds (non-sick kitchen ware, Polychlorinated naphthalenes (rubber and plastic additives), Chlorinated paraffins (flame retardant, plasticizer in rubber)
POPs used for tree and wood treatment	Endosulfan, Lindane, Pentachlorophenol, Polychlorinated naphthalenes



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Area of Use	POPs / Way of Use
POPs used in Industry	PCBs (heat exchange fluids, electric transformers and capacitors, additives in paint, etc.), Hexachlorobutadiene (solvent for chlorine containing compounds), Pentachlorophenol (textile industry and antifouling paints), Perfluorooctanoic acid (PFOA) and related compounds (textile industry, paints, paper, firefighting foams), Polychlorinated naphthalenes (insulating coatings, capacitor dielectrics, lubricants), Chlorinated paraffins (flame retardant, plasticizer, paint, lubricant), Polybromodiphenyl ether congeners (flame retardants)
Unintentionally produced POPs	Dioxins and Furans (produced due to incomplete combustion including car exhaust, and during manufacture of certain pesticides), alpha/beta Hexachlorocyclohexane (by-product in lindane production), Polychlorinated naphthalenes (high-temperature processes in the presence of chlorine)



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Priority POPs Contaminating Sectors

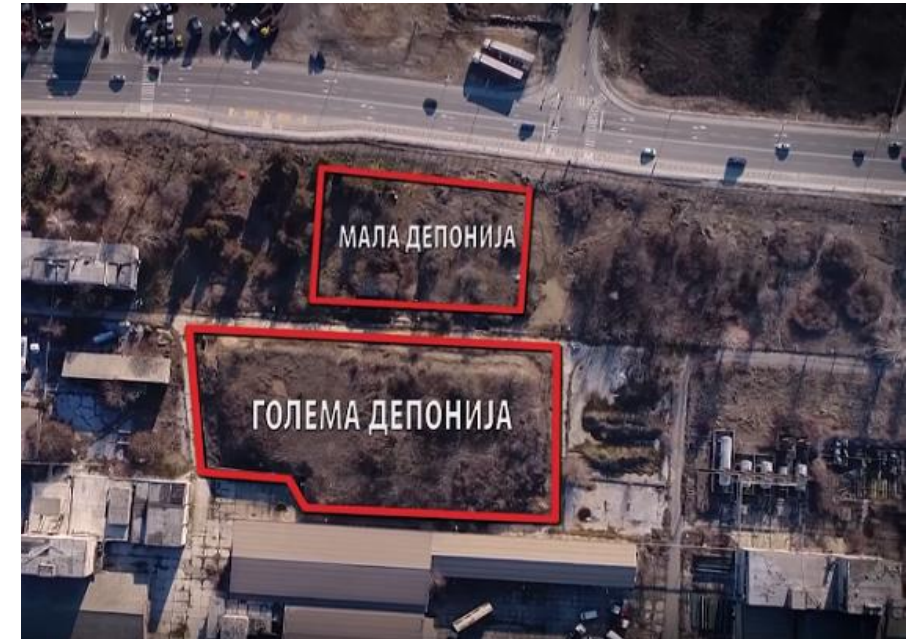
Sector	Potentially contaminated sites
Chemical industry - POPs production	<ul style="list-style-type: none">● POPs production sites● Produced POPs storage sites● Disposal sites for waste from the production of POPs
Agriculture	<ul style="list-style-type: none">● Pesticide storage sites● Agricultural land on which pesticides are applied● Livestock breeding areas● Obsolete pesticide storage and disposal sites



*Chemko Strazske, Slovakia
Former PCB production plant*



*OHIS Skopje, Macedonia
Former Lindane production plant*



Africa (Cameroon)



America (Paraguay)



Asia (Syria)



Europe (Moldova)





