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Selected case studies - effectiveness evaluation, long-term monitoring studies

Seçilmiş vaka örnekleri – temizleme etkinliği değerlendirme, uzun süreli izleme çalışmaları

Robert Raschman

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- ***Investigation***
- ***Risk Assessment***
- ***Feasibility Study***
- ***Implementation Design***
- ***Remediation & Supervision***
- ***Post-Remediation Monitoring***

Implementation Design

- Complete design documentation, which to the necessary extent describes all activities that will be carried out at a specific site during the implementation of remediation measures.
- Primarily, the design must comply with all requirements of applicable legislation, including law related to: (i) environmental protection and water management (soil contamination, water protection, waste management, air protection, etc.), (ii) construction and demolition works; (iii) fire protection and occupational safety and (iv) freight transport (transport of dangerous goods).
- In addition, the remediation project must comply with:
  - Decisions of the relevant state and local government authorities concerning the contaminated site (requirement for remediation, monitoring etc.)

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- Binding national technical standards (e.g. a standard for rehabilitation of former landfill sites)
- Applicable methodological guidelines

- Unlike other (e.g. construction) designs, a remediation design is usually burdened by a certain inaccuracy of the initial information on the basis of which the remediation measures were proposed (contamination data, geological / hydrogeological conditions etc.). Therefore, it is necessary that the design includes remediation monitoring, which will enable ongoing evaluation of the effectiveness of the implemented measures.
- Due to the potential impacts of a remediation project on various components of the environment, its approval may be more complicated than for other projects (involvement of river basin management, public etc.)
- Environmental impact assessment may be required to implement the designed remediation measures.

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Implementation Design - Content

1. Introduction
   - Project background and objectives
   - Document organization
2. Site description and background information
   - Site description and location
   - Site history
   - Summary of previous investigations and findings
   - Site characterization investigations
   - Human health risk assessment
   - Cleanup levels
   - Feasibility study

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Implementation Design - Content

3. Implementation of selected remediation alternative
   - Preparatory activities (electric power connection, construction of service roads and facilities for contaminated materials handling etc.)
   - Mobilization
   - Removal of waste and contaminated equipment
   - Demolition works
   - Handling with contaminated debris
   - Soil remediation - Ex situ
   - Soil remediation - In situ
   - Groundwater remediation
   - Demobilization and handover of the site

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- ***Post-Remediation Monitoring***

Implementation Design - Content

4. Remediation Monitoring
   - Soil excavation monitoring
   - Construction waste monitoring
   - Groundwater monitoring
   - Material quantity monitoring
   - Air quality monitoring at work areas
   - Noise monitoring
   - Technological monitoring
   - Air emission (dust and odor) monitoring
   - Meteorological Monitoring

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- ***Implementation Design***
- ***Remediation & Supervision***
- ***Post-Remediation Monitoring***

Implementation Design - Content

5. Waste and wastewater management
   - Overview of generated waste streams (waste codes and quantities) and waste characterization
   - Handling with generated waste streams
   - On-site facilities for treatment and temporary storage of generated waste
   - Waste transportation
   - Final disposal of hazardous and non-hazardous waste streams
   - Waste management records (quality, transportation, disposal etc.)

   - Wastewater characterization – quantity, quality
   - Wastewater treatment and disposal

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- ***Implementation Design***
- ***Remediation & Supervision***
- ***Post-Remediation Monitoring***

Implementation Design - Content

6. Permitting requirements
   - Construction permit
   - Demolition and asbestos handling / disposal permit
   - Waste management permit
   - Water management permit
   - Electric power connection permit

   etc.
7. Health and safety measures
8. Project organization roles and responsibilities
9. Reporting

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- ***Implementation Design***
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- ***Post-Remediation Monitoring***

Implementation Design - Content

10. Supporting plans and documentation
    - Health and safety plan
    - Excavation plan
    - Backfilling plan
    - Stormwater pollution prevention plan
    - Construction traffic management plan and haul route plan
    - Emergency response plan
    - Post-excavation documentary sampling plan
    - Surface containment and soil management plan
    - Validation sampling plan
    - Long-term monitoring plan

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Long-term Monitoring

Contaminated Site Management:

- Investigation
- Risk assessment
- Feasibility study
- Implementation design
- Remediation activities
- Supervision
- Post-Remediation monitoring (PRM)

- Investigation
- Risk assessment
- Feasibility study
- Implementation design
- Long-term Remedial Approach (Natural Monitored Attenuation, Reactive barriers, Encapsulation etc.)

