

Contaminated Land



A contentious issue?

Contaminated Land

- Some key points
 - Land contamination in England and Wales mainly dealt with through the planning system
 - All local authorities have produced strategies for inspecting their areas for contaminated land
 - In the UK some 360,000 hectares of land is thought to be contaminated
 - Cost of inspection is around £30 million
 - By end of March 2007 some 781 sites had been determined under Part 2A
 - Remediation of most contaminated land sites starts more than one year after site has been determined
 - Common remediation technique has been 'dig and dump'

Contaminated Land: Definition

“...any land which appears to the local authority in whose area it is situated to be in such a condition, by reasons of substances in, on or under the land, that

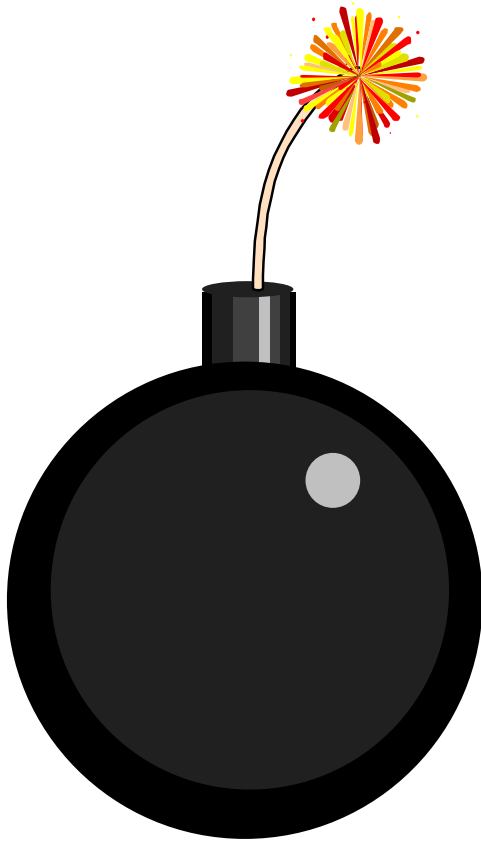
- (a) significant harm is being caused or there is a significant possibility of such harm being caused; or
- (b) pollution of controlled waters is being, or is likely to be caused:

This definition was modified under the Radioactive *contaminated land* (Modification of Enactments) (Wales) Regulations 2006 to read...

“...on or under the land, that –

- (a) harm is being caused; or
- (b) there is a significant possibility of harm being caused...”

Contaminated Land



Harm is defined as...

“harm to the living organisms or other interference with the ecological systems of which they form part, and in the case of man, includes harm to his property.”

EA 1995

Contaminated Land

What is significant in the context of harm?

Human beings

Living organisms or ecological systems

Property (livestock, other owned, wild animals)

Property (buildings)



Sources of contamination

Dry cleaners

Power stations

Chemical industries

Electricity substations

Paint manufactures

Scrap metal

Heavy engineering works

Rail depots

Gasworks

Landfill sites

Oil refineries

Likely contaminants



ArsenicCadmium

Lead Combustible materials

Mercury Cobalt

Magnesium CO

Chromium

Cyanides Sulphides

Sulphates Asbestos

Oils Coal tars

Phenols PCBs Methane

CO₂ Ammonia

Hydrogen sulphide

Contaminated Land

- Significant pollution linkages:
 - A contaminant
 - A receptor
 - A pathway
- *All need to be present to identify a pollutant linkage*
- For contaminated land the pollutant linkage needs to be shown to be significant
 - Significant harm is being caused; or
 - Harm is being caused (due to radioactivity); or
 - Pollution of controlled waters is occurring

Identification of contaminated land

Responsibility rests with Local Authorities...

- Inspect their areas for contaminated land
- Establish responsibility for contamination
- Decide on the remediation techniques
- Maintain a public register of remediation actions
- Prepare, publish and implement a strategy for dealing with contaminated land



Contaminated land: special sites

- Local authorities can designate contaminated land as a special site if one or more of the cases listed in the Regulations apply.
 - Four main areas:
 - Water pollution
 - Industrial land use
 - Defence
 - Radioactivity



Contaminated Land



Polluter pays
principle

Appropriate person

Class A Person

those persons who caused or knowingly permitted the pollutant in the significant pollutant linkage to be in, on or under the land.