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Sector	Potentially contaminated sites
Municipal sphere – Diseases, insects and rodents control	<ul style="list-style-type: none">● Storge sites● Areas, where pesticides have been repeatedly applied● Obsolete pesticide storage and disposal sites
Municipal sphere - POPs contained in consumer goods	<ul style="list-style-type: none">● Overall polluted communal sphere● Consumer goods disposal sites (landfills, incinerators)
Municipal sphere - Transportation	<ul style="list-style-type: none">● Overall polluted communal sphere by car exhausts



<https://kalicikirleticiler.com/en/kimyevi-en/>





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Sector	Potentially contaminated sites
Power plants and Transformer stations using PCB containing oil	<ul style="list-style-type: none">● PCB oil storage areas● Transformer operation areas● Transformer oil leakage areas
Asphalt mixing plants using PCB containing heat exchange fluid	<ul style="list-style-type: none">● Heat exchange fluid storage area● Heat exchange fluid leakage areas● Heat exchange fluid disposal areas
Chemical industry – using POPs	<ul style="list-style-type: none">● POPs containing chemicals storage sites (e.g. additives in plastics, solvents etc.)● POPs containing products disposal sites (landfills, incinerators)



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Transformer station



Asphalt mixing plant





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Sector	Potentially contaminated sites
Tree and wood treatment using POPs containing chemicals	<ul style="list-style-type: none">• Storage sites for POPs containing chemicals• Treated wood storage and processing sites• Treated wood disposal sites
Paint industry using POPs containing components	<ul style="list-style-type: none">• Paint/coating production sites• Paint/coating storage sites• Paint/coating application sites
Textile industry	<ul style="list-style-type: none">• Storage sites for POPs containing chemicals• Areas affected by wastewater from textile industry



This Project is co-financed by
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Sector	Potentially contaminated sites
Firefighting foams production and use	<ul style="list-style-type: none">● Firefighting foams production sites● Firefighting foams storage sites (fire brigades, chemical factories, airports etc.)● Areas for firefighter training● Places where large-scale fires were extinguished
Waste disposal	<ul style="list-style-type: none">● Areas contaminated by Dioxins and Furans contained in air emissions produced by incineration plants● Landfill sites



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Firefighting raining area



Firefighting foam

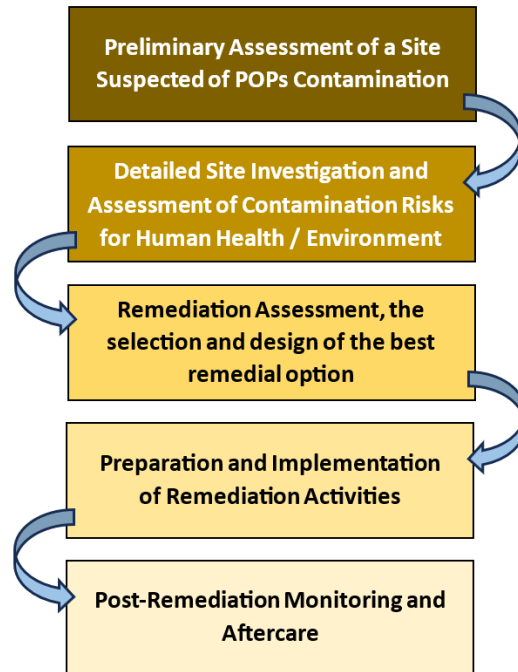




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Remediation of POPs Contaminated Site Management Projects

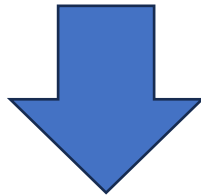
- Stepwise approach:



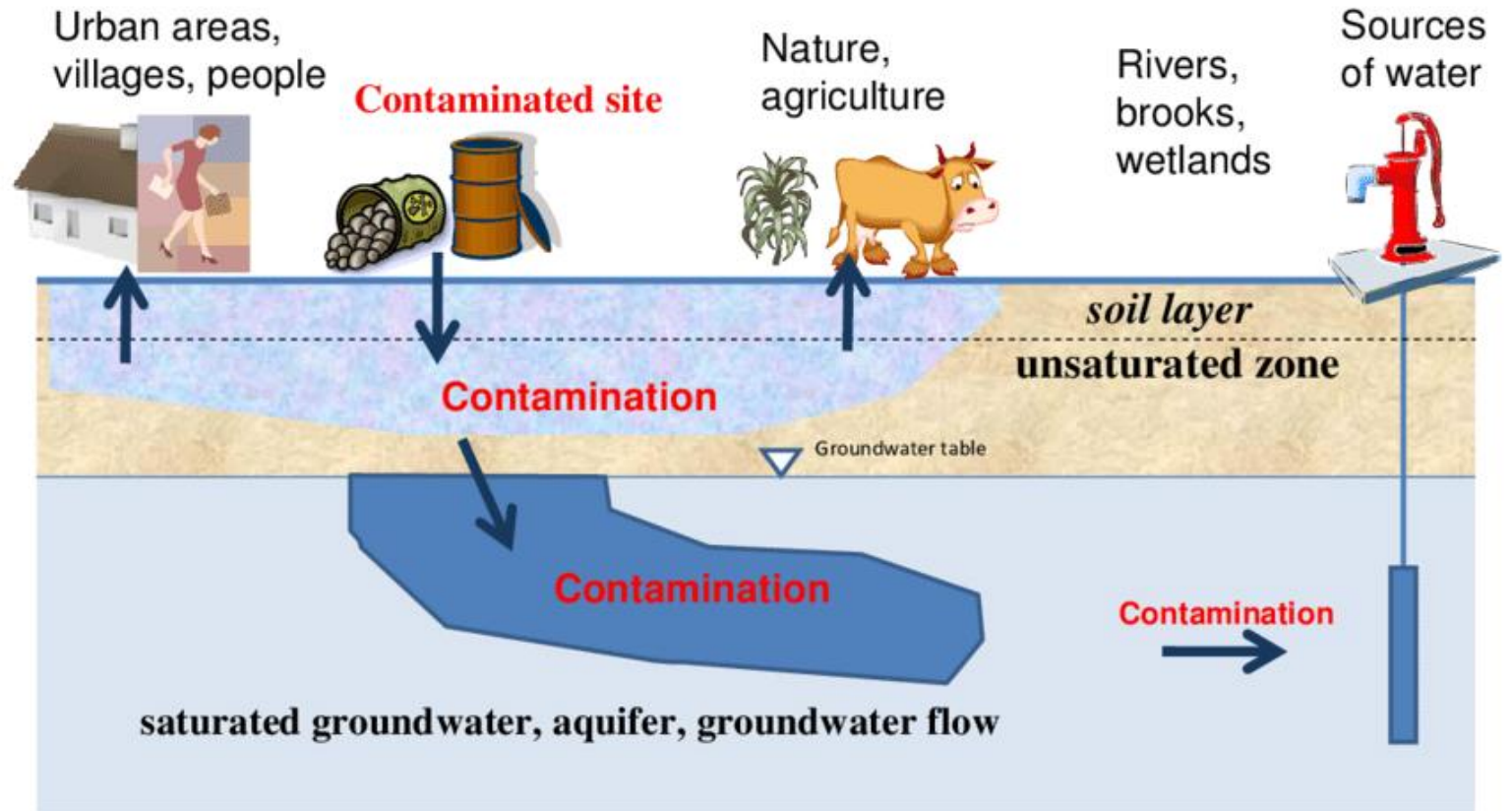


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- The site is contaminated. Is remediation necessary?



RISK ASSESSMANT





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Examples of POPs Contaminated Site Management Projects

Vrakuna chemical waste dumpsite, Bratislava, Slovakia





This Project is co-financed by
the European Union and the Republic of Turkey.