+ Long-term Monitoring (LTM)

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Post-Remediation Monitoring

- Primarily concerned with residual contamination at a site
- Verification of long-term sustainability of implemented remediation measures
- Demonstrates that the objectives of the remedy are being met and that the risks to human health and the environment remain low and acceptable in the long term.
- Most often is associated with groundwater contamination (because it is often impractical to completely remove contamination from groundwater)
- „Post-Remediation Monitoring „ vs. „Validation Monitoring“ - utilized to demonstrate that at the time of completion of the remediation project, the remediation objectives were met (typically threshold limits were achieved).

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PRM vs. Effectiveness of Remediation Methods

PHYSICAL	CHEMICAL	BIOLOGICAL	OTHER
Soil (waste)	Soil (waste)	Soil (waste)	Soil (waste)
mechanical treatment and sorting	chemical oxidation	bioventing	landfilling
solidification/stabilisation	chemical reduction	phyto-remediation	isolation of contamination
venting	neutralisation	biodegradation	by underground sealing
washing			and by covering
incineration			
thermal desorption			
Groundwater	Groundwater	Groundwater	Groundwater
air sparging	chemical oxidation	biological reductive	hydraulic barriers
pumping and subsequent treatment:	chemical reduction	dechloration	reactive barriers
▌ separation by gravity	neutralisation	biological reduction	monitored /
▌ stripping (by air or steam)		bio-slurping	assisted attenuation
▌ sorption		biodegradation	isolation of contamination
▌ coagulation			by underground sealing
▌ flocculation			and by covering

Soil excavation + Off-site disposal
(Landfilling, Incineration etc.)

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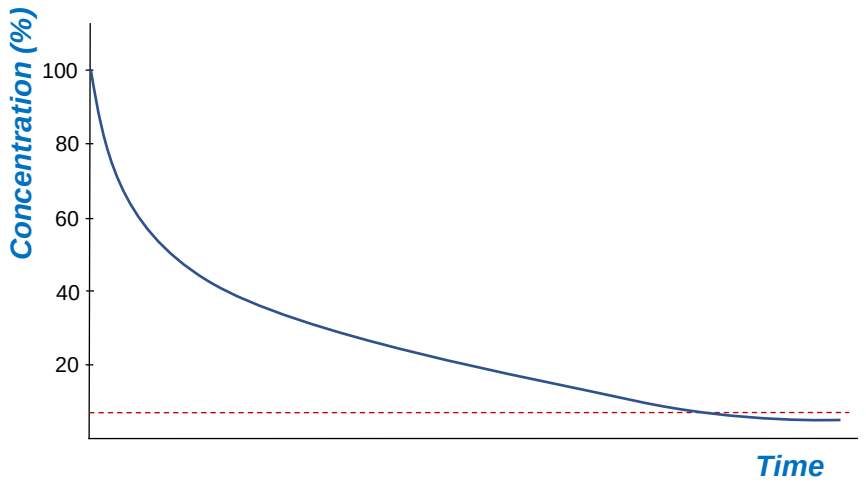
PRM vs. Effectiveness of Remediation Methods

Soil excavation + On-site treatment (Thermal desorption, Soil washing, etc.)

Soil bioremediation, Soil vapor extraction, Bioventing, In situ thermal desorption etc.