Appropriate person



Class B person

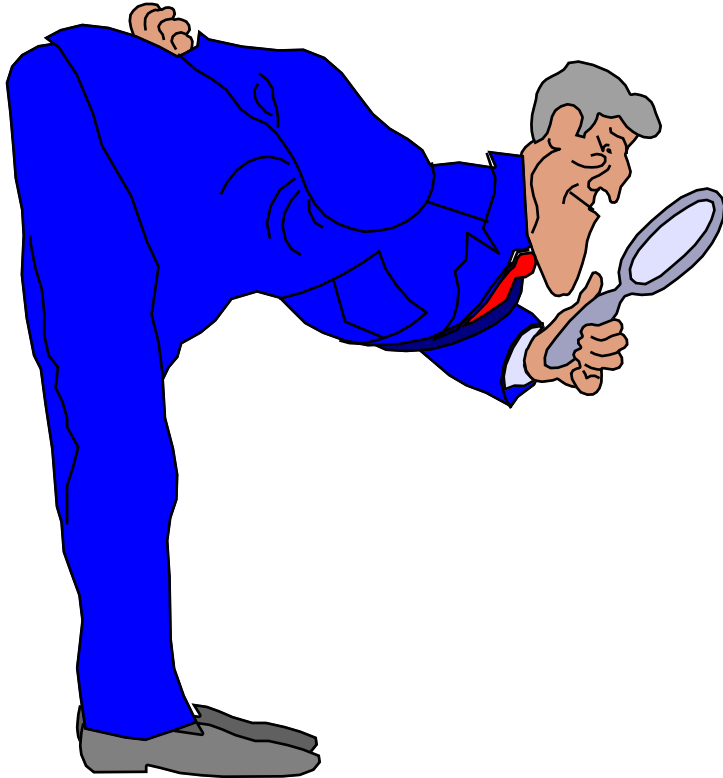
a site owner or occupier –
but would only be liable if
a Class A appropriate
person cannot
be found for a particular
significant pollutant
linkage.

Why be so concerned about contamination?



- Health and safety impacts
- Liability
 - Remediation
 - Existing contamination
- Delays to the programme
- Pollution
 - Groundwater and surface water
 - Surrounding land

Site investigation



Must be sufficiently comprehensive, so as to present a reasonably accurate picture of the site condition, and not a misleading impression.

Preliminary assessment

Desk study

To identify what contamination is likely to be found on the site and where, its associated hazards, and potential scale of risk lies.

On-site reconnaissance

To identify what special procedures / protective equipment might be necessary during preliminary on-site reconnaissance or subsequent site investigation.

Site investigation



Typical strategy:

- Determine the nature and extent of any contamination of soils and groundwater on the site
- Determine the nature and extent of any contamination of soils migrating into the site
- Determine the nature and extent of any contamination of soils migrating off the site
- Determine the nature and engineering implications of other hazards and features on the site

Site investigation

- Identify, characterise and assess potential targets and likely pathways
- Provide sufficient information to identify and evaluate a range of remedial strategies
- Determine the need for, and scope of, short and long term monitoring and maintenance
- Provide for an effective health and safety procedure.



The desk study

History of the site.

Details of owners,
users and occupiers as
far back as possible.



The desk study

Processes used:

- Locations
- Raw materials
- Products
- Waste residues
- Disposal methods



The desk study



- Chemical / physical properties of potential contaminants on site
- Presence of waste disposal areas
- Mining history
- Previous survey data
- Accuracy of information
- Populations at risk

The desk study



Location and layout of proposed site

- Storage areas
- Roadways
- Hard-cover areas
- Existing structures
- Pits
- Services
- Habitats

Investigating a contaminated site

In summary:

- Review of site history
- Site reconnaissance
- Review of legislation
- Identify nature and extent of contamination
- Risk assessment
- Remedial options
- Feasibility study
- Remediation
- Final design
- Monitoring