Information Summary:

- Former blind arm of the river Maly Dunaj
- From 1966 till 1979 officially used as a landfill for disposal of waste from chemical plant CHZJD / Istrochem (pesticide production)
- Area: 46 500 m²
- Thickness of deposited waste layer: 1,5 - 2,5 m.
- Quantity of deposited waste: 90 000 m³
- Rehabilitation of the landfill: 1980 (just covering with 2-3 m of clean soil)
- Priority contaminants: Chlorinated pesticides (Hexachlorobenzene, Hexachlorocyclohexane isomers), Herbicides, Chlorinated benzenes (chlorobenzene, dichlorobenzenes), PCBs, PAHs, BTEX, TPHs, Heavy metals





This Project is co-financed by the European Union and the Republic of Turkey.

Detailed Site Investigation

- Sampling and analysis of deposited waste, soil and groundwater
- Evaluation and visualization of contamination data

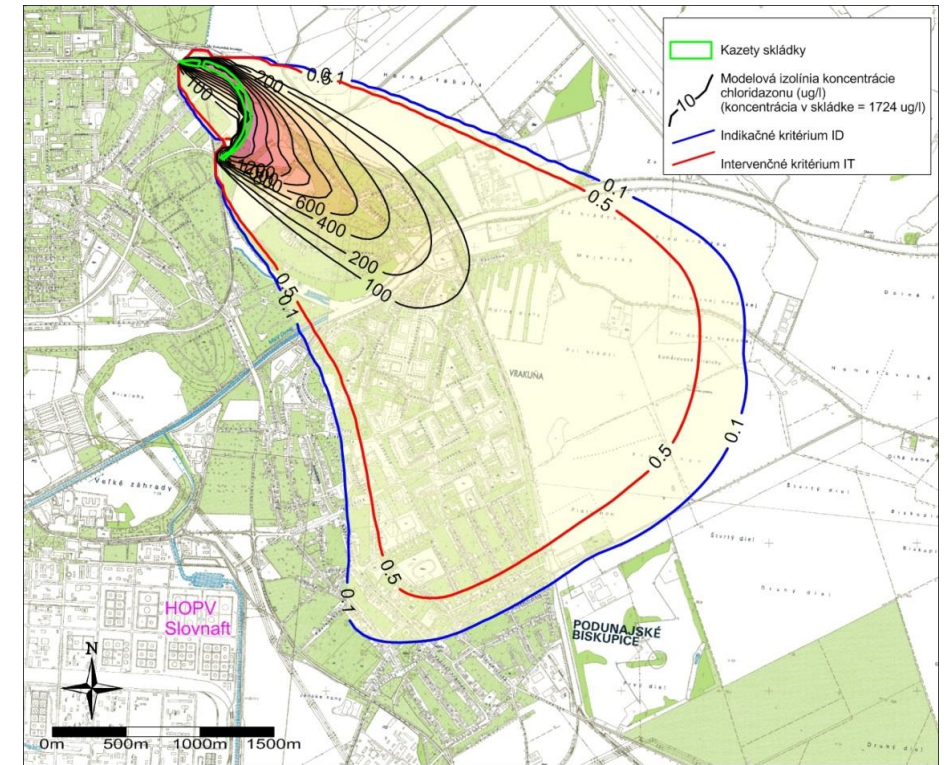




This Project is co-financed by the European Union and the Republic of Turkey.

Risk Assessment

- Mathematical modelling of contamination spread in groundwater
- Risk assessment and determination of measures for the risk mitigation:
 - Preventing the spread of contaminants in groundwater
 - Ban to groundwater use for drinking, bathing (pools), washing and garden watering
 - Ban to new construction activities at the landfill area
 - Elimination of access to the landfill area (fencing)





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Remediation Assessment and Design