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In Situ Bioremediation

Soil Vapor Extraction

Steam Enhanced Soil Vapor Extraction – In situ Thermal Desorption

In Situ Bioremediation

Soil Vapor Extraction

Steam Enhanced Soil Vapor Extraction – In situ Thermal Desorption

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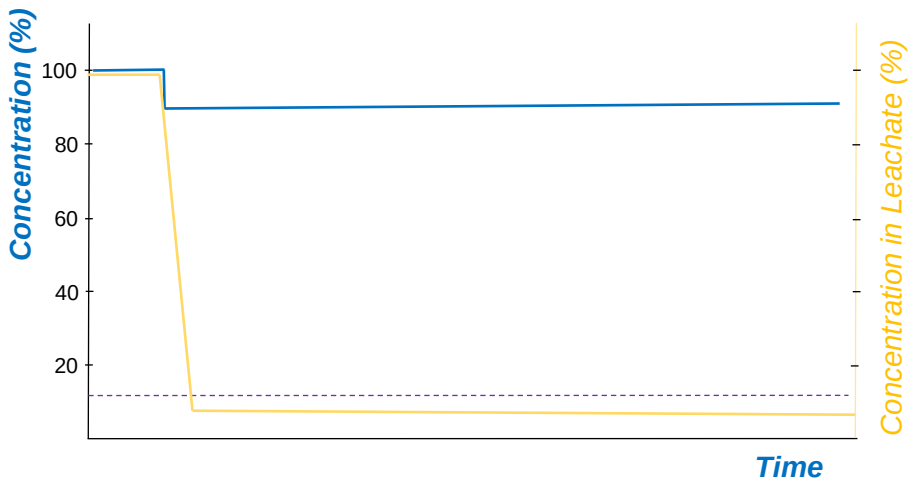
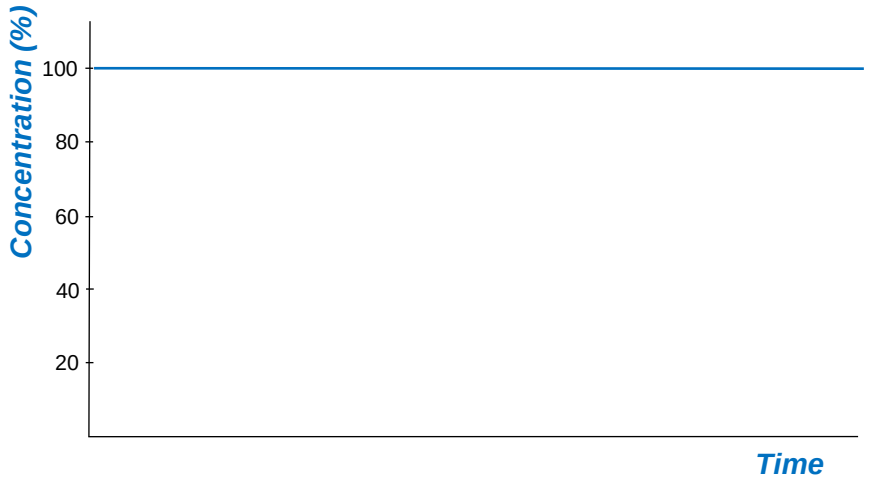
PRM vs. Effectiveness of Remediation Methods