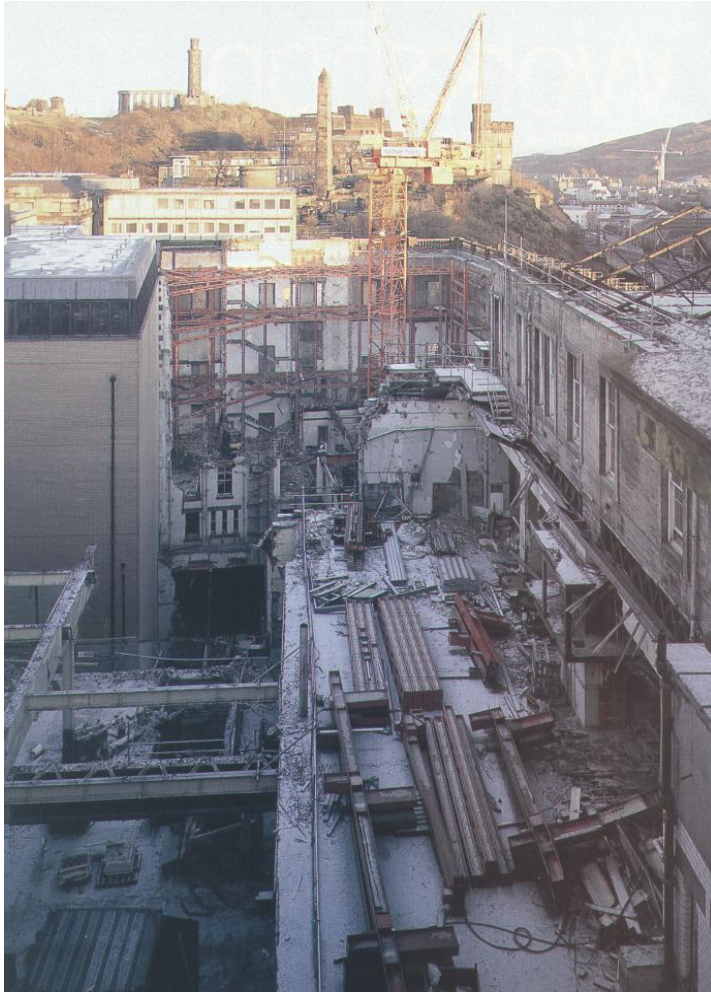
Contaminated Land

Effective management of ground contamination...

- Do not cause it or spread it
- Deal with it appropriately



Contaminated Land



Problems on site may arise...

- Encountering contamination during the construction period
- Handling or excavating contaminated ground

Contaminated Land

Typically managers will need to consider the following...

- Windblown contaminated dust
- Stockpiling contaminated soil
- Stockpiling materials containing contaminants
- Spillages
- Dewatering
- Nearby water courses



Contaminated Land

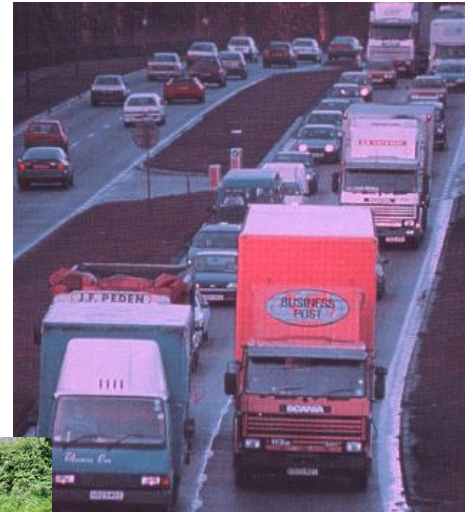


The what if scenario!



Contaminated Land: what to look out for...

- Discoloured soil
- Fibrous texture to the soil
- Presence of foreign objects
- Evidence of previous soil workings
- Evidence of underground structures and tanks



- Existence of waste pits
- Made ground
- Old drain runs
- Nearby road systems

Finding contamination



When contamination is suspected do the following...

- Stop work
- Seal off the area
- Report the discovery
- Seek expert advice

Contaminated Land

What next?

Remediation

Often taken to mean
'clean-up techniques'

