Session 1

Legislation 1

Legislative Contexts

- Policy
- Legislation
  - Planning Regime
  - Part 2A
  - Other relevant legislation

UK Contaminated Land Policy

- To prevent future pollution
  - e.g. Groundwater Regulations, Environmental Damage Regulations and Pollution Prevention and Control Act
- To restore past damage/contamination in an orderly way
  - Planning and Part 2A regimes
  - reduce unacceptable risks to:
    - human health and
    - environment
  - enable re-use of brownfield sites & protect greenfield sites
  - using a risk-based approach

Planning process

- [Generally] Applies where a change in land use is proposed
- Implemented [mainly] by Local Authorities
  - National policy and local plan set the development framework for an area
  - Pre-application advice/consultation
  - Applicant applies for planning permission
  - Local Planning Authority undertakes consultation
    - Environmental Health will usually deal with land contamination issues
    - Environment Agency/SEPA/Natural Resources Wales is a consultee
- LPA may grant planning permission subject to conditions which MUST BE discharged
- Not discharging conditions may render planning permission invalid

Planning process: Legislation

- Town and Country Planning Act 1990
  - England and Wales
- The Housing and Planning Act 2016
  - England
  - To boost homeownership and housebuilding
- Planning (Wales) Act 2015
  - Devolves certain powers to Welsh Ministers
- Town and Country Planning (Scotland) Act 1997
- Planning (Scotland) Act 2019
- Planning Act (Northern Ireland) 2011
  - Supercedes: Planning (Northern Ireland) Order 1991 (Only Article 2, Part 3, Part 7, Part 9, Schedule 2 remain)

Planning process: Guidance

- England
  - National Planning Policy Framework 2021 (NPPF)
- Wales
  - Planning Policy Wales (Edition 11, Feb 21)
- Scotland
  - Planning Advice Note (PAN) 33 (Dec 17/October 2000)
- Northern Ireland
  - Strategic Planning Policy Statement for Northern Ireland (2015)

NPPF 2021: Key Features

- "Presumption in favour of sustainable development"
- **Key requirements for land affected by contamination effectively unchanged since 2012!**
  - 183. Planning policies and decisions should ensure that:
    - a) a site is **suitable for its proposed use** …;
    - b) **after remediation**, as a minimum, land should not be capable of being determined as contaminated land under Part IIA…; and
    - c) **adequate** site investigation information, prepared by a **competent** person, is available to inform these assessments.
  - 184. Where a site is affected by contamination… responsibility for **securing a safe development** rests with the developer and/or landowner.
- Promotes development on BF/PDL

NPPF: Land affected by contamination

- Para 174 "Planning policies and decisions should contribute to and enhance the natural and local environment by::……..
  - e) preventing **new and existing** development from contributing to, being put at **unacceptable risk** rom, or being adversely affected by, unacceptable levels of soil, air, water or noise **pollution** or land instability. Development should, wherever possible, help to improve local environmental conditions such as air and water quality, taking into account relevant information such as river basin management plans; and
  - f) **remediating** and mitigating despoiled, degraded, derelict, **contaminated** and unstable land, where appropriate.

Ground conditions and pollution P183

- Planning policies and decisions should ensure that:
  - a) a site **is suitable for its proposed use** taking account of ground conditions and any risks arising from land instability and contamination. This includes risks arising from natural hazards or former activities such as mining, and any proposals for mitigation including land remediation (as well as potential impacts on the natural environment arising from that remediation);
  - b) after remediation, **as a minimum**, land should not be capable of being determined as contaminated land under Part IIA of the Environmental Protection Act 1990; and
  - c) **adequate** site investigation information, prepared by a **competent person**, is available to inform these assessments.

adequate

competent

Not Part2A

NPPF: Land affected by contamination

- P183: responsibility for securing a safe development rests with the developer and/or landowner.
- P185: Planning policies and decisions should also ensure that new development is appropriate for its location taking into account the likely effects (including cumulative effects) of pollution on health

developer

Planning authority

NPPF: Competent person

- In Annex 2 Glossary
- Competent person (to prepare site investigation information):
  - A person with
    - a recognised relevant qualification,
    - sufficient experience in dealing with the type(s) of pollution or land instability, and
    - membership of a relevant professional organisation.

NPPF: What is Site Investigation Information?

- In Annex 2 Glossary
- Includes a **risk assessment of land potentially affected by contamination**, or ground stability and slope stability reports, as appropriate. All investigations of land potentially affected by contamination should be carried out in accordance with established procedures (eg **BS10175**).

National Planning Practice Guidance website

https://www.gov.uk/government/collections/planning-practice-guidance

Collection
Planning practice guidance

The National Planning Policy Framework and relevant planning practice guidance.

From: Department for Levelling Up, Housing and Communities and Ministry of Housing, Communities & Local Government
Published 29 November 2016
Last updated 24 June 2021 — See all updates

In response to the spread of Coronavirus (COVID-19), MHCLG has published planning guidance. We will be adding to this as guidance is updated, so please check the page regularly. Best practice advice and links are also available from the Planning Advisory Service website

The National Planning Policy Framework was published on 27 March 2012 and revised in 2018, 2019 and most recently 20 July 2021. It sets out the government's planning policies for England and how these are expected to be applied.

Housing needs of different groups
24 May 2021 Guidance

Housing for older and disabled people
26 June 2019 Guidance

Housing: optional technical standards
27 March 2015 Guidance

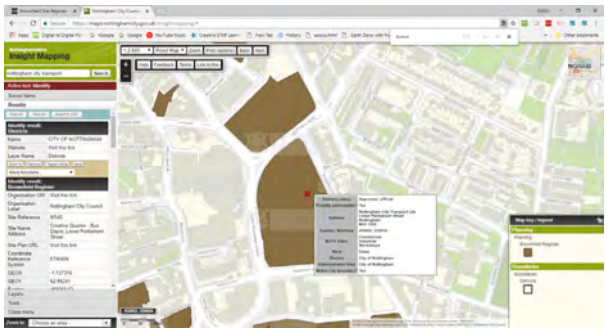
Housing supply and delivery
22 July 2019 Guidance

Land affected by contamination
22 July 2019 Guidance

Land stability
22 July 2019 Guidance

Housing and Planning Act 2016

- duty for local authorities to keep a register of brownfield land
- can grant "permission in principle" for housing on sites on registers
  - planning permission for housing-led development
  - technical details to be approved by LA



Identify result: Brownfield Register	
Organisation URI	Visit this link
Organisation Label	Nottingham City Council
Site Reference	9/540
Site Name Address	Creative Quarter - Bus Depot, Lower Parliament Street

Planning in Wales: Planning policy Wales (Edition 11; February 2021)

- Promotes redevelopment of PDL
- Land Contamination 6.9.16 ff.
  - "onus will remain with the **developer** to ensure that the development of the site will remove any unacceptable risks and the **planning authority** in making development management decisions will need to ensure that the land is suitable for its proposed use and would not meet the legal definition of contaminated land under Part IIA. " (6.9.17)
  - Local planning authority requires evidence of investigation and RA prior to the determination of the application (6.9.19)
  - responsibility and subsequent liability for safe development and secure occupancy of the site rests with the developer and/or landowner (6.9.21)

developer

Planning authority

NPPF does not apply

Planning in Scotland: PAN 33

- The developer should….
  - ".. build-up a picture of the source(s), pathway(s) and receptor(s) that are relevant to the particular site, consider the risks that are relevant and design an appropriate remedial solution"
  - ".. undertake an adequate risk assessment of a site, … to propose measures to ensure that these risks are appropriately addressed"
  - "The planning authority must consider whether a developer's restoration plan is adequate to avoid unacceptable risks to human health and the wider environment from the contamination on the site, both during the restoration period and for the final end use"
  - "the responsibility for the safe development of the site rests with the developer"

NPPF does not apply

developer

Planning authority

https://www.gov.scot/publications/pan-33-development-of-contaminated-land/

Planning in Northern Ireland:

- Where present, contamination is likely to be regarded as a material consideration under planning
- Limited planning guidance on contaminated land issues
  - https://www.daera-ni.gov.uk/articles/planning-and-land-contamination
  - Tends to look to rest of UK
- Likely to be updated once Part III Waste and Contaminated Land Order has been implemented in Northern Ireland – was due 2007 – not yet implemented
- NIEA's Historical Land Use database
  - https://www.daera-ni.gov.uk/publications/historical-landuse

NPPF does not apply

Summary: Planning

- Risk-based regime
- Preferred route for dealing with historic contamination
  - Most contaminated land is identified and managed under this regime (cf Part 2A)
- Read the NPPF - Contamination is a "material consideration"
- Understand your Local Plan and Council's planning policies
- The planning system should ensure that once developed, land is safe and suitable for use and after remediation cannot be determined under Part 2A.

Session 2

Legislation 2

Part 2A of the Environmental Protection Act 1990

- Significant Harm
- ~~Safe~~
- SPOSH
- Significant Pollution
- SPoSPoCW

Part 2A: Contaminated Land Regime

- Regime for the control of specific threats to health or the environment from existing land contamination. Improved and coordinated previous mechanisms.
- Provides a legal definition of "contaminated land"
- Proactive and strategic approach by local authorities
- Based on "suitable for use" and "polluter pays"
- Aim: identify and remove unacceptable risks to human health and the environment

Part 2A: What is 'Suitable for Use'?

- Part 2A deals with the current use of the land
- "Suitable for use" means the:
  - clean up targets reflect current use
    - Includes temporary use, informal use
  - stringency increases with sensitivity of use:
    - industrial use <least>
    - open space
    - residential <most>

Unacceptable Risk in statutory guidance

- P2A/IIA regime provides framework to identify land which poses unacceptable risks to:
  - Health
  - Environment
- It is only P2A if:
  - unacceptable risks clearly identified, after a RA carried out

3.2 All soils contain substances that could be harmful to human or environmental receptors, although in the very large majority of cases the level of risk is likely to be very low. In conducting risk assessment under the Part 2A regime, the local authority should aim to focus on land which might pose an unacceptable risk.

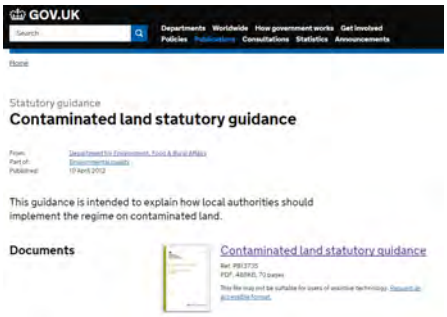
Current Use

Part 2A: The legislation & guidance

- Part 2A of the Environmental Protection Act, 1990 - inserted by section 57 of the Environment Act 1995
  Implemented by the:
  - The Contaminated Land (England) Regulations 2006, as amended 2012
  - The Contaminated Land (Wales) Regulations 2006, as amended 2012
  - The Contaminated Land (Scotland) Regulations 2005
  - Draft Northern Ireland regulations- Part III – not commenced
- Statutory Guidance was issued for each:
  - **Revised guidance published for England and for Wales in April 2012**
  - Part IIA Contaminated Land statutory guidance: Edition 2 (Scottish Executive Circular SE/2006/44)
- Controlled waters provisions in modified by Section 86 of The Water Act 2006
  - The Water Act 2003 (Commencement No.11) Order 2012

Revised Statutory Guidance: England

- "Environmental Protection Act 1990: Part 2A – Contaminated land Statutory Guidance"
  - Published by Defra
  - 10th April 2012



www.gov.uk/government/publications/contaminated-land-statutory-guidance

Revised Statutory Guidance: Wales

- "Contaminated Land Statutory Guidance – 2012"
  - Published by the Welsh Government in April 2012
  - Document Number: WG19243
  - https://www.gov.wales/sites/default/files/publications/2019-08/contaminated-land-statutory-guidance-2012.pdf

Statutory Guidance: Scotland

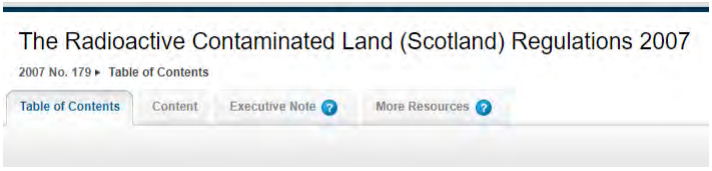
- Environmental Protection Act 1990 - Part **IIA** Contaminated Land: statutory guidance edition 2 2006
  - https://www.gov.scot/publications/environmental-protection-act-1990-part-iia-contaminated-land-statutory-guidance/pages/0/

Radioactive Contaminated Land

- Separate, but related regime

The Radioactive Contaminated Land (Enabling Powers and Modification of Enactments) (England) (Amendment) Regulations 2018

2018 No. 429 ▸ Regulation 2



Part 2A: Duties of Local Authorities

- Inspect their area "from time to time"
  - Rational, ordered and efficient – Inspection Strategy
  - Prioritisation of detailed inspection activity
  - Prepare risk summaries prior to determining land
- Identify contaminated land
  - Consult Environment Agency and other agencies
  - Most pressing and serious problems are located first
  - Where appropriate determine land as Contaminated Land
    - Written record of determination
- Identify who is liable – "appropriate persons"
- Secure remediation, where necessary, or to act in default (and recover costs)
  - Serve Remediation Notice
- Maintain a public register of contaminated land

Part 2A: Appropriate Person(s)

- Class A person:
  "Any person … who caused or knowingly permitted the substances, or any of the substances, by reason of which the contaminated land in question is such land to be in, on or under that land"
- Class B person:
  "If no person has, after reasonable enquiry, been found who is … an appropriate person to bear responsibility … the owner or occupier for the time being of the land in question is an appropriate person"
- Orphan Linkages
- Liability Groups
  - Procedure for determining liabilities
- A developer may be classed as an appropriate person if they introduced the receptor involved in the significant pollutant linkage irrespective of the original polluter
  - e.g. Circular Facilities vs. Sevenoaks District Council

Part 2A: Special sites

- Some sites if determined may be "Special Sites"
  - Enforcing authority becomes Environment Agency (England); National Resources Wales or SEPA (in Scotland)
  - Local authority must determine land as contaminated land first - consult with appropriate enforcing body
- Types of special sites include:
  - Those affecting specified geology eg Chalk;
  - Those affected by specified contaminants eg cyanide; MoD land; Acid tar lagoons; Explosive factories; Refineries etc.

Detailed in the Con Land Regs 2006 (as amended) https://www.legislation.gov.uk/

Revised Statutory Guidance (2012): Key Changes from 2006 version

- Constant reference to undertaking decisions in line with "the broad objectives of the regime"
- Starting point: land is NOT contaminated land
- More explicit on what is **not** contaminated land
- Changes to definition of 'significant harm to human health'
- Changes to pollution of controlled waters elements
- *NEW* Consideration of background or "normal" contamination
- Procedures for local authorities to record decision making
  - Likely that land may be determined: LA produces a risk summary
  - Land not contaminated land: LA issues a written statement to that effect
  - Land is contaminated land: LA prepares a written record of determination

Part 2A: What is 'Contaminated Land'?

*Any land which appears to the **local authority** in whose area it is situated to be in such a condition, by reason of substances in, on or under the land, that:*

*(a) **Significant harm** is being caused or is there is a significant possibility of such harm being caused; or*

~~*(b) **Pollution of controlled waters** is being, or is likely to be, caused*~~

*(b) **Significant Pollution of controlled waters** is being, or there is a significant possibility of such pollution being caused."*

Significant Harm

Significant Pollution

Definitions in revised statutory guidance updated in line with Water Act, 2003.

Part 2A: Harm

- Section 78A(4) of Part 2A defines "harm" as:

  "harm to the health of 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"

- Harm could be to:
  - human health
  - protected ecological systems
  - property (crops, produce, livestock, wild animals subject to fishing/shooting rights)
  - property (buildings)

Harm

Human Health: Significant Harm

- Always significant harm
  - Death, life threatening disease (e.g. cancer)
  - Other diseases likely to have serious impacts on health
  - Serious injury, birth defects
  - Impairment of reproductive functions
- Other health effects
  - E.g. gastro-intestinal, central nervous system effects

Significant Harm

2012 Statutory Guidance

Human Health: Significant Possibility of Significant Harm

- First understand possibility of significant harm (=risk estimation)
  - Ie contaminant linkage, evidence that unacceptable risk could exist
  - And associated certainty/uncertainty
- Then decide if possibility is significant (=risk evaluation)
  - Remember decision is a positive legal test

POSH

SPOSH

SPOSH

2012 Statutory Guidance

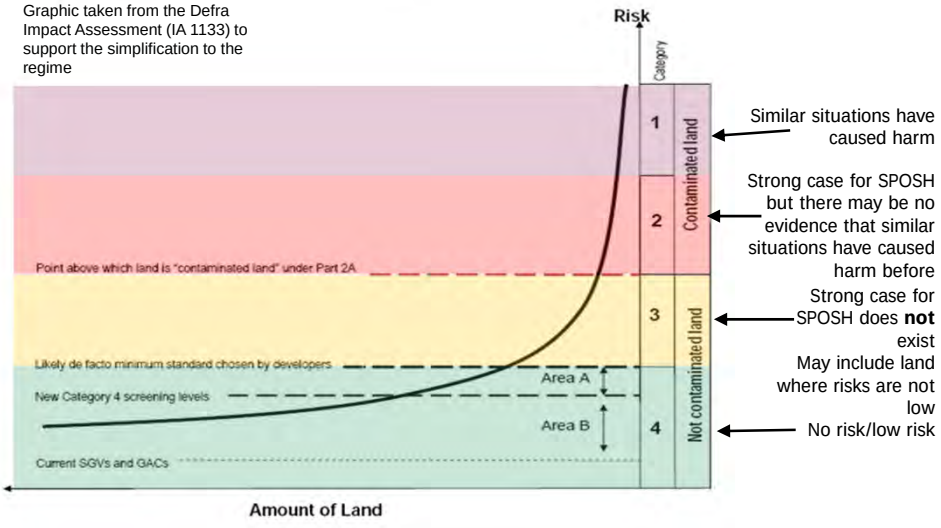
Human Health: Significant Possibility of Significant Harm

- Local authority decides if the possibility of significant harm is "sufficiently high that regulatory action should be taken to reduce it"
- Based on:
  - Category 1 and 2 = "Land which is capable of being determined as contaminated land on grounds of significant possibility of significant harm to human health"
  - Category 3 and 4 = "Land which is not capable of being determined" (as contaminated land).

2012 Statutory Guidance

Human Health: Category 1 to 4

Graphic taken from the Defra Impact Assessment (IA 1133) to support the simplification to the regime



Part 2A: What is 'Significant Possibility of Significant Harm'?

- Very difficult to define and focus of 2012 Statutory guidance (England)
- Local authority must take into account:
  - likelihood and impact (ie risk)
  - Strength of evidence
- Sites assigned to categories:
  - 1: **Definitely is** SPOSH (Similar situations have caused harm)
  - 2: Uncertain – strong case to assume SPOSH, but no similar situations
  - 3: Uncertain – no strong evidence for SPOSH, may include land where risks are not low
  - 4: **Definitely not** SPOSH (no or low risk)

Controlled waters: Pollution of Controlled Waters?

"entry into controlled waters of any poisonous, noxious or polluting matter or any solid waste matter"

- "Controlled waters"* include:
  - Territorial waters
  - Coastal waters
  - Inland freshwaters (including lakes and ponds)
  - And groundwaters
    - except that "ground waters" does not include waters contained in underground strata but above the saturation zone

* Section 104 of the Water Resources Act, 1991 or COPA (1974) in Scotland

2012 Statutory Guidance

Controlled waters: Significant Pollution (SPoCW)

- In simple terms SPoCW is
  - Exceeding a water quality standard at the receptor
    - EQS (risk to river)
    - DWS (risk to drinking water)
- + Links to related legislation eg Water Framework Directive

Significant Pollution

Controlled waters: Significant Pollution

- Pollution equivalent to "**environmental damage**" to surface water or groundwater as defined by The Environmental Damage (Prevention and Remediation) Regulations 2009, but which cannot be dealt with under those Regulations.
- Inputs resulting in **deterioration of the quality of water abstracted**, or intended to be used in the future, for human consumption such that additional treatment would be required to enable that use.
- A **breach** of a statutory surface water **Environment Quality Standard**, either directly or via a groundwater pathway.
- Input of a substance into groundwater resulting in a **significant and sustained upward trend** in concentration of contaminants (as defined in Article 2(3) of the Groundwater Daughter Directive (2006/118/EC)5).

Para 4.38 Defra Statutory Guidance

Significant Pollution

2012 Statutory Guidance

Controlled waters: Significant Pollution

- LA **may** also consider:
  - significant concentrations of hazardous substances or non-hazardous pollutants in groundwater.
  - significant concentrations of priority hazardous substances, priority substances or other specific polluting substances in surface water;
    - at an appropriate, risk based compliance point.
  - Normally LA should conclude that less serious forms of pollution are not significant.

Significant Pollution?

2012 Statutory Guidance

Controlled waters: Significant pollution is being caused

- Substances are continuing to enter controlled waters
- Substances have entered controlled waters and are likely to do so again
- "Entered controlled waters" =
  - they are dissolved or suspended in those waters
  - if they are immiscible with water - they have direct contact with those waters on or beneath the surface of the water.
- "Continuing to enter" =
  - any measurable entry of the substance(s) into controlled waters additional to any which has already occurred.
- "Likely to do so again" =
  - more likely than not to occur again.

Significant Pollution

2012 Statutory Guidance

Controlled waters: Significant possibility of significant pollution

- First understand possibility of significant pollution (SPoCW)
  - And associated certainty/uncertainty
- Then decide if possibility is significant
  - Remember decision is a positive legal test
- Based on:
  - Category 1 and 2 = the authority considers that a significant possibility of significant pollution of controlled waters exists
  - Category 3 and 4 = the authority considers that a significant possibility of such pollution does not exist

SPoSPoCW

2012 Statutory Guidance

Controlled waters: Significant possibility of significant pollution

- BUT we may have:
  - Soil contamination
  - Groundwater contamination
- Which do not exceed a water quality standard at the receptor
  - Eg concentration in river < EQS
- Might the contaminant reach the river and exceed EQS in future?

SPoSPoCW

Controlled waters: Significant possibility of significant pollution

- Significant possibility of significant pollution
  - 4 categories – similar to HH
- Sites assigned to categories:
  - 1: **Strong case** for SPOSPCW, eg robust evidence that would get SP if nothing done to stop it
  - 2: Uncertain – without strength of evidence of cat 1 but risks of sufficient concern, including low likelihood
  - 3: Uncertain – unlikely to get SPOSPCW
  - 4: **definitely not** SPOSPCW (no or low risk)

'Normal' Concentrations of Contaminants in Soils

- Is contamination within the bounds of what might be considered typical or widespread?
- Normal levels of contaminants in soils should not be determined "unless there is particular reason to consider otherwise"
- "normal" levels of contaminants includes:
  - natural contaminants at typical regions levels that appear not to pose unacceptable risks to health or the environment.
  - low level diffuse contamination (form leaded petrol fumes and spreading of domestic ash in gardens) at levels that might reasonably be considered typical.
- Defra funded BGS project (SP1008) to establish background or 'normal' levels of some contaminants
  - www.bgs.ac.uk/gbase/NBCDefraProject.html

2012 Statutory Guidance

Summary: Part 2A

- Risk-based regime
- Legal definition of contaminated land
- Four category system
- Positive legal test
  - No requirement to demonstrate land is not contaminated land
  - If at any point available evidence indicates there is no longer a reasonable possibility that a significant contaminant linkage exists on the land, the local authority should not carry out any further inspection in relation to that linkage
- Read the primary legislation and the revised Statutory Guidance carefully!
  - 'must', 'should', 'may'
  - It will require more than one read!
- **FOLLOW the primary legislation FAITHFULLY**

Activity

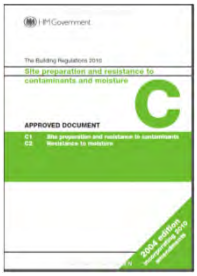
- List differences between Planning and Part 2A
- Hints
  - Use
  - Who is responsible?
  - Proactive or reactive

Other Legal Contexts

- Building control
- European directives
  - Regulations implementing these
- Waste legislation- covered in more detail in Essentials IV
- Common Law

Building Control: England

- Approved document C – "Site preparation and resistance to contaminants and moisture"
  - www.planningportal.gov.uk/buildingregulations/approveddocuments/partc/documentc
- 2004 Edition incorporating 2010 and 2013 amendments
- Contaminants **must** be considered when changing use to residential
- Requires a risk assessment
- All land associated with the building to be considered
  - not restricted to building footprint (now includes garden)
- Specifies radon protection zones



Building Control: Wales

GUIDANCE

Building regulations guidance: part C (resistance to contaminants and moisture)

Guidance for contractors on the regulations for preparing sites and resistance to contaminants and moisture.

View details

Part of: Building regulations: approved documents and Building regulations guidance

First published: 3 April 2017

Last updated: 3 April 2017

Sound science: Defensible decisions

Building Control: Scotland

- The Building (Scotland) Act 2003 came into force May 2005
- Technical Handbooks 2023: Domestic
  - Updated regularly
  - Standard 3.1 – Site preparation – harmful and dangerous substances
  - Available at http://www.gov.scot/Topics/Built-Environment/Building/Building-standards/publications/pubtech
    - Domestic
    - Non domestic
  - Reflects the requirements of Part IIA
- Requires a risk assessment


Domestic Technical Handbook June 2023 Edition

3.1 Site preparation – harmful and dangerous substances

Mandatory Standard

Standard 3.1

Every building must be designed and constructed in such a way that there will not be a threat to the building or the health of people in or around the building due to the presence of harmful or dangerous substances.

Limitation:

This standard does not apply to the removal of unsuitable material, including turf, vegetable matter, wood, roots and topsoil on the site of a building (other than a dwelling) intended to have a life not exceeding the period specified in regulation 6.

Sound science: Defensible decisions

Building Control: Northern Ireland

- Building Regulations (Northern Ireland) 2012
- Part C Preparation of site and resistance to moisture
  - C2 Preparation of site and resistance to dangerous and harmful substances
- Technical Booklet C "Preparation of site and resistance to moisture" – Appendix 1
- www.buildingcontrol-ni.com
- May be updated once Part III Waste and Contaminated Land (NI) Order 1997 has been implemented in Northern Ireland

Unified Approach

- Is land contaminated land (Part 2A)?
- Is land safe and fit for intended purpose (Planning and building control)?
- What are suitable *clean-up* standards for voluntary remediation ?
- **Same risk-based approach applies in each case**
  - **Different levels of risk and evaluation considered**

Common law

Common Law in the form of torts is an important part of contaminated land law – particularly for third parties harmed by or suffering loss as a result

- Nuisance – person may be liable if he owns or occupies land and behaves in such a way so as to cause foreseeable injury, loss or damage by creating a nuisance e.g. allowing migration; dusts etc
- Negligence – claimant must prove the owner of the contaminated land owed him a duty of care which was breached. Claimant does not need to have an interest in the land.
- Trespass - e.g. contamination on the defendants land has directly interfered with his property. Claimant must have an interest in the land.
- The Rylands vs Fletcher rule

Common law

- Strict liability: e.g. Rylands vs Fletcher
  - you are responsible for all substances or materials imported to your site
  - you may be prosecuted for vandalised fuel tanks
  - You are responsible for any soils you import onto site (eg asbestos)
  - Now considered a sub tort of nuisance
- **But** Cambridge Water Co Ltd vs Eastern Counties Leather plc established that the damage or pollution should be "reasonably foreseeable"
  - Leak of PCE into chalk affected well several miles away

European Legislation

- Environmental Liabilities Directive (2004/35/EC)
  - Implemented in Environmental Damage (Prevention and Remediation) Regulations 2009 (into force 1 March 2009)
- Water Framework Directive (2000/60/EC)
  - Groundwater daughter directive (2006/118/EC)
  - The **Groundwater** (England and Wales) **Regulations** 2009

Still Relevant post Brexit as transposed into UK Legislation

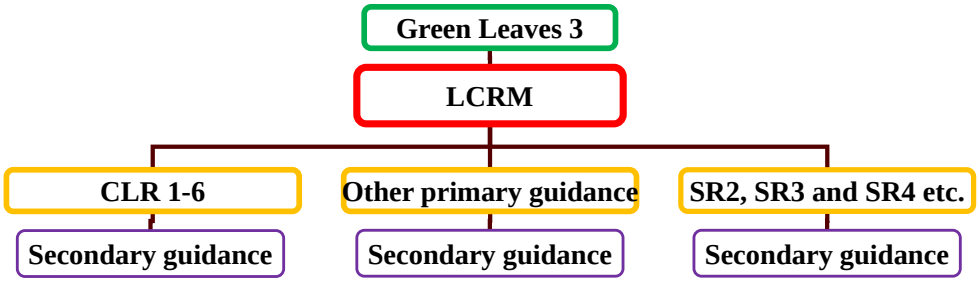
Session 3

www.lqm.co.uk

The Risk Assessment Framework

www.lqm.co.uk

Land contamination guidance



Green Leaves III: Environmental risk assessment

- "Guidelines for Environmental Risk Assessment and Management"
  - Jointly published by DEFRA and Cranfield University Nov 2011
  - www.defra.gov.uk/publications/files/pb13670-green-leaves-iii-1111071.pdf
- Commonly known as "Green Leaves III"
  - It has green leaves on the cover
  - It's the third version
- Significant rewrite of earlier versions using different terms and phrases

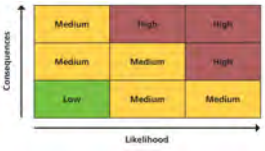
Green Leaves III: Risk vs Hazard

Flood hazard is about the nature of the physical event eg intensity within a particular return period.
Flood risk takes account of vulnerability of the receptor (people and property).

- **Hazard:**
  - "A situation or biological, chemical or physical agent that may lead to harm or cause adverse affects"
    - Defra and Cranfield University (2011)
- **Risk:**
  - "The potential consequence(s) of a hazard combined with their likelihoods/probabilities."
    - Defra and Cranfield University (2011)

Motorway traffic is a hazard but risk is generally controlled by pedestrians not being allowed to walk on motorways. For those who do cross motorways the risk is high.

Arsenic contamination in the ground is a hazard but not necessarily a risk



Defra and Cranfield University (2011) Figure 1

Terms like safe and suitable for use or SPOSH do not fit on this table

www.lqm.co.uk
Sound science: Defensible decisions

RA: The question …

- Does the contaminant of concern pose an unacceptable level of risk to the receptors?

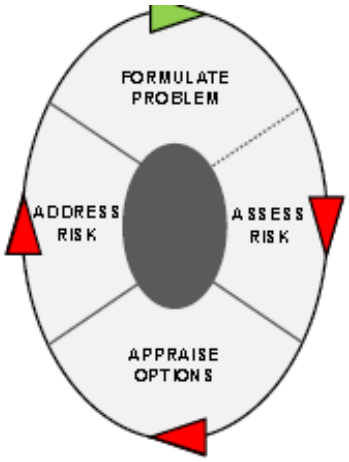
Hazard = contaminant

Risk assessment: process of *estimating* risk from hazard:
- Under a stated set of conditions (assumptions)
- In a particular timeframe (acute, chronic)

www.lqm.co.uk
Sound science: Defensible decisions

Green Leaves III: Structured Approach to Risk Management

- Formulating the problem
- Assessing the risk
  - Identify the hazard
  - Assess the consequences
  - Assess their probabilities
  - Characterise risk and uncertainty
- Appraising the options
- Addressing the risk
- S-P-R paradigm



www.lqm.co.uk
Sound science: Defensible decisions

Green Leaves : Tiered approach

- Designed to promote cost effective risk management
- Each tier tends to :
  - Require more detailed information
  - Require more technical knowledge
  - Be more costly
  - Provide better resolution and understanding of problem

www.lqm.co.uk
Sound science: Defensible decisions

Land Contamination Risk Management webssite:

Guidance

Land contamination risk management (LCRM)

How to assess and manage the risks from land contamination.

From: Environment Agency
Published 8 October 2020
Last updated 19 April 2021 — See all updates

Applies to: **Wales, England, and Northern Ireland**

Google LCRM

https://www.gov.uk/government/publications/land-contamination-risk-management-lcrm

www.lqm.co.uk

Sound science: Defensible decisions

Archived: CLR11

- CLR11 “Model procedures for the management of land contamination”
- Published October 2004 by Defra and EA
- replaced by LCRM

www.lqm.co.uk

Sound science: Defensible decisions

Phase 1 Phase 2 Phase 3 terminology present in many guidance documents

LCRM: Reports

- Stage1: Risk assessment reports - need to report on each tier of risk assessment:
  - Preliminary risk assessment report (Phase 1)
  - Site investigation report / Generic quantitative risk assessment report (Phase 2)
  - Detailed quantitative risk assessment report – if required (Phase 2)
- Stage 2: (Phase 3)
  - Unless the site is complex you'll normally produce a single OA report
  - NEW – CLR11 grouped OA and Remediation strategy
- Stage 3: (Phase 3)
  - Remediation strategy
  - Remediation progress reports.
  - Verification report.
  - Tier 3 long term monitoring and maintenance report - if required.

Emphasis on documenting a "Decision record"

+ Site Investigation
+ Reporting

www.lqm.co.uk

Sound science: Defensible decisions

LCRM: Stages and Tiers

Chapter 1 – Overview

Chapter 2 – Risk Assessment
- Tier 1: Preliminary Risk Assessment
- Tier 2: Generic quantitative risk assessment (GQRA)
- Tier 3 Detailed quantitative risk assessment (DQRA)

Chapter 3 – Options Appraisal
- Identify feasible options
- Evaluate options
- Produce remediation strategy

Chapter 4 – Implementation
- Preparing the implementation plan
- Design, implement and verify remediation
- Long-term monitoring and maintenance

CLR11

- Before you start
- Stage 1 – Risk assessment
  - Tier 1: Preliminary Risk Assessment
  - Tier 2: Generic quantitative risk assessment (GQRA)
  - Tier 3 Detailed quantitative risk assessment (DQRA)
- Stage 2 – Options appraisal
  - Tier 1 -Identify feasible options
  - Tier 2 - Evaluate options
  - Tier 3 - Select remediation options
- Stage 3 – Remediation
  - Tier1 - Develop a Remediation Strategy
  - Tier 2 - Remediation and verification
  - Tier 3 - Long-term monitoring and maintenance
- **Site investigation**
- **Reporting requirements**

https://www.gov.uk/guidance/land-contamination-how-to-manage-the-risks

www.lqm.co.uk

Technical Guidance: CLR11/LCRM

- Introduces terminology
- The process described involves:
  - Pollutant linkages /contaminant linkage
  - Site conceptual model (next lecture)
  - Stages/tiers (phases) risk assessment and management process
- Key references
  - CLR11 (2004) references out of date
  - CL:AIRE Water and Land library (WALL)
    - https://www.claire.co.uk/information-centre/water-and-land-library-wall

Stage 1:

Tier 1: Preliminary risk assessment

- Preliminary risk assessment
  - Desk study & Walkover (Phase 1)
- Establish former uses and activities
- Formulate **initial** conceptual model
  - Likely sources (contaminants), pathways, receptors
  - Likely pollutant/contaminant linkages
  - Uncertainties
- Identify additional work needed

Stage 1:

Ground Investigation

- To characterise the uncertainties in the CSM
  - What contamination is present on the site ? Where? At what depth?
  - What types of materials are present beneath the site ?
  - Characterise the gas and groundwater regimes
- Physical investigation of ground
  - Boreholes, trial pits, dynamic sampling… Geophysics?
  - Sampling of soils, waters, gases and vapours, vegetation, *etc.*
  - Field and/or laboratory testing
- Important part of Stage 1 Risk assessment
  - GI may be staged or phased
- Additional GI to inform Stage 2(OA) and Stage 3 (Rem)

More on Day 2

www.lqm.co.uk

Stage 1:

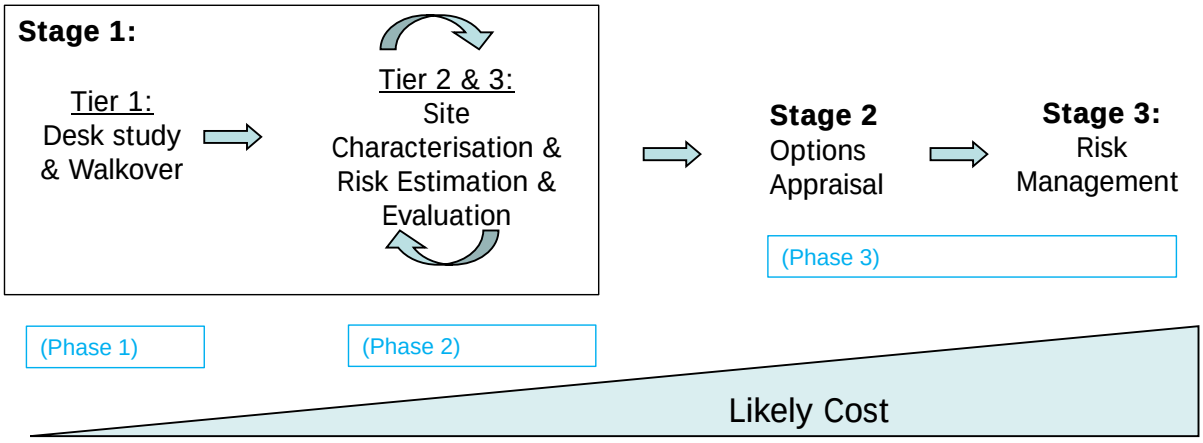
Tier 2 and 3: Risk assessment

- Does the contamination at the site present a risk to the receptors of concern?
- Tier 2: Generic Quantitative Risk Assessment (GQRA)
- Tier 3: Detailed Quantitative Risk Assessment (DQRA)
- **Update** conceptual model
  - Increased information
  - Reduce uncertainty
  - Some/all potential sources eliminated
  - Some/all potential contaminant linkages eliminated

More on Day 3

www.lqm.co.uk

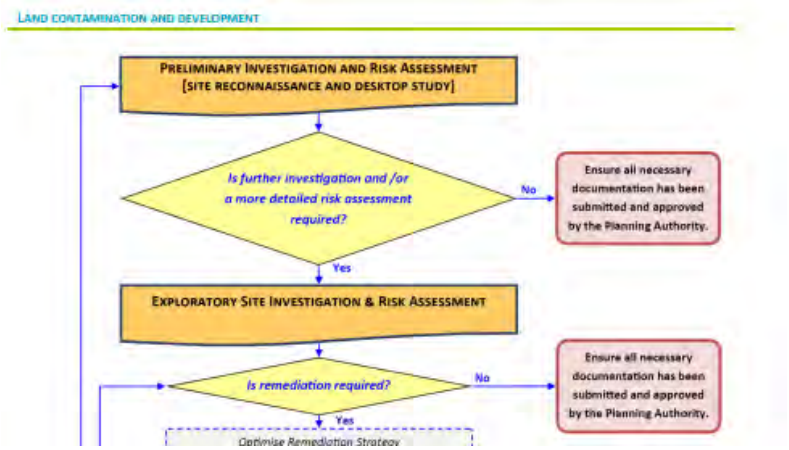
Economic sense



General Guidance: R&D 66 report

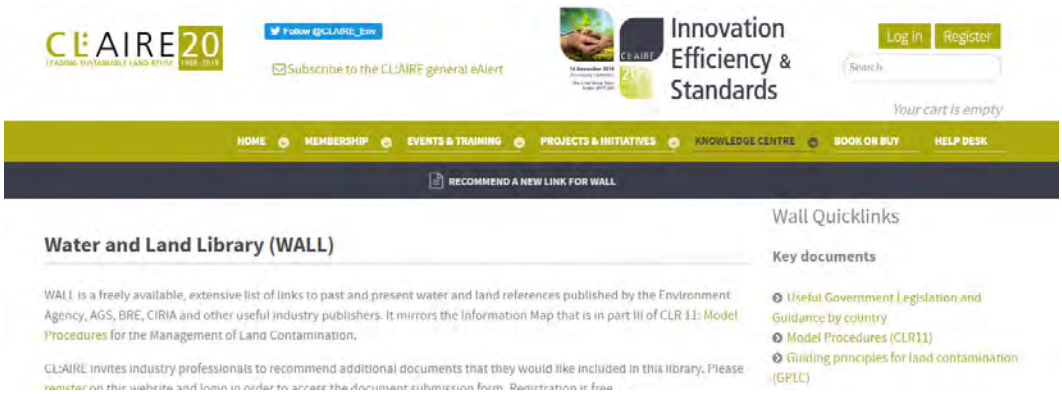
- June 2008 by NHBC, EA and CIEH
- Aimed at housebuilding
- www.cieh.org
- www.nhbc.co.uk
- www.gov.uk
- Vol 1 and 2
  - http://www.nhbc.co.uk/NHBCPublications/LiteratureLibrary/Technical/filedownload,33596,en.pdf
  - http://www.nhbc.co.uk/NHBCPublications/LiteratureLibrary/Technical/filedownload,33595,en.pdf

https://www.ep-scotland.org.uk/wp-content/uploads/2019/09/ConLanDevGuide_12-Aug19-FINAL.pdf



www.lqm.co.uk

Guidance Tools – CL:AIRE



- CL:AIRE Water and Land library (WALL)
  - https://www.claire.co.uk/information-centre/water-and-land-library-wall

Essentials of Contaminated Land Management I

www.lqm.co.uk

What is a Contaminant linkage?

- Fundamental concept
- Contaminant – Pathway - Receptor

Source/Contaminant

Pathways

Receptors

- No linkage = No risk

www.lqm.co.uk

CPR Definitions

- Contaminant – substance in/on/under land with potential to cause
  - harm
  - pollution of controlled waters;
- Receptor – something that could be adversely affected by a contaminant:
  - people, an ecological system, property, water body
- Pathway – a route or means by which a receptor can be exposed to, or affected by, a contaminant.

CLR11 (2004)

www.lqm.co.uk

Sources / Contaminants

- Sources
  - Fuel tank
  - Factory
  - Paint booth
  - Gas holder
  - Dry cleaners
  - Agricultural land
  - Many more
- Contaminants
  - Arsenic
  - Benzene
  - Pentachlorophenol
  - Benzo(a)pyrene
  - …..etc
- Part 2A deals with contaminants not sources!

www.lqm.co.uk

Receptors: some examples

- Human
  - Current/future residents/workers
  - Adjacent residents
  - Public
- Controlled Waters
  - Aquifer(s) (maybe > 1)
  - River/lake/canal
  - Water supply borehole
- Ecological
  - Site of Special Scientific Interest (SSSI)
  - National Nature Reserve (NNR)

Construction workers require assessment under H&S legislation

www.lqm.co.uk

Receptors: property examples

- Buildings
  - Structures
  - (water supply pipes)
- crops, including timber
- produce grown domestically, or on allotments, for consumption;
- livestock
- other owned or domesticated animals eg pets
- wild animals which are the subject of shooting or fishing rights

www.lqm.co.uk

Pathways - human health

Primary routes of chemical exposure:

http://maincircle.miscellanynews.org/tag/international-living-building-institute/

- Pathways could include:
  - Ingestion of soil and household dust,
  - Dermal contact with soil and household dust
  - Ingestion of homegrown produce
  - Ingestion of soil attached to homegrown produce
  - Inhalation of indoor vapours and household dust
  - Inhalation of outdoor vapours and household dust

www.lqm.co.uk

Pathways - human health

- But may also include:
  - Migration of gases via saturated/unsaturated zone resulting in explosion / asphyxiation
  - Consumption of water from on site water supply (private water supply)
  - Washing/showering in water from an on-site water supply
  - Ingestion of meat, dairy products, milk or eggs produced on site
  - Eating fish from a contaminated pond

www.lqm.co.uk
Sound science: Defensible decisions

Pathways – controlled waters

- Unsaturated zone
- Saturated zone
- Preferential pathways
  - Drains, boreholes, shafts, adits, mineworkings …
- Flooding
- Surface water run off

www.lqm.co.uk
Sound science: Defensible decisions

Pathways –Ecological

- Ecological
  - Ingestion soil/dust/water
  - Inhalation dust/vapour
  - Migration of animals
  - Transfer via the food chain

www.lqm.co.uk

Pathways – Property: Buildings

- Buildings
  - Direct contact
  - Explosion
  - Vapour/Gas accumulation
  - Unstable materials

www.lqm.co.uk

Pathways – Property: "animal or crop effect"

- Crops
  - Root uptake
  - Leaf contact
  - Irrigation water

www.lqm.co.uk

Linkages may be more complex than S-C-P-R

- Secondary Sources and Multi step Pathways
  - Leaked oil sorbed to foundation materials (post oil spill) then desorbs into soil –inhalation – future residents
  - Contamination in soil migrates via unsaturated zone to groundwater and saturated zone to PWS BH
  - Vapours in soils – upward migration via unsaturated zone migration into building –inhalation – future residents

www.lqm.co.uk

Risk Assessment Summary

- Hazard vs Risk
- Tiered approach
- PRA
  - SPR
  - PL
  - CSM
- Different RA approaches for different receptors
  - GQRA, DQRA

www.lqm.co.uk

Sound science: Defensible decisions

Session 4

"Phase 1"/PRA reports

- Before you start
- Stage 1 – Risk assessment
  - Tier 1: Preliminary Risk Assessment
  - Tier 2: Generic quantitative risk assessment (GQRA)
  - Tier 3 Detailed quantitative risk assessment (DQRA)
- Stage 2 – Options appraisal
  - Tier 1 -Identify feasible options
  - Tier 2 - Evaluate options
  - Tier 3 - Select remediation options
- Stage 3 – Remediation
  - Tier1 - Develop a Remediation Strategy
  - Tier 2 - Remediation and verification
  - Tier 3 - Long-term monitoring and maintenance

Phase 1 report components:

- Historical review
- Regulatory review
- Other desk information
- Geology
- Walkover survey
- Interviews

- Develop CSM Uncertainties
- LQA Phase 1 report

Purpose of Phase 1/PRA

- Collate available information
  - Site history
  - Current site
  - Geology and hydrology
- Site reconnaissance/walkover
- Develop the initial CSM
  - Identify potential contaminant linkages
  - Identify uncertainties and assumptions
- Assist site investigation design (Phase 2):
  - what needs to be investigated?
  - health and safety issues?
- Identify targets or features of immediate concern

Desk study: Sources of information

- Maps
  - Historical
  - Geology/hydrogeology
- Regulatory data
- Site sensitivity
- Previous reports

Other

- Aerial photographs
- DoE Industry profiles

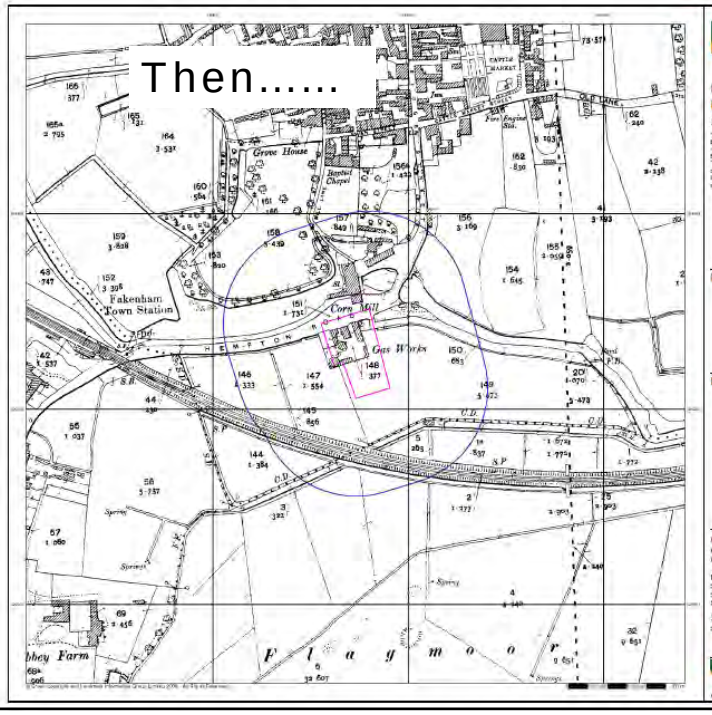
- Also useful
  - Mining records
  - Libraries, archives & museums
  - Business directories
    - Kelly's
    - Post Office

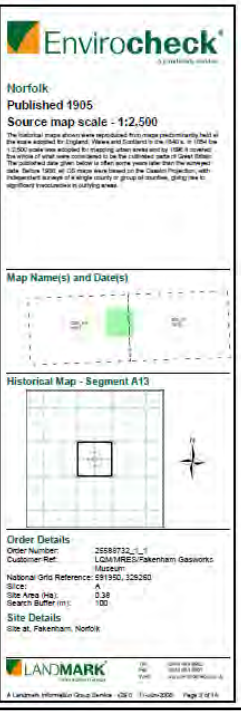
Desk study: Search companies

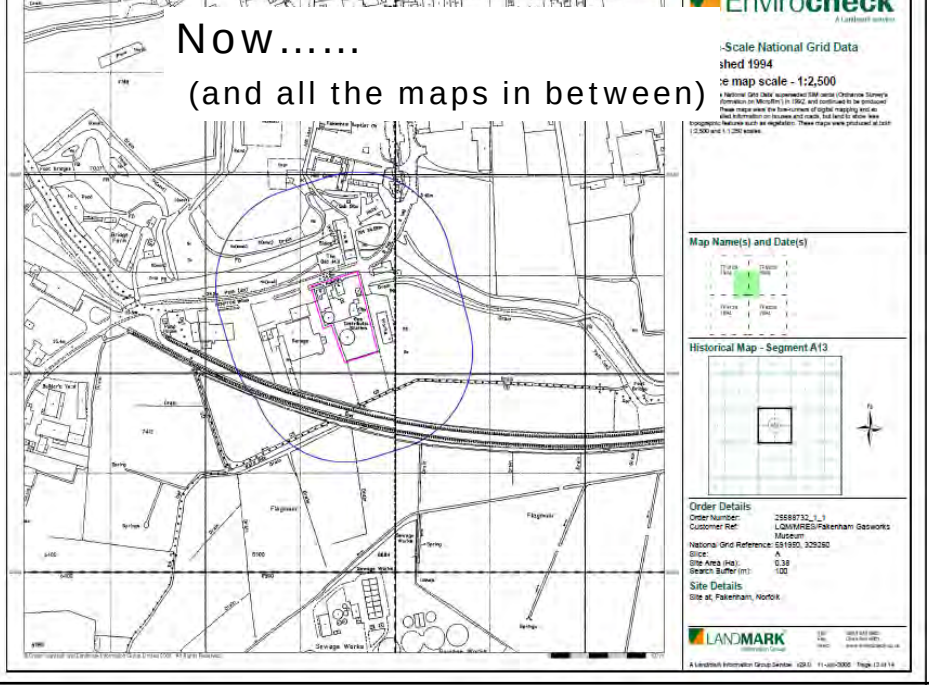
- Several companies will collate **some** of the information required:
  - www.envirocheck.co.uk
  - www.groundsure.com
  - www.findmaps.co.uk/
- Understand what is/is not covered!
- Additional sources of information are likely to be needed
- Such reports do **not** constitute a phase 1 on their own:
  - interpretation & hazard identification
  - conceptual model
  - walkover survey etc

Desk study: Historical maps

- Ordnance Survey (OS) maps
  - Past & present
  - Small scale 1:10,000/10,560
  - Large scale 1:2,500/1,250
- Other maps
  - Goad's fire insurance maps (now Landmark Historical Building Plans)
  - Town plans
  - Site plans
- Normally included by commercial data providers







Desk study: Aerial photographs

RICARDO EMAQ+

- May fill data gaps
  - between OS map editions
    - RAF aerial surveys
    - Luftwaffe reconnaissance!
  - identify site activities *etc*. not visible on mapping
- Numerous sources
  - https://historicengland.org.uk/images-books/archive/collections/aerial-photos/
  - https://ncap.org.uk/
  - Site owner

https://commons.wikimedia.org/wiki/File:RAF_Husbands_Bosworth_aerial_photograph_1943_IWM_C_5408.jpg

LQM
Sound science:
Defensible decisions

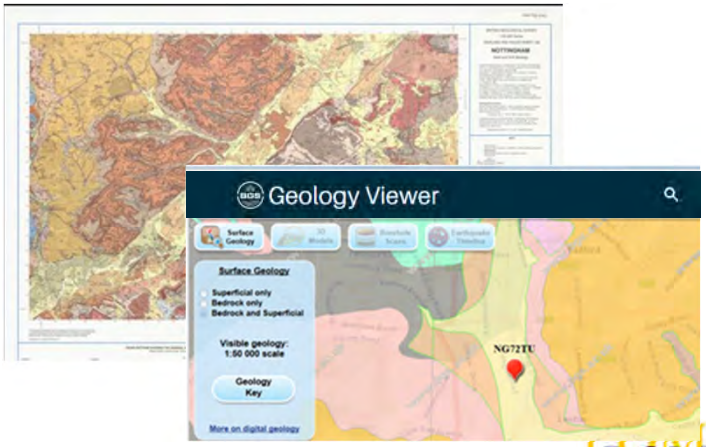
Desk study: Geology can be …

- Source:
  - methane & carbon dioxide
  - Radon
  - sulphate & acid mine drainage
  - potentially harmful elements e.g. arsenic
  - natural hydrocarbons
- Pathway:
  - flow of water, leachate, gases, Non Aqueous Phase Liquids (NAPLs)
- Receptor:
  - groundwater

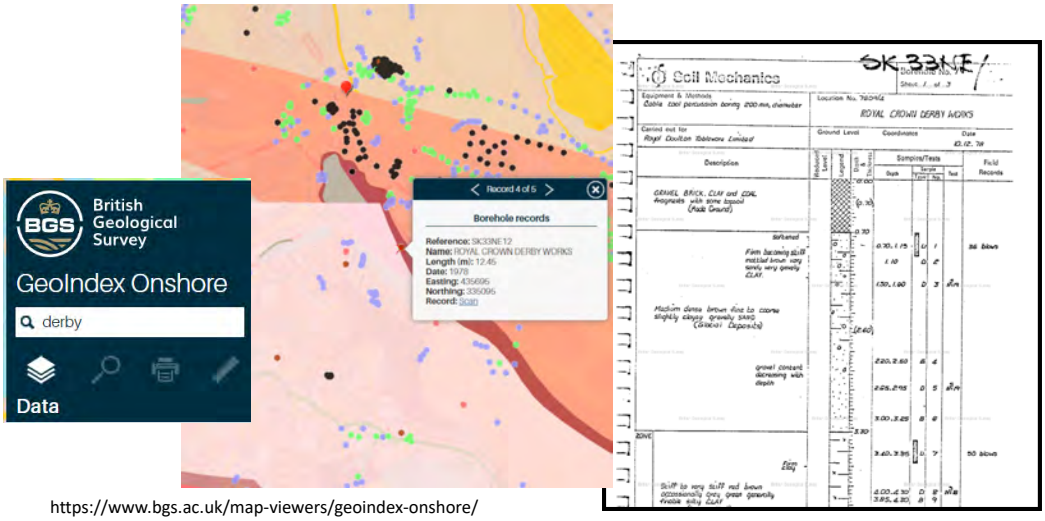

Fractures in Quaternary fine sand
West Cumbria, UK

Desk study: Geology & hydrogeology

- Geology maps
  - Drift / Superficial
  - Solid /Bedrock
- Designations
  - Groundwater vulnerability
  - Source Protection Zones (SPZ)
  - Drinking water protected area
  - Drinking water Safeguard zones
- Other information
  - BGS borehole data
  - Applied Geology Reports
  - Previous SI reports

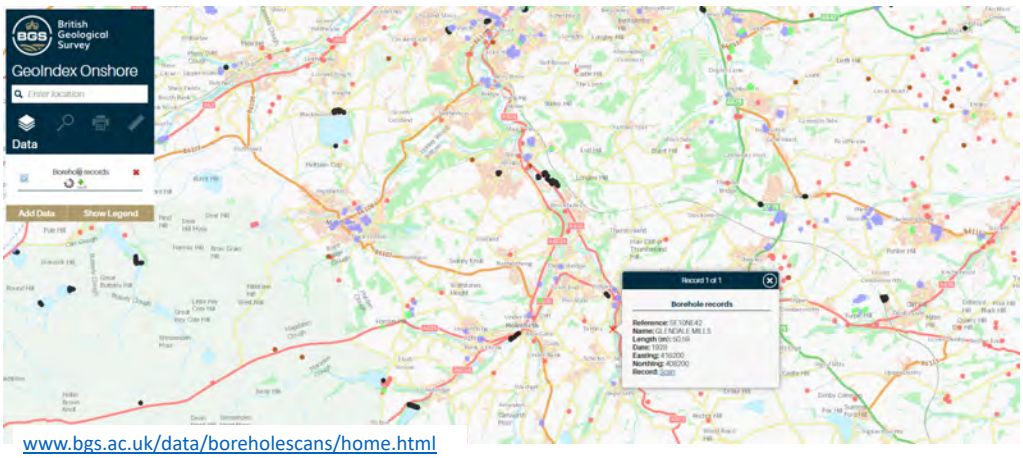


BGS Borehole Records



https://www.bgs.ac.uk/map-viewers/geoindex-onshore/

BGS Borehole Records – on Geoindex



www.bgs.ac.uk/data/boreholescans/home.html

Defra Magic Map

- Multi-Agency Geographic Information for the Countryside https://magic.defra.gov.uk/
- Numerous layers
  - SPZ, aquifer, groundwater vulnerability …

Desk study: Regulatory Review

- Sources of regulatory information
  - District and county councils
    - Planning departments
    - Environmental health departments etc
  - Environment Agency/SEPA/Natural Resources Wales

Online registers

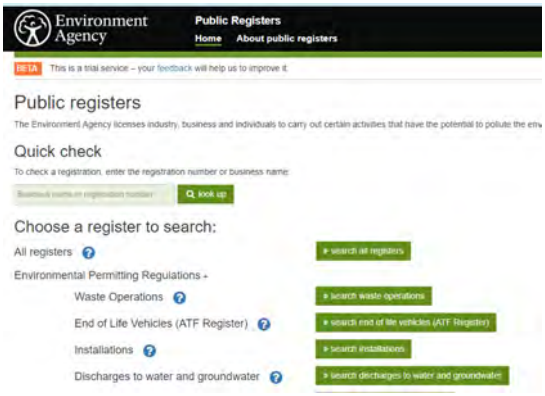
Contact regulators in writing/ by phone

"Landmark" report

- www.envirocheck.co.uk ("Landmark")
- www.groundsure.com
- http://www.findmaps.co.uk/

Public Registers - England

- Environment Agency:
- https://environment.data.gov.uk/public-register/view/index



Example: Discharge Consent

Permit MI/T/62/45115/T/001 – BOOTS COMPANY PLC

Permit number	MI/T/62/45115/T/001
Permit Holder Name	BOOTS COMPANY PLC
Start Date	18/02/1997
Revocation Date	04/09/2000

Site

Site name	PREMISES AT BEESTON
Site type	Undefined or Other
Site Address	BEESTON WKS, PREMISES AT BEESTON, NOTTINGHAM, NOTTINGHAMSHIRE, NG2 3AA
Site Postcode	NG2 3AA
Site Grid Reference	SK5430036400

Example: EA Waste Operations

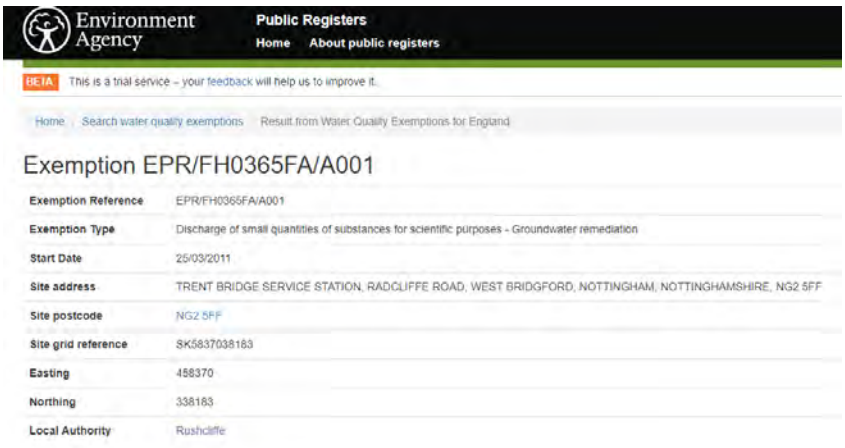
Permit PP3792EL/V003 – Veolia E S Nottinghamshire Ltd

Permit number	PP3792EL/V003
Waste Management Licence No.	43411
Pre-EA Permit Ref	5/92/271/53NW
Licence Holder Name	Veolia E S Nottinghamshire Ltd

Site

Site name	Lilac Grove Household Waste Centre
Site type	S0813 No 13: 75kte Non-hazardous & hazardous HWA Site
Site Address	Lilac Grove H W C, Lilac Grove, Beeston, Nottingham, Nottinghamshire, NG9 1PF
Site Postcode	NG9 1PF
Site Grid Reference	SK5403836683

Example: Water Quality Exemptions



Public Registers

- Natural Resources Wales:
  - https://naturalresources.wales/permits-and-permissions/check-for-a-permit-licence-or-exemption/?lang=en
- SEPA
  - https://www.sepa.org.uk/environment/environmental-data/
  - Or request info

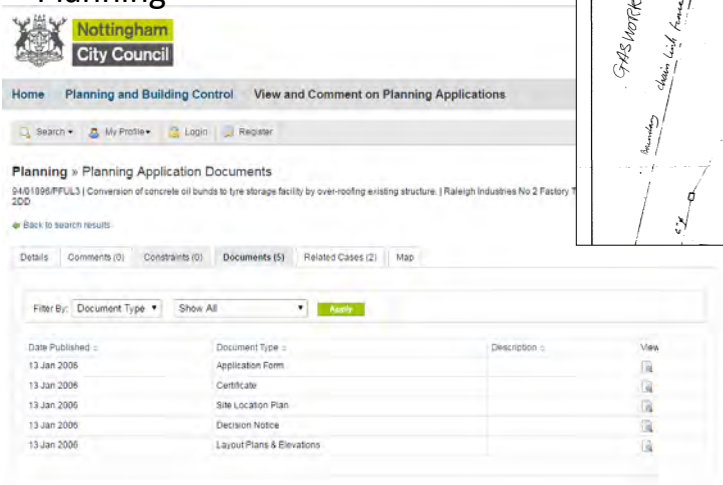
Desk study: Planning Department

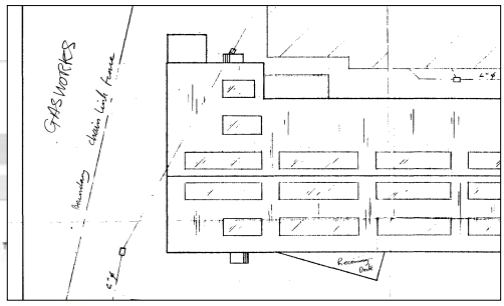
- Much information now web based
- Former paper records may be available; check with department
- Not reported in Landmark/Groundsure

- Former/current uses (source)
- Tree preservation orders (receptor)

Desk study: Council

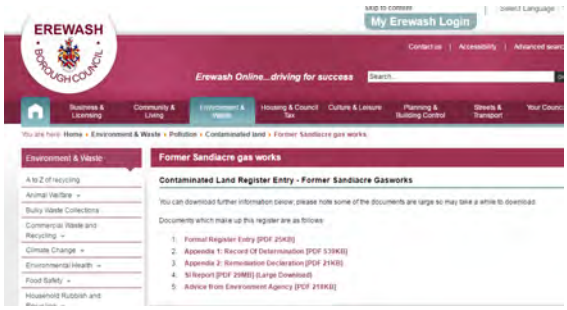
- Planning





Desk study: Council

- Contaminated land Register (online for some councils)
  - Remediation Notices
  - Remediation Declarations/Statements
  - Appeals against Notices
  - Designation of special sites
  - Notification of Claimed Remediation
  - Convictions for Offences



Register of land determined as contaminated land

Desk study: Council

- Brownfield Register

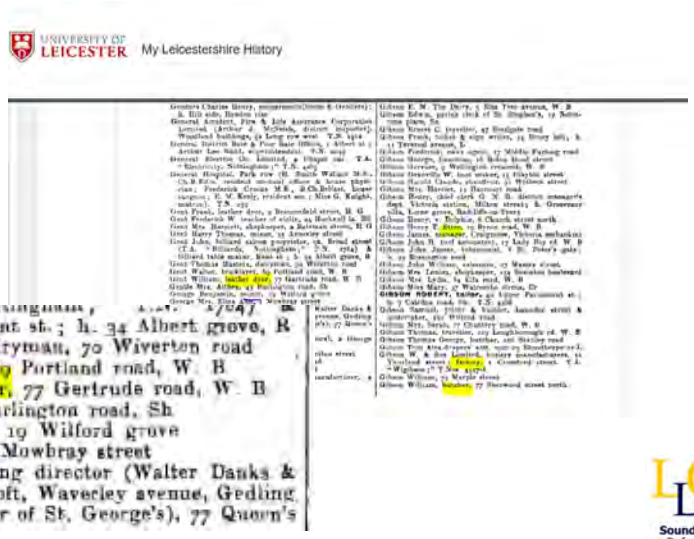
Register of brownfield land which local authorities consider to be appropriate for residential development

The Town and Country Planning (Brownfield Land Register) Regulations 2017

Essentials of Contaminated Land Management I

Desk Study - Directories

- http://specialcollections.le.ac.uk/digital/collection/p16445coll4

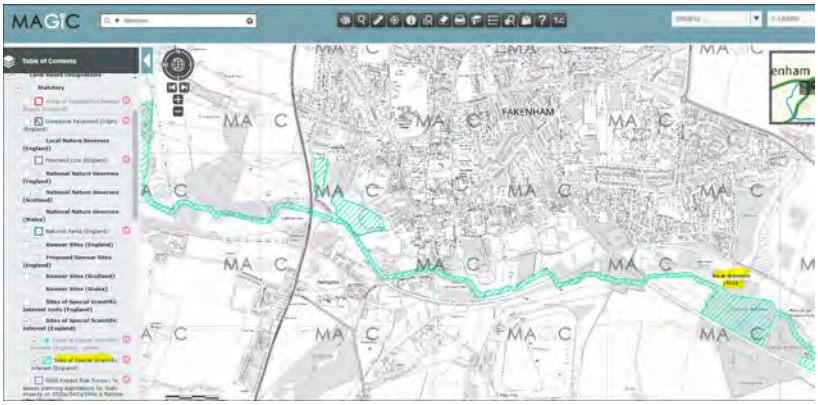


Desk study: Sensitive land use

- Receptors
- Wildlife conservation areas
  - Site of Special Scientific Interest
  - National Nature Reserve / Marine Nature Reserve
  - Special Area of Conservation / Special Protection Area
  - Ramsar sites
- Protected archaeology or architecture etc
  - Scheduled ancient monuments
  - Listed buildings
  - Tree Protection Orders

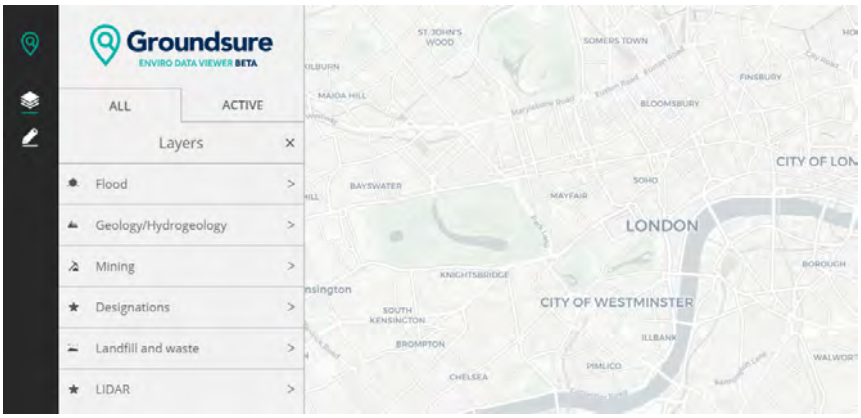
Site Sensitivity: Defra Magic Map

- https://magic.defra.gov.uk/



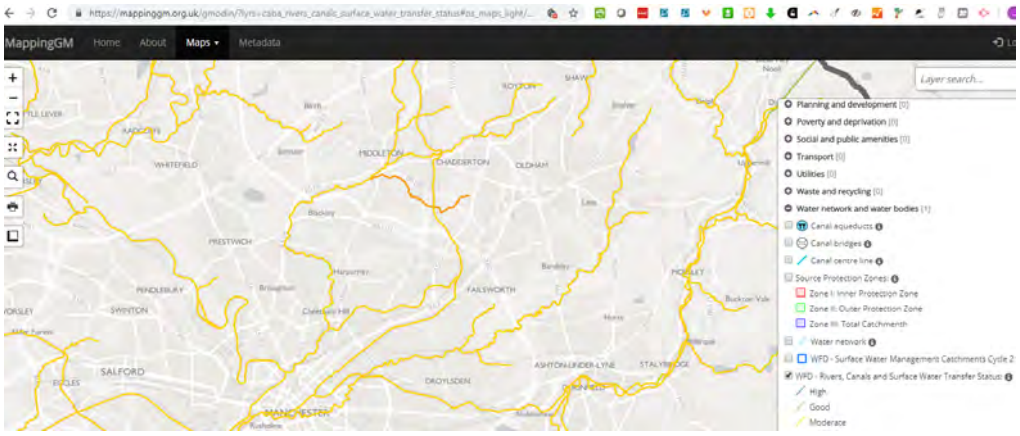
Other interactive maps

- http://groundsure.io/



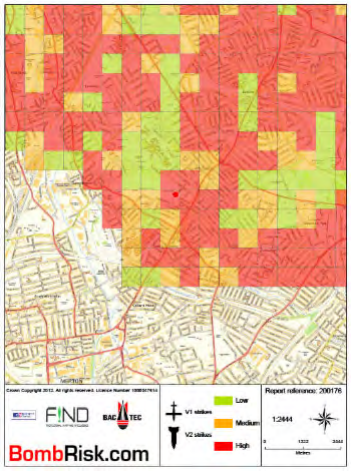
Other interactive maps

- https://mappinggm.org.uk/gmodin/



Unexploded ordnance

- WW1 WW2
  - 10% bombs did not go off in WW2
  - Bombing density
  - Known bomb strikes
- Military sites eg
  - Historical MoD sites
  - Military bases
  - Requisitioned sites for military use
  - Royal Ordnance Factories
  - Munitions storage depots
- Often separate activity to Phase 1 PRA



Desk study: Interviews

- Staff; past and present
- Locals
- Local Authority staff
- Regulators
- Previous owners
- Neighbours

DoE Industry Profiles


DoE Industry Profile - Airports (4 MB)
DoE Industry profile - Animal & Animal processing works (5 MB)
DoE Industry profile - Asbestos manufacturing works (4 MB)
DoE Industry profile - Ceramics, cement and asphalt manufacturing works (4 MB)
DoE Industry profile - Chemical Works - coatings, paints and printing inks manufacturing works (5 MB)
DoE Industry Profile - Chemical Works - cosmetics and toiletries manufacturing works (5 MB)
Chemical Works - disinfectants manufacturing works (4 MB)
DoE Industry profile - Chemical Works - explosives, propellants and pyrotechnics manufacturing works (7 MB)
DoE Industry profile - Chemical Works - fertiliser manufacturing works (1 MB)
DoE Industry profile - Chemical Works - fine chemicals manufacturing works (4 MB)
DoE Industry Profile - Chemical Works - inorganic chemical manufacturing works (8 MB)
DoE Industry profile - Chemical works - linoleum, vinyl and bitumen-based floor covering manufacturing works. (6 MB)
Chemical Works - mastics, sealants, adhesives and roofing felt manufacturing works (4 MB)
Organic Chemical Works (4 MB)
DoE Industry Profile - Chemical Works - pesticide manufacturing works (4 MB)
DoE Industry Profile - Chemical Works - pharmaceutical manufacturing works (4 MB)
DoE Industry Profile - Chemical Works - rubber processing works (4 MB)
DoE Industry Profile - Chemical Works - soap and detergent manufacturing works (4 MB)
DoE Industry Profile - Dockyards and dockland (4 MB)
DoE Industry Profile - Engineering Works - aircraft manufacturing works (5 MB)
Engineering Works - electrical and electronic equipment manufacturing works (including works manufacturing equipment containing PCBs) (5 MB)
Engineering Works - Mechanical engineering and ordnance works (5 MB)

- See DoE Industry Profiles on CL:AIRE WALL:
  - https://www.claire.co.uk/useful-government-legislation-and-guidance-by-country/198-doe-industry-profiles
- Defra Industry Profile; Radioactive contaminative uses: http://sciencesearch.defra.gov.uk/Default.aspx?Menu=Menu&Module=ProjectList&Completed=0&Keyword=Radioactive%20materials
- http://webarchive.nationalarchives.gov.uk/20130123162956/http:/www.defra.gov.uk/environment/radioactivity/conland/pdf/industryprofile.pdf
- Not an exhaustive list of contaminative land uses
- Use with care

Remember: Naturally-occurring gases

- Radon
  - natural gas produced by uranium-rich rocks
  - Hazard due to decay of Ra222 to daughter products eg Po - lodged in lung → cancer
  - Radon Affected Areas e.g. in SW England, Northamptonshire etc
  - **But** radon excluded from Part 2A
- CH_4, CO_2
  - form naturally in peat and Coal-beds/mines/other organic deposits

Remember: Naturally-occurring metals

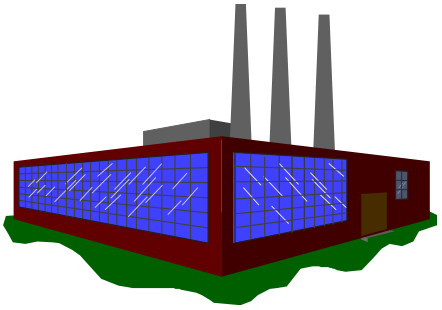
- Natural arsenic can be present e.g.
  - in soils of old mining areas
  - in soils developed on bedrock with high concentrations of iron oxide e.g. soils in areas of the Northampton Sand Formation
- Natural nickel can be present at elevated concentrations in soils developed on volcanic rocks
- Natural lead can be present in soils of old mining areas

Remember: Diffuse Pollution

- Aerial deposition from industrial processes;
- Nutrients e.g. nitrogen and phosphorus;
- pathogens e.g. human or livestock sewage or burial pits
- pesticides, medicines and biocides from industrial, municipal and agricultural use;
- organic wastes (e.g. slurries, surplus crops, sewage sludge) - poorly stored or spread on land;
- oil and hydrocarbons - car maintenance, disposal of waste oils, spills from storage and handling, road and industrial run-off;
- chlorinated solvents - industrial areas where the use of solvents is ubiquitous;
- Flood events distributing contamination

Site Walkover Survey

- Complements historical desk study
- What is there today ?
- Preferably visit before demolition/site clearance
- Visual inspection
  - Little or no sampling
- Take photographs – they are a useful record
- Visit all buildings, structures, rooms etc but
- **Remember health and safety issues**



Walkover: The surroundings

- Look over the fence!!
  - surrounding property types
  - nearby industrial processes and activities
  - evidence of subsidence etc
- Nearby water courses or ponds, nature reserves or protected species (eg bats newts etc) ?
- Nearby residential or leisure facilities that may be affected during intrusive works (eg noise, dust)
- Evidence of local water abstraction
- Phase 2 considerations
  - Access to services (eg water, electric)
  - Site security issues

Walkover: Environmental practice

- Are all storage facilities bunded?
- Is there evidence of spillages?
- Could spillages have got into drains or sewers?
- Is the site clean and tidy?
- Is waste stored at the site? If so what types and what condition is it is?

Walkover: Stained soils

- Yellow stained soil at a former paint factory due to cadmium contamination
- Can use colour scale used to ensure correct colour balance in image
- Beware not all contamination is visible !

Walkover: Look out for Hazchem signs!

Preliminary Risk Assessment: Phase 1 conceptual model

- Vision of the site based on desk/walkover information including:
  - site characteristics
  - historic, current and planned uses
  - geology & hydrogeology
  - potential contaminant linkages
- Lists assumptions and uncertainties
- There will be many uncertainties at Phase 1:
  - are buried tanks present ?
  - is there contamination at the site? Is it associated with made ground?
  - is contaminated groundwater present or impacting a nearby river?

Phase 2 objectives

- Phase 2 objectives should:
  - be justified by the findings of the Phase 1 risk assessment
  - clarify the uncertainties
  - confirm the assumptions
- For example, where arsenic and diesel contamination is suspected objectives may include:
  - locate any buried tanks in the suspect area (e.g. geophysics?)
  - investigate depth and extent of arsenic/diesel contamination at the site (e.g. soil sampling)
  - investigate the presence of arsenic/diesel contamination in the river (e.g. surface water sampling)

Summary of PRA/Phase 1

- PRA/ Phase 1
  - Collate information
    - Desk
    - Walkover
    - Interviews
  - Identify Hazards
  - Initial Assessment of Risks
  - Capture in CSM
    - Pollutant linkages
    - Key features of Site

SK 51251

Activity – Collect Phase 1 information

- Site information:
  - Bramcote Hills Garage, Derby Road, Inham Nook, Bramcote Hills, Bramcote, Nottinghamshire, East Midlands, England, NG9 3GX, United Kingdom
  - Grid Reference SK 51251 38092
  - Grid Reference (6 figure) SK512380
  - X (Easting) : 451251
  - Y (Northing) : 338092
  - Latitude : 52.937783
  - Longitude : -1.2388802

Session 4a

www.lqm.co.uk
Sound science: Defensible decisions

Practical - PRA

www.lqm.co.uk
Sound science: Defensible decisions

ACTIVITY - Collating Phase 1 information

What are the current uses of the site?

Can you guess what former uses might be?

What is the geology at the site

- http://mapapps.bgs.ac.uk/geologyofbritain/home.html

What is the aquifer classification

- https://magic.defra.gov.uk/magicmap.aspx

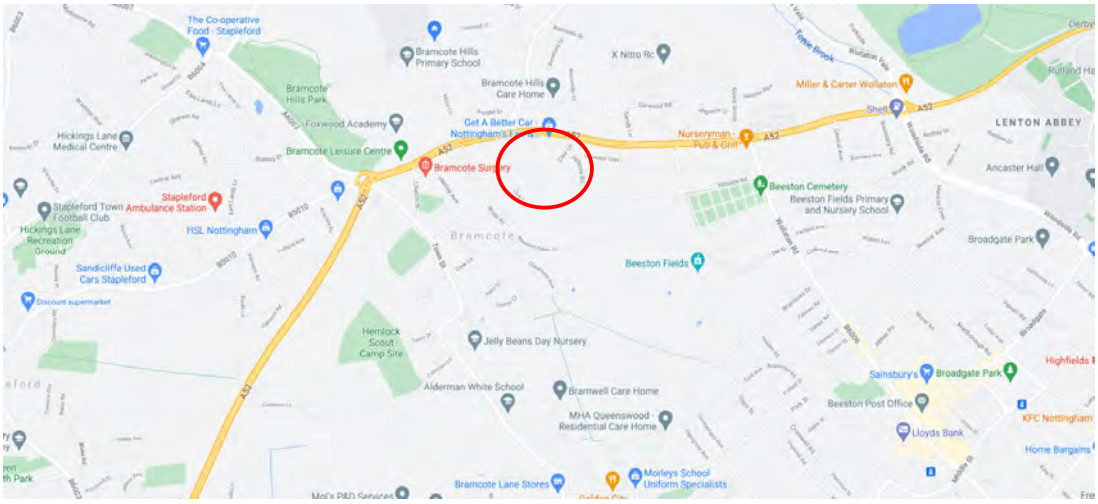
Can you see any surface water features nearby

- Google maps /OS map

www.lqm.co.uk

Sound science: Defensible decisions

Site Location



www.lqm.co.uk

Sound science: Defensible decisions

BRAMCOTE HILLS GARAGE

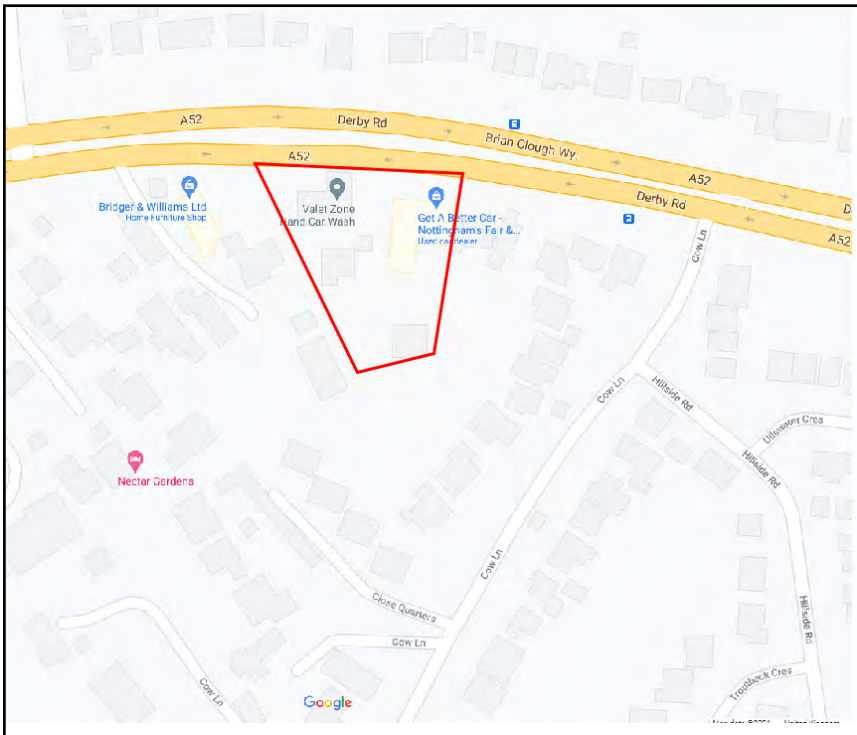
Google maps

https://www.google.co.uk/maps/@52.9376964,-1.2393096,18.17z

Streetview