Soil Stabilization



Encapsulation



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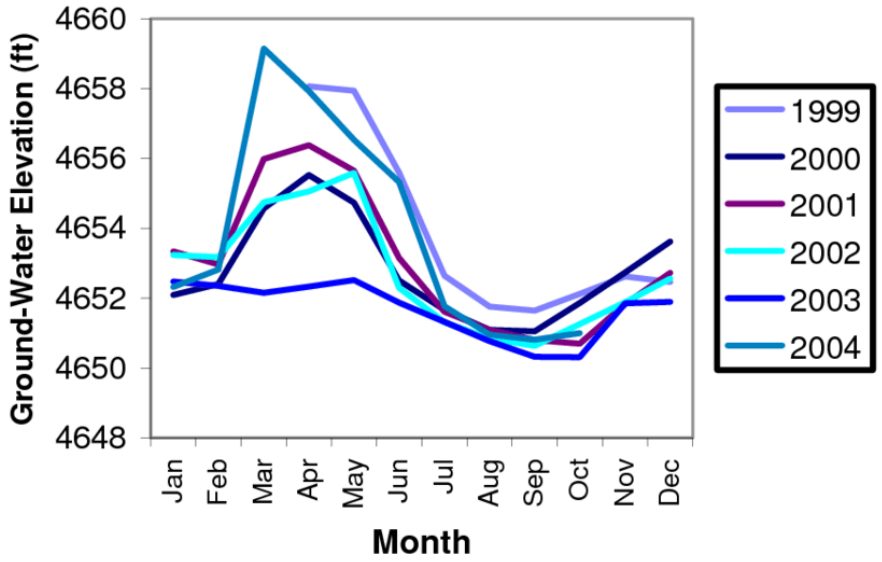
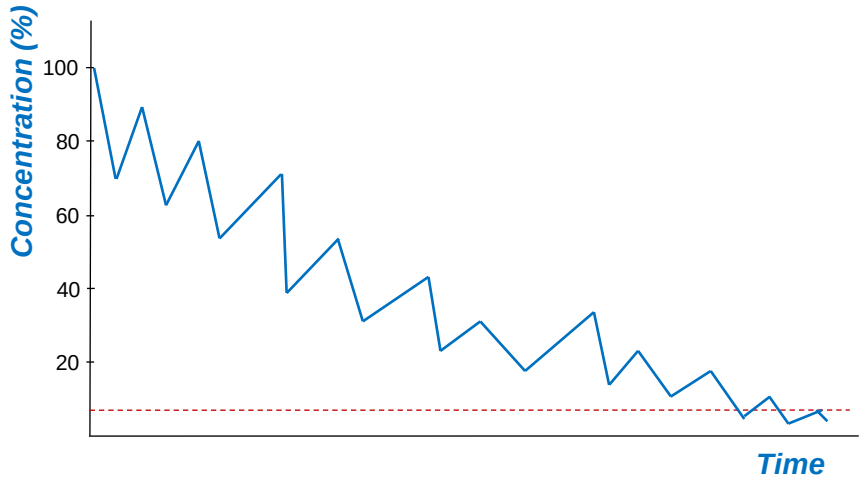
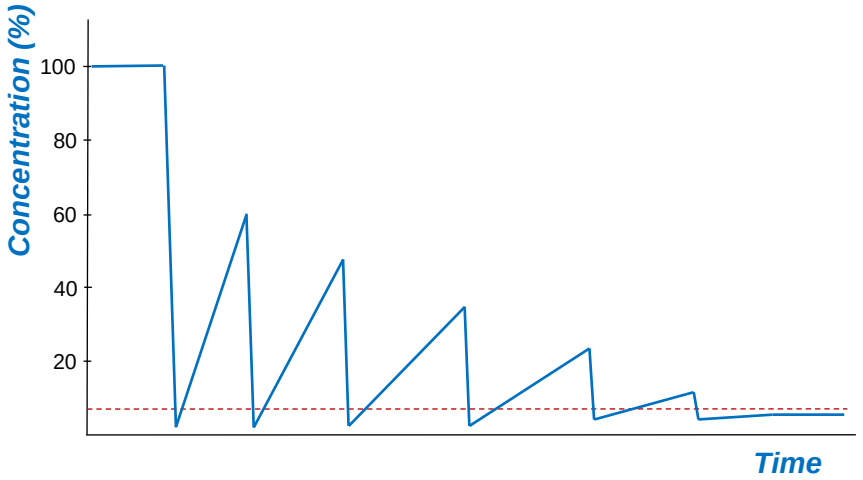
PRM vs. Effectiveness of Remediation Methods



Groundwater Pump & Treat, Air sparging, Biological methods



Chemical destruction (Oxidation, Reduction)