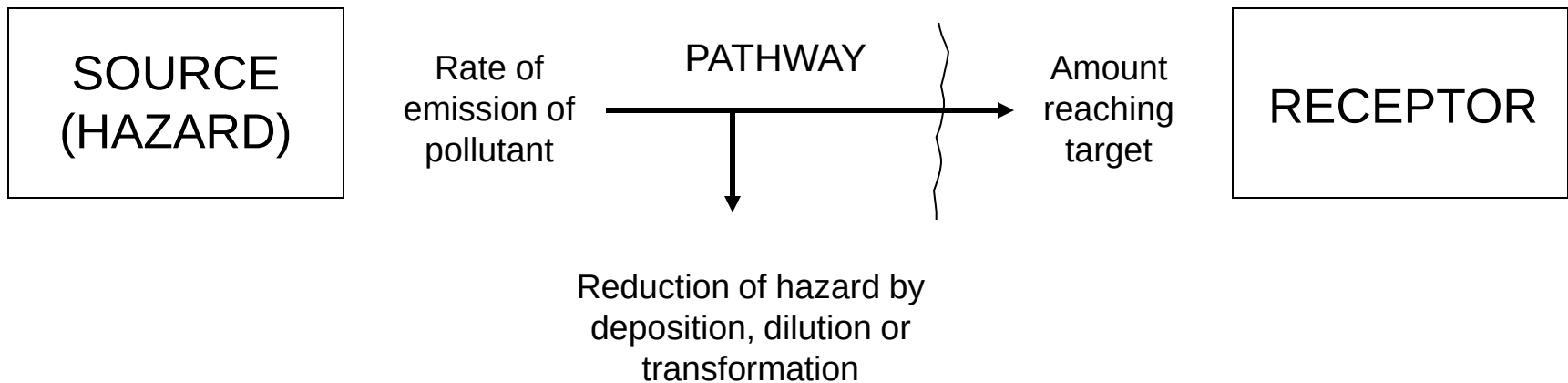


Why remediate?

- ❑ What are the drivers?
 - Brownfield redevelopment
 - Legal requirements as condition of planning
 - Legal requirement under Part IIA
 - Voluntary

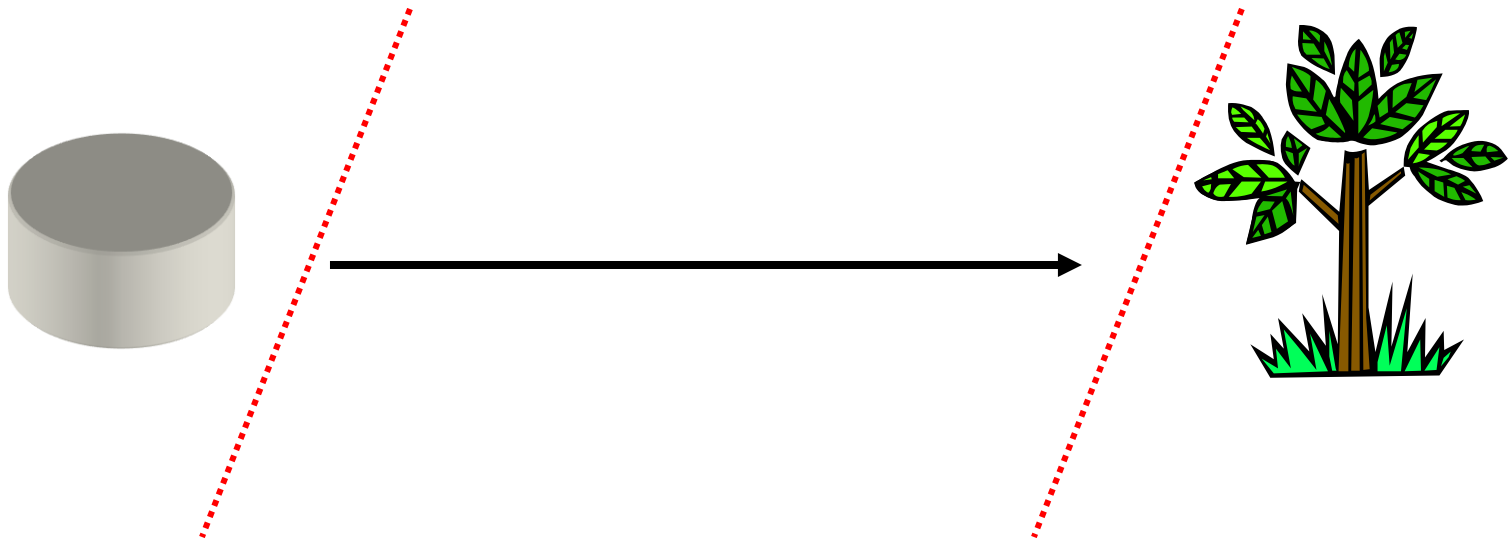


Risk assessment



Manage risk by controlling source, pathway or receptor

What is remediation?



Breaking or modifying the **source-pathway-receptor** linkage

Who are the stakeholders?