➤ ***Evaluated Remediation Approaches:***

- *“No action” scenario:* All the identified risks will endanger public health and the environment for a very long time.
- *Institutional control scenario:* The main identified risks will endanger public health and the environment for a very long time.
- *Engineering control scenario* - Application of technical measures aimed at minimizing the contact with the contaminated environment and elimination of further migration of pollution. It does not remove or reduce the level of contamination in the area of interest.
 - Construction of an underground slurry wall around the entire landfill area (total length 2,050 m)
 - Capping of the landfill area with impermeable surfaces
 - Pumping and treatment groundwater from the area surrounded by an underground slurry wall



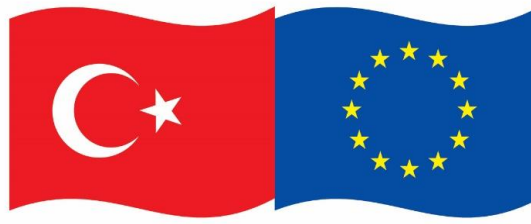
- Implementation time: 18 months
- Estimated investment costs: EUR 14 600 000
- Estimated operational costs (groundwater pumping, maintenance, monitoring): EUR 240 000 / year
- *Treatment scenario* - Technical solution:
 - Ex situ remediation of source area
 - Enhanced attenuation of plume zone
 - Implementation time: 59 months
 - Estimated costs: EUR 113 130 000

➤ **Detailed Implementation Design**

Preparation and Implementation of Remediation

➤ **Permitting, Tendering**





Safeguarding and disposal of hazardous chemical waste in Pascani, Moldova

Case Study 1

Client:

Food and Agriculture Organization of
the United Nations,
Viale delle Terme di Caracalla
Rome 00153, Italy

Contact person:

Richard Thompson
Tel: +39 06 570 53 625
E-mail: Richard.Thompson@fao.org

Location:

Moldova

Value of the contract:

US\$ 941,000

Implementation period:

1/2015 - 9/2016



*Photo: Re-packed obsolete pesticides waste to be
exported for disposal*



This Project is co-financed by
the European Union and the Republic of Turkey.

Description of the Project:

As a part of a region-wide project funded by FAO, the main goal of the project was the destruction of approximately 360 tonnes of obsolete pesticides from a storehouse located in the Pascani district of Criuleni in Moldova. The main tasks carried out in this project were re-packaging, export and final disposal of the hazardous waste to an incineration facility in Poland. In addition, this project also had a capacity-building component that included the training of local experts in health and safety, as well as a community awareness component.

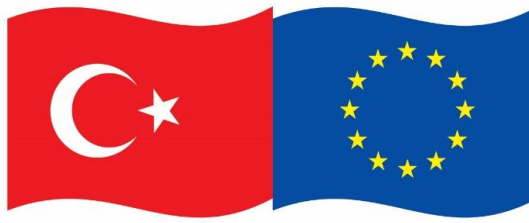
Types of services provided by DEKONTA:

DEKONTA was the main contractor and the leader of the consortium, responsible for the following tasks:

- Import of all necessary equipment and site set-up
- Sampling and inventory update
- Completing the Environmental, Health and Safety Plan
- Training of local experts in the field of site zoning, PPE usage, safeguarding of hazardous waste, also the health and safety rules to be observed when implementing remediation projects and first aid.
- Re-packaging of the waste
- Solidification and stabilization of contaminated sand found in the storehouse
- Organization of the export documents according to the provisions of the Basel Convention
- Transportation of the waste in accordance with the ADR rules to an incineration facility, where it was disposed of
- Public awareness campaign

Case Study 1





Environmentally-sound management campaign of two sites in Sao Tome & Principe contaminated by POPs pesticides

Case Study 2

Client:

United Nations Industrial Development Organization (UNIDO)

Funding agency

(if different from the Client):

State Environmental Fund of the Czech Republic

Location:

Sao Tome

Value of the contract:

254,961 USD

Implementation period:

12/2016 – 3/2019



Photo: Fieldwork preparations at one of the pesticides storehouses



This Project is co-financed by
the European Union and the Republic of Turkey.