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Pump & Treat

Chemical Oxidation

Pump & Treat

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Chemical Oxidation

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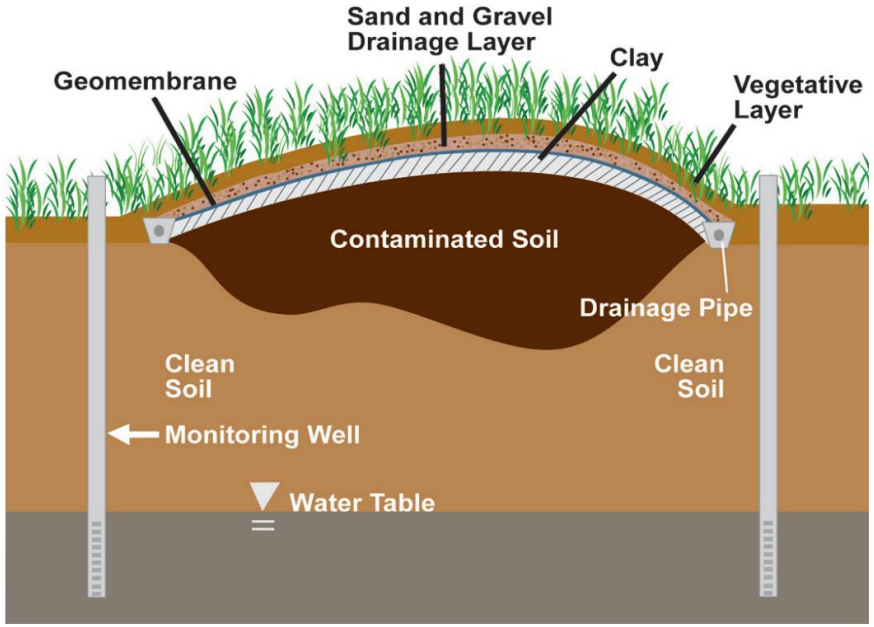
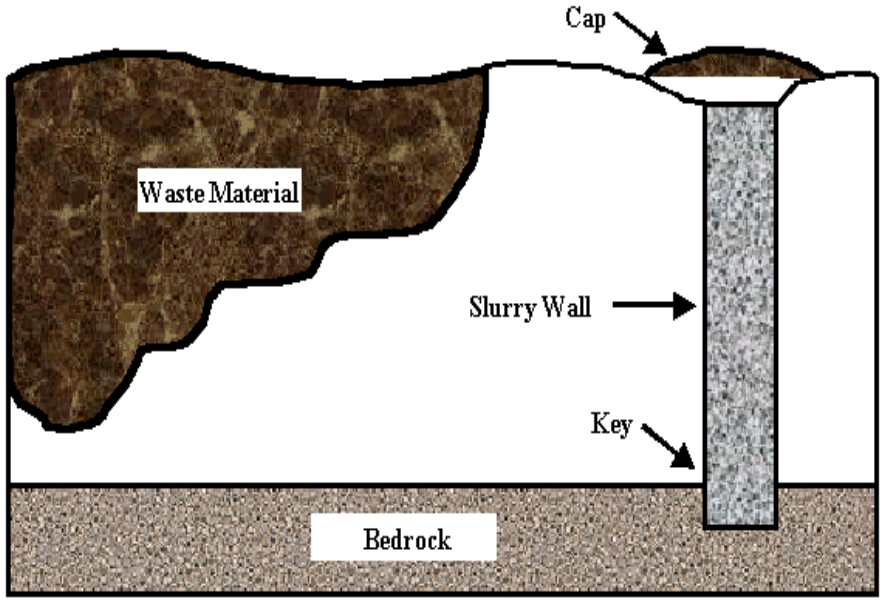
Long-term Monitoring of Containment

Capping



Slurry wall



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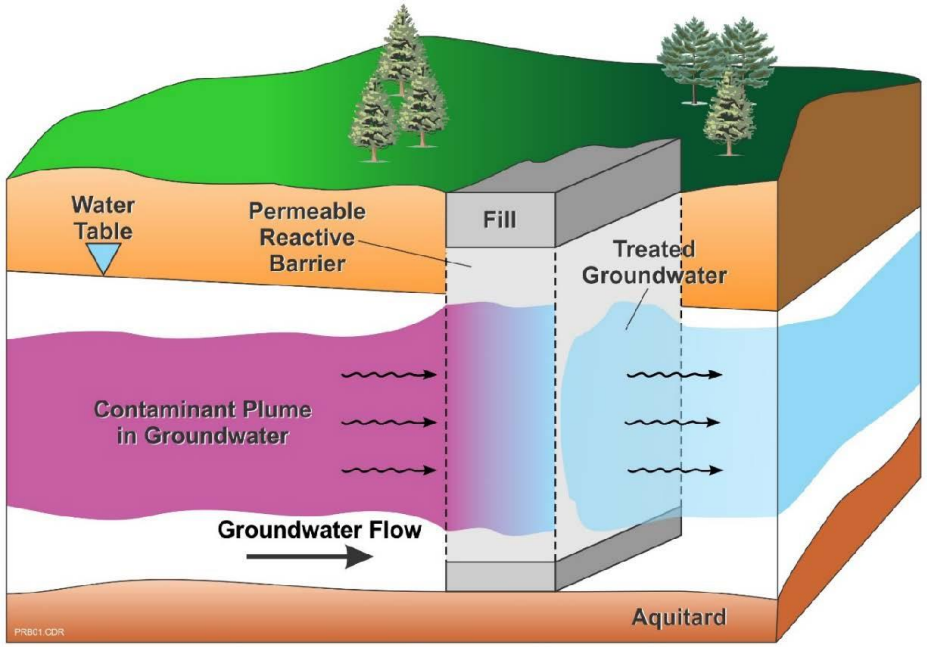
Long-term Monitoring of PRB



Trench Boxes

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Monitored Natural Attenuation