Example of stakeholders	Roles	Objectives
Land owner	Provide access and co-operation, financially responsible	Limit or remove his / her liability
Developer	Responsible for site remediation and redevelopment	Redevelopment of site in cost-effective manner / make profit
Local authority	Regulator	Fulfil duties under Part IIA
Regulatory authority EA / SEPA	Responsible for Special Sites and overseeing remediation of controlled waters	Fulfil statutory responsibilities
Contractors / consultants	May undertake: site investigation, risk assessment, remediation and aspects of development	Make profit
Residents	Consultees	Protect neighbourhood / property /selves
Special interest groups	Consultees	Limit or reduce risk to other environmental / ecological receptors
Financial institutions	Mortgage or finance provision	Financial return
Insurance guarantors	Underwrite risk	Financial return

Management objectives

During remediation, eg:

- within budget?
- within timescale?
- best value for money?
- treatment area to be confined to site?
- treatment to take account of ongoing site operations?

Post treatment, eg:

- minimal maintenance and monitoring?
- compatible with end-use?
- reduction in long-term liabilities?
- acceptable to funders, insurers and regulators?
- restrictions on redevelopment?

Prioritising



- By site area
- By media type
- By chemical grouping

- By severity of risk
- By external regulatory requirements
- By speed/ease of treatment



Site-specific constraints



e800301 [RM] © www.visualphotos.com

- Physical
- Infrastructure
- Site use (current or proposed)
- Location of site
- Regulatory acceptance
- Community acceptance

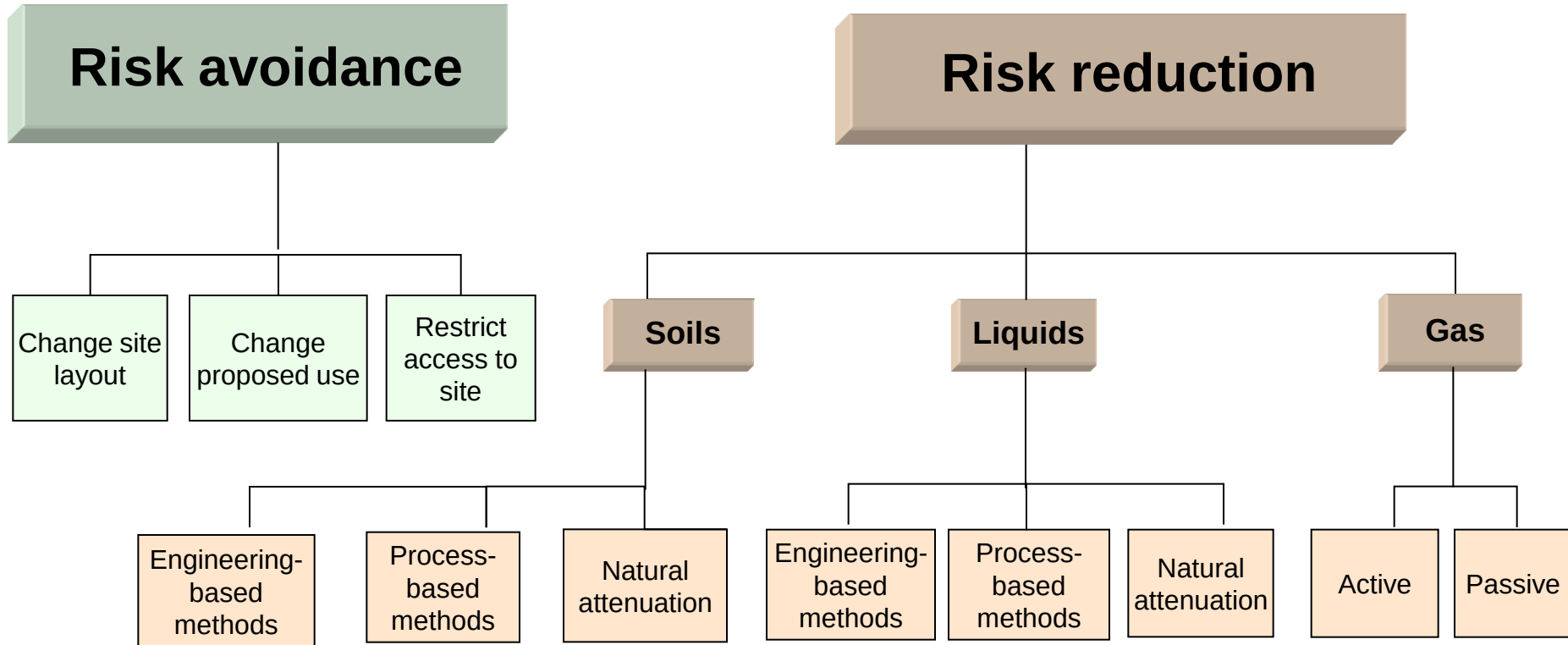
Engineering objectives

- Improvements, eg stability or bearing capacity
- Modifications, eg changes in ground levels



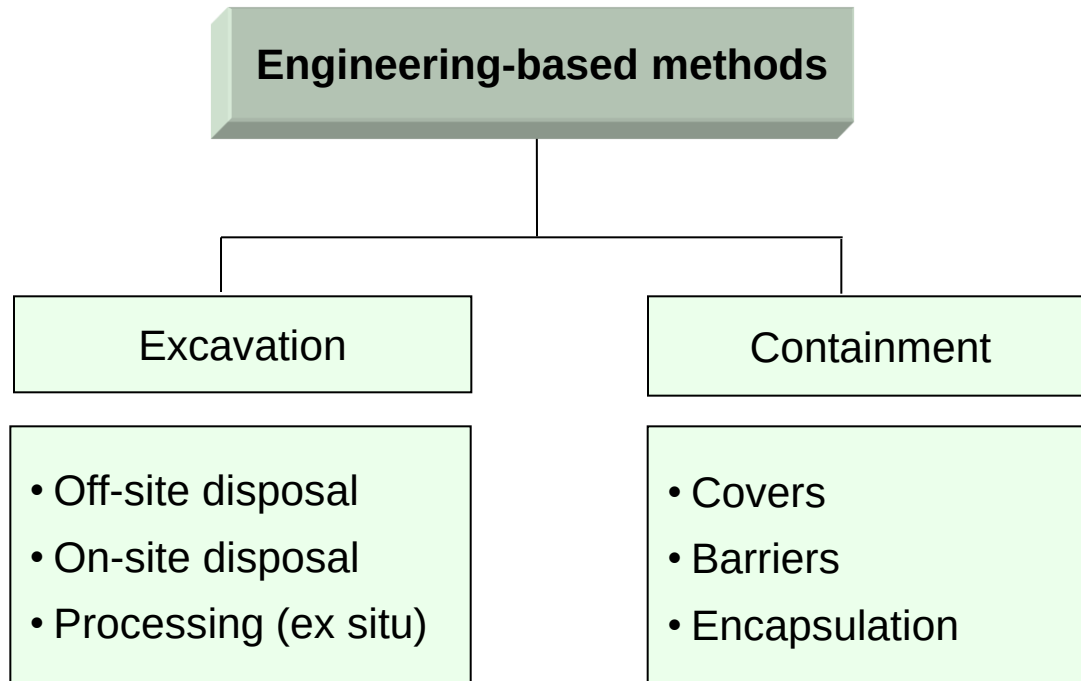
Need to overcome conflicts, eg
treatment may change soil properties

Options for remediation



Options for soils

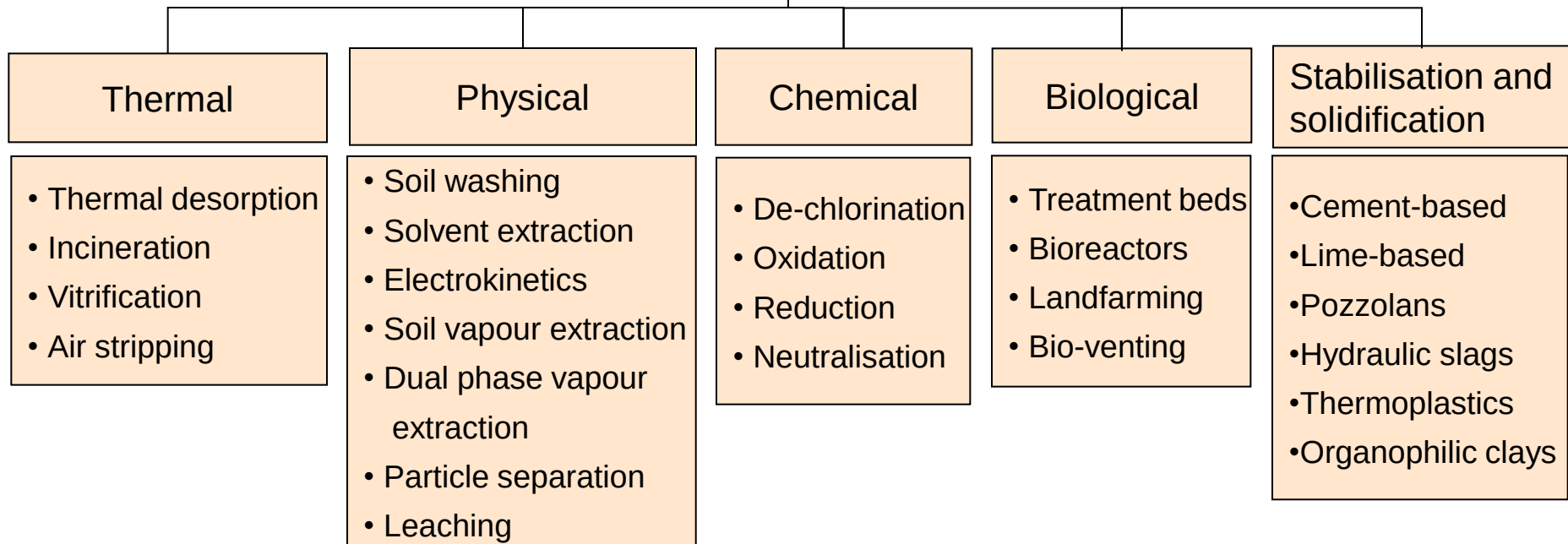
Engineering-based methods



Options for soils

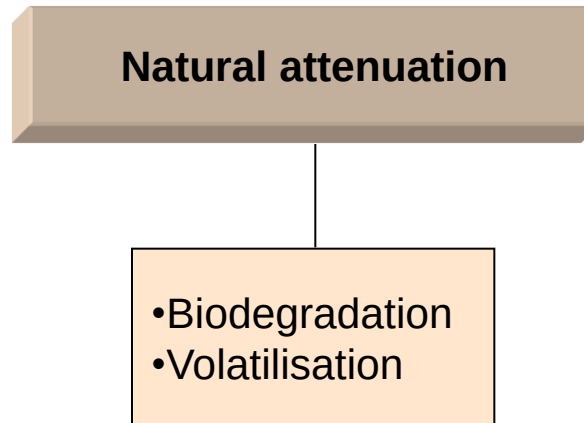
Process-based methods

Process-based methods



Options for soils

Natural attenuation



Options for liquids

Engineering-based methods

- Isolation/containment
- Pump to treat
- In support of physical measures

Process-based methods

Physical

- Air stripping
- Air sparging
- Sedimentation
- Adsorption
- Coagulation and flocculation

Chemical

- Precipitation
- Oxidation
- Reduction
- Neutralisation

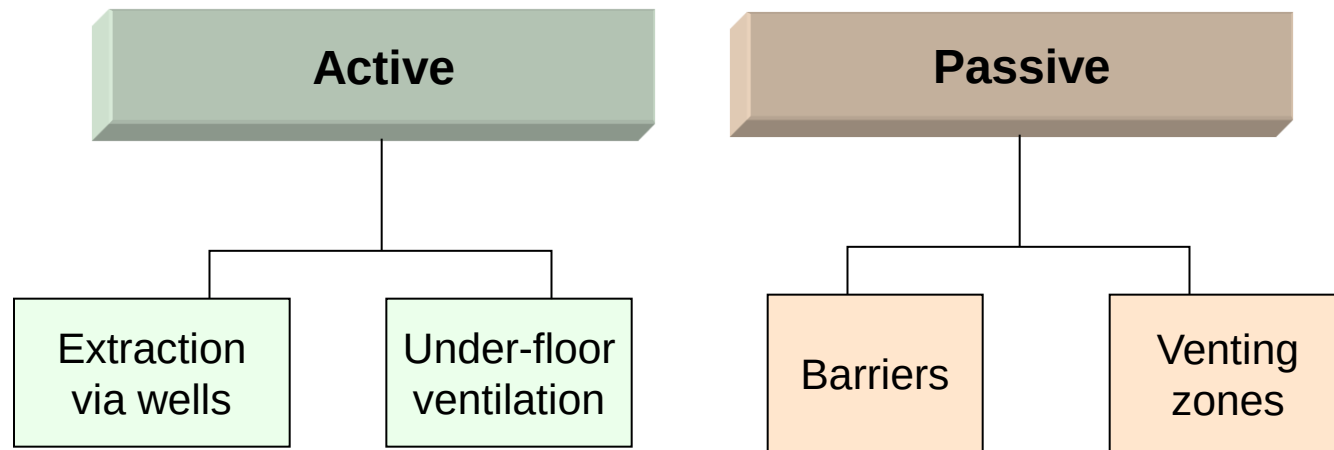
Biological

- Bioreactors

Natural attenuation

- Biodegradation
- Sorption
- Dilution
- Volatilisation

Options for gases



Developing a strategy

Factors to take into account include:

- applicability
- effectiveness
- limitations
- cost
- development status
- availability
- operational requirements
- regulatory requirements
- local concerns
- information requirements
- planning and management needs
- monitoring needs
- health and safety aspects
- potential environmental impacts
- development of method statements
- validation requirements
- post-treatment management needs

Assumptions for indicative costing

Assumption

Sources of information

Maximum and minimum volume of material	→ Site investigation data
Sensitivity of costs to changes in volumes of material	→ Discussions with contractors
Suitability of remedial option to physical and chemical properties	→ Published information
Off-site disposal costs	→ Waste disposal operators
Treatment costs	→ Discussions with contractors
Services and infrastructure	→ Discussions with contractors and service authorities
Long-term monitoring requirements	→ Discussions with contractors or regulators

Final evaluation – key criteria



- Protection and compliance
- Long-term performance/permanence
- Technical effectiveness
- Impact on the workforce and environment

- Practicality (including timescale)
- Cost
- Social and community impact/acceptance
- Institutional acceptance

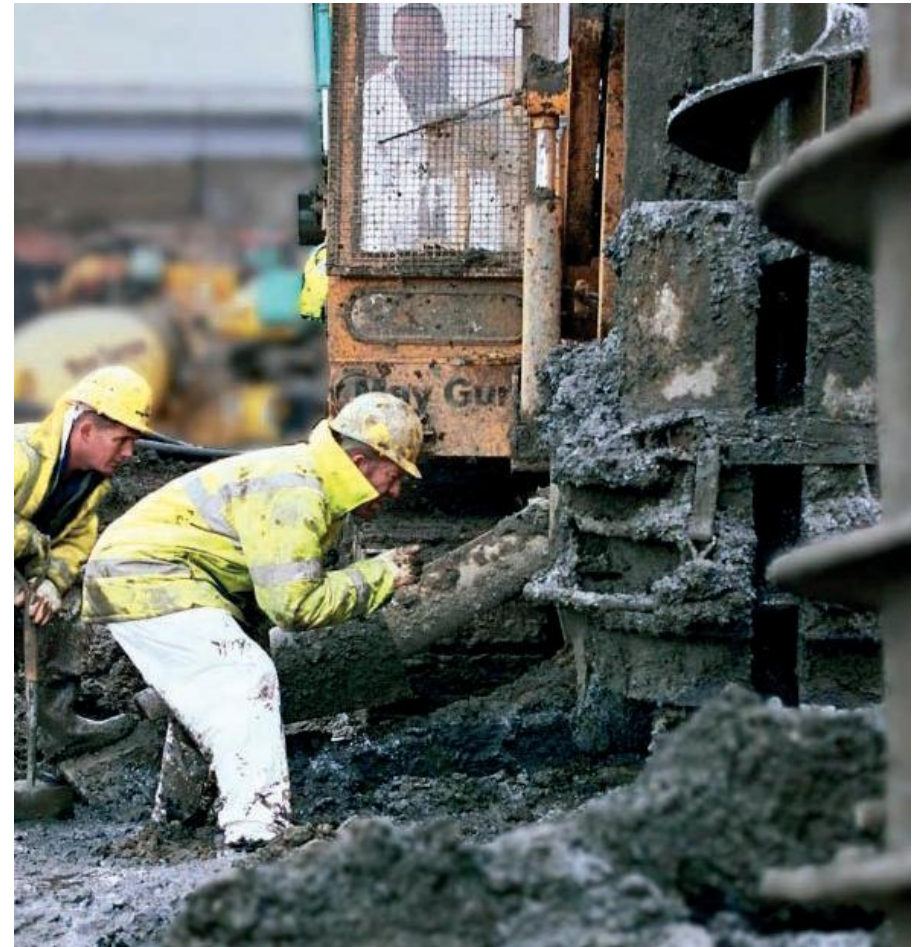


Contaminated land: Case study

Solidification / Stabilisation

Read the accompanying article,
Cement offers real solution for brownfield land remediation,
(Concrete, Jan/Feb 2006) and answer
the following:

1. Compare and contrast the use of in situ methods with ex situ methods of S/S
2. Identify the key factors that have driven S/S as a means of cleaning up contaminated lands
3. Why is S/S such a versatile and flexible remedial technique?



Contaminated land: Workshop

Put forward reasons why contaminated land has come to represent one of the most significant environmental issues.



Propose and justify a suitable remediation process for land contaminated with industrial wastes