Description of the Project:

Funded by UNIDO, the main goals of this project had been to safeguard, export and dispose of 31.2 tonnes of obsolete pesticides and pesticide-contaminated material from two storehouses located on the island of Sao Tome. The project also included soil sampling and assessment of the investigation results. In addition to its main goal, DEKONTA had also provided training to a local team of workers on the safeguarding of the waste. DEKONTA also provided training to local experts from the Ministry of Infrastructure, Natural Resources & Environment. This focused on on-site chemical analyses and procedures in accordance with the Basel Convention for exporting hazardous waste for disposal abroad. Furthermore, the project included an awareness campaign regarding the risks of obsolete pesticides to the local community living next to one of the sites. The main contaminants were: Dieldrin, endrin, DDT, HCH, aldrin.

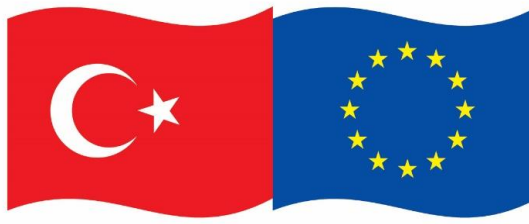
Types of services provided by DEKONTA:

As the Project Leader, DEKONTA had been responsible for the set-up and management of the site, implementation of health and safety protocols, as well as the supervision of the safeguarding activities. In addition, DEKONTA had also been responsible for obtaining the documentation related to the notification process to export the waste for disposal abroad, in accordance with the protocols of the Basel Convention.



Case Study 2





Disposal of hazardous waste

from an underground pesticide storage in Boršov (Kyjov), Czech Republic

Case Study 3

Client:

NAVOS, a.s.
Celakovskeho 1858/27
767 01 Kromeriz
Czech Republic
Contact person:
Mr. Pavel Trefil
Tel.: +420 723 365 919

Location:

Czech Republic

Value of the contract:

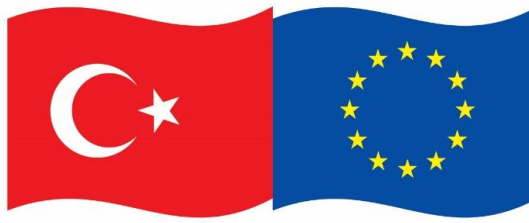
1,238,529 USD

Implementation period:

8/2018 - 4/2019



Photo: Removal of hazardous waste from an underground storage



This Project is co-financed by
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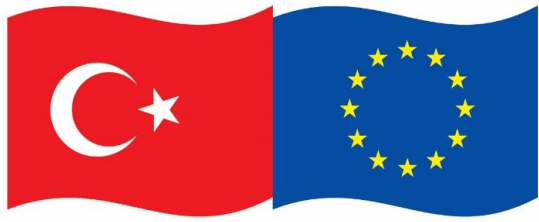
Description of the Project:

The project scope involved remedial intervention, consisting of the removal of sources of contamination, (mainly organophosphorus pesticides stored in steel containers, removal of contaminated building structures, demolition of reinforced airtight concrete underground storage (constructed to store contaminated material after a fire at a local chemical storehouse)), and the subsequent recultivation of the site. In total, 1,185 tonnes of hazardous waste was repacked and disposed of at incineration facilities in the Czech Republic.

Type of services provided by DEKONTA:

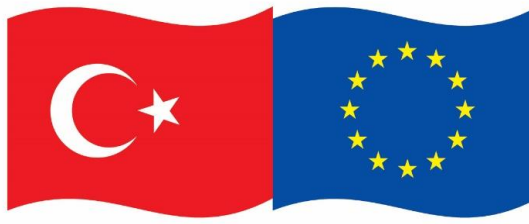
- Ground and surface water quality monitoring, together with air monitoring of working environment and outside the environmental enclosures
- Sampling and field or laboratory analyses of hazardous waste, identification of waste
- Removal of main source of pollution, (hazardous waste based on pesticides stored in steel containers – 566 tonnes)
- Removal of contaminated building structures – 281 tonnes
- Demolition of contaminated concrete storage structures
- Removal of tar from an underground storage (275 tonnes) and pesticide waste stored in steel drums (2,36 tonnes)
- Disposal of steel containers contaminated with pesticides – 62 tonnes
- Transport of hazardous waste to final destruction facilities in the Czech Republic
- Site recultivation
- Elaboration of final report and updated risk analysis.