- Monitored natural attenuation (MNA) relies on natural processes to decrease or “attenuate” concentrations of contaminants in soil and groundwater:
  - Biodegradation (naturally present microflora)
  - Adsorption of contaminants to soil particles or rock surfaces. It does not destroy the contaminants, but it keeps them from moving deeper underground or from leaving the site with groundwater flow.
  - Dilution decreases the concentrations of contaminants as they move through and mix with clean groundwater.
  - Evaporation of volatile contaminants (like gasoline and industrial solvents)

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Monitored Natural Attenuation

- Chemical reactions with natural substances underground may change contaminants into less harmful forms (e.g. in a reductive environment, the toxic “Chromium VI” can be converted to a less toxic and mobile form called “Chromium III”).

- MNA is sufficiently fast and efficient only if there are favorable conditions at the site.
- MNA works best as the last step in the cleanup process when contaminant concentrations are low - e.g. after the source of contamination was removed and the most highly contaminated soil and groundwater was treated to lower contamination levels, MNA may remove the remaining, smaller amount of contaminants in the soil or groundwater.
- Regular monitoring is necessary to make sure that contaminants are not migrating out of the site and that they attenuate fast enough to meet site cleanup objectives.
- MNA may take several years to decades to clean up a site.

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Monitoring Strategy

- Following the identification of the need for LTM at a site an LTM strategy should be formulated. The strategy will be different for each site, and be dependent on:
  - Objectives of the LTM
  - Site conditions
  - Remediation already deployed
  - Scale of the monitoring (shall correspond to the complexity of the site)
  - Regulatory requirements, including orders or notices
  - Sensitivity of potential receptors
  - Uncertainty (e.g. seasonal fluctuations)

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Monitoring Frequency

- There are many factors that influence how frequently monitoring should occur, including:
  - Nature of the contamination
  - Site characteristics
  - Seasonal fluctuations in conditions;
  - Regulatory requirements;
  - Stakeholder perception of risk (including community perspectives).
- A staged approach involves frequent monitoring in the early stages of the LTM to assist in characterizing seasonal or other variations, with subsequent monitoring occurring at longer intervals.

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Monitoring Parameters

- It is recommended that the monitoring parameters and analytical methods are consistent with those employed in the validation phase. Target parameters will include:
  - Analytes identified as contaminants of concern during the remedial phase
  - Analytes identified as potential contaminants of concern based on the CSM update following validation
  - Parameters which provide information regarding hydrogeological or geochemical conditions affecting the fate of identified contaminants of concern (eg oxidation/reduction potential, soil pH)
  - Parameters which provide information regarding environmental change (e.g. groundwater levels, temperature)

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Long-term Monitoring Plan

- An example table of contents for an LTMP :
  - Introduction
  - Background
  - Roles and responsibilities
  - Monitoring activities
  - Quality control / quality assurance
  - Maintenance activities
  - Contingency planning
  - Reporting
  - Closure
  - Uncertainty

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Long-term Monitoring Plan - Content

- Background:

  » Executive summary » Site identification » Site history » Conceptual site model » Summary of previous investigation and remediation activities

- Roles and responsibilities:

  » Site owner » Site occupier » Regulator » Party responsible for ensuring that the LTM objectives are achieved » Details on accessing the site to conduct monitoring

- Monitoring activities:

  » Target media » Target analytes » Monitoring locations » Monitoring frequency at each location » Sampling (Sampling and testing methods and equipment, Calibration procedures, Number and type of QA/QC samples to be collected, Decontamination and preservation techniques, Sample storing and transport) » Laboratory analysis (Analytical methods)

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Long-term Monitoring Plan - Content

- Quality assurance and quality control:
  » Field and laboratory quality assurance / quality control (QA/QC) procedures
- Maintenance activities:
  Due to the LTM timescales, the monitoring infrastructure may require maintenance to ensure its longevity and the reliability of collected data – e.g. groundwater monitoring wells may need redevelopment due to silting etc.
- Contingency planning:
  The contingency plan should include trigger levels for the indicator parameters that are important in protecting human health, the environment, and the environmental values of the site, which if exceeded necessitate implementation of the contingency plan.

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Long-term Monitoring Plan - Content

Such triggers may include, but are not limited to, evidence of:

- increased contaminant concentrations
- changing contamination extent or migration
- new contaminants being released from the source, contaminant rebound, or a new primary source;
- contaminant concentrations are not decreasing at a sufficient rate to achieve the remedial objectives within a reasonable timeframe
- changes in land, groundwater, or land resource utilisation that could adversely affect the remediation.