Case Study 3



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Remediation

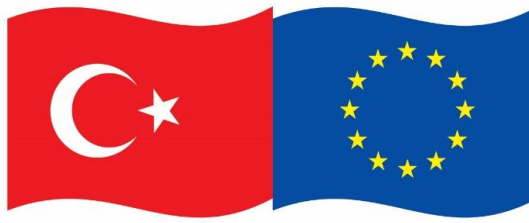
of river bank sediments contaminated with PCBs at Střekovský most

Case Study 4

Client: Proficolor Ltd. Radiová 1121/1, 102 00 Praha 10 Czech Republic Contact person: Ján Nandráži Tel: +420 602 532 776 e-mail: nandrazi@proficolor.cz
Funding agency (if different from the Client):
Location: Czech Republic / Střekovský most
Value of the contract: 84,450 USD
Implementation period: 11/2016 – 04/2017



Photo: Site works



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the European Union and the Republic of Turkey.

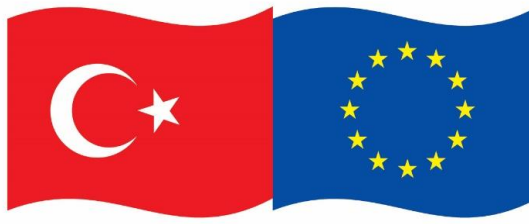
Case Study 4

Description of the Project:

The goal of the project was to survey and remediate the PCB contaminated sediments located at the banks of the Elbe river, (under the Střekovský Bridge), in Ústí nad Labem. The project included investigation work of the area to assess the depth of the pollution of the river banks, (caused by the use of PCB-containing coating of the railway bridge over the River Elbe). During the remediation work, 673 tonnes of contaminated PCB soils were excavated and removed from the site. The contaminated soil was transported for disposal.

Types of services provided by DEKONTA:

- Project Management
- Reporting
- Implementation of remediation technologies
- Site preparation



Remediation

of soil under EUROŠARM warehouse in Plzeň contaminated with chlorinated hydrocarbons

Client:

EKOSYSTEM spol. s.r.o.
Na Radosti 184/59, Prague 5, 155 21
Czech Republic

Contact person:

Mgr. Martin Šrámek,
Tel.: +420 775 142 923
E-mail: sramek@g-servis.cz

Funding agency

(if different from the Client):

Location:

Czech Republic / Plzeň

Value of the contract:

984,250 USD

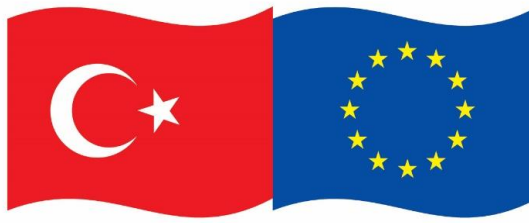
Implementation period:

8/2018 – ongoing (exp. 2/2022)



Photo: Site works

Case Study 5



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the European Union and the Republic of Turkey.

Case Study 5

Description of the Project:

The project goal is to remediate an unsaturated zone under a warehouse belonging to EURO-Šarm s.r.o. in Plzeň, by means of thermal desorption and soil venting through horizontal boreholes under the warehouse and vertical boreholes in its vicinity.

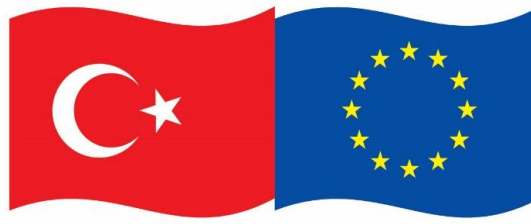
Types of services provided by DEKONTA:

- Project Management
- Reporting
- Implementation of remediation technologies
- Site preparation



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Reclamation

of the hazardous waste landfill in Cișmichioi

Client:

Czech Development Agency
Nerudova 3, 118 50 Praha 1
Czech Republic

Contact person:

Mrs. Vlasta Gernerová
E-mail: gernerova@czechaid.cz

Funding agency

(if different from the Client):

Location:

Moldova / Cișmichioi

Value of the contract:

935,000 EUR

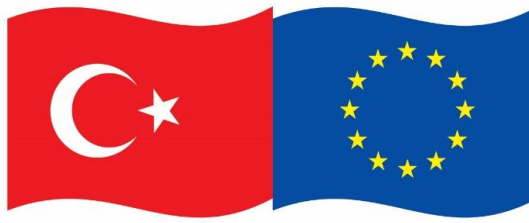
Implementation period:

7/2018 – 10/2019



Photo: Cișmichioi hazardous waste landfill

Case Study 6



This Project is co-financed by
the European Union and the Republic of Turkey.

Description of the Project:

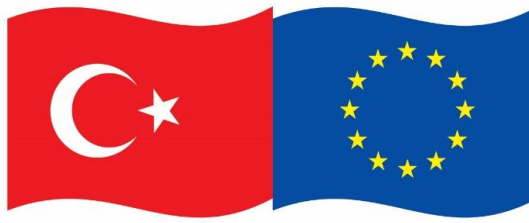
The main objective of the project was to provide services aimed at the reclamation and sealing of a hazardous waste landfill in Cișmichioi, Republic of Moldova.

Case Study 6

Types of services provided by DEKONTA:

The main activities carried out within the project were the following:

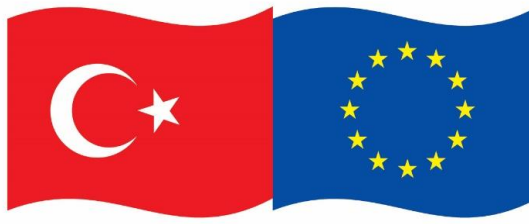
- Drilling work – well monitoring
- Sampling activities – ground water, ambient air
- Elaboration of the project documentation
- Hazardous landfill reclamation
- Project management and reporting



This Project is co-financed by the European Union and the Republic of Turkey.

Case Study 6





Remediation

of an area contaminated by historic wood impregnation at Česká Lípa

Case Study 7

Client:

Ing. Vlastimil Ladýř (site owner)
Československé armády 1566/2, 470 01
Česká Lípa

Funding agency

(if different from the Client):

State Environmental Fund of the
Czech Republic

Location:

Czech Republic / Srní u České Lípy

Value of the contract:

3,290,056 EUR

Implementation period:

5/2019 - ongoing (exp. 8/2023)



Photo: Aerial view of the contaminated site



This Project is co-financed by
the European Union and the Republic of Turkey.

Case Study 7

Description of the Project:

Funded by State Environmental Fund of the CR, the project aims to remove an old environmental burden in the vicinity of a drinking water source, due to impregnation of wood (mainly railway sleepers) by creosote oil and water-soluble inorganic salts during the 20th century. The main contaminants are: PAHs, petroleum substances (C10-C40) and heavy metals (Hg, Zn). Estimated contamination is up to 300 tonnes of PAHs and 400 tonnes of oil substances within the unsaturated zone.

Types of services provided by DEKONTA:

The following activities were carried out within the project:

- Soil remediation of PAHs and oil substances by means of co-composting on-site. Total volume of 20,880 m³
- Remediation of PAHs and oil substances by ISCO (Fenton's reagent) on rock mass
- PAHs remediation of groundwater by pumping and purification, and photo-oxidation methods

Case Study 7





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THANK YOU
FOR YOUR
ATTENTION