The contingency plan should be initiated when trigger levels are exceeded.

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Long-term Monitoring Plan - Content

- Reporting:
  - Following each monitoring event, a report should be prepared
  - Reporting requirements will differ between each site, depending on regulatory or legislative requirements, or proponent or community expectations.
- Closure
  - A key part of formulating the LTM strategy is to identify whether site closure is likely to be achievable (e.g. the remedial objectives are forecast to be met after a period of time) or whether the site will require monitoring in perpetuity (e.g. a coastal containment cell).

Case Study 1

Safeguarding and disposal
of hazardous chemical waste in Pascani, Moldova

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

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Case Study 1

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 2

Environmentally-sound management campaign

of two sites in Sao Tome & Principe contaminated by POPs pesticides

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

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Case Study 2

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 3

Disposal of hazardous waste

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

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

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Case Study 3

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 4

Remediation

of river bank sediments contaminated with PCBs at Střekovský most

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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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

Case Study 5

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

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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

Case Study 6

Reclamation

of the hazardous waste landfill in Cişmichioi

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 / Cismichioi

Value of the contract:
935,000 EUR

Implementation period:
7/2018 – 10/2019

Photo: Cişmichioi hazardous waste landfill

REPUBLIC OF TURKEY
MINISTRY OF ENVIRONMENT,
URBANIZATION AND CLIMATE CHANGE

Environment and Climate Action
Sector Operational Programme

Persistent
Organic
Pollutants

UNDP

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the European Union and the Republic of Turkey.

Case Study 6

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 Cişmichioi, Republic of Moldova.

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

Case Study 7

Remediation

of an area contaminated by historic wood impregnation at Česká Lípa

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

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Environment and Climate Action Sector Operational Programme

Persistent Organic Pollutants

UNDP

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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 m^3
- 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 8

Remediation

of groundwater contaminated with chlorinated ethylenes in the vicinity of Olšany u Prostějova I

Client:
Olšany u Prostějova village
798 14 Olšany u Prostějova 50
Czech Republic

Contact person:
RNDr. Milan Elfmark
Mayor

Funding agency
(if different from the Client):
Environmental Operational Program

Location:
Czech Republic

Value of the contract:
141,079,529.80 CZK, excl. VAT

Implementation period:
2019 – ongoing (exp. 2023)

Photo: Remediation works at the site

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Case Study 8

Description of the Project:

The first phase of the remediation is planned from 2019 to 2023. As a first step, an MIP investigation was performed. The main aim of the MIP investigation was to obtain data on the localization of CHCs contamination and the properties of the rock environment. In situ chemical reduction (ISCR) and biological reductive dechlorination (BRD) are going to be used for remediation of contaminated aquifer. NZVI (ISCR) will be applied to the most contaminated horizons by direct-push technology. The BRD technology consists of proper delivery of an organic substrate, (whey, 765 m^3 in total), into the aquifer. This can be achieved via 300 permanent application wells. The application wells are divided into 3 lines.

Types of services provided by DEKONTA:

The following activities were carried out within the project:

- Membrane interface probe investigation
- NZVI direct-push application
- Biological reductive dechlorination

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the European Union and the Republic of Turkey.

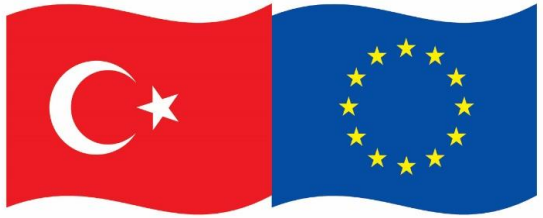
Case Study 9

Boyukshor Lake Rehabilitation Project - Baku, Azerbaijan

Client: **Baki Abadliq Xidmeti LLC**
Address: Neftchiler ave, 24, Dalga Plaza, Baku, Azerbaijan
Contact Person: Abraham Visagie, Project Manager
Tel: + 994 55 414 66 00
Email: a.visagie@archico.az

Primary contaminants:	Petroleum hydrocarbons
Volume of stabilized waste:	724 261 m^3
Implementation time:	03/2019 - 11/2021
Project costs:	Confidential information

Case Study 9



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

THANK YOU…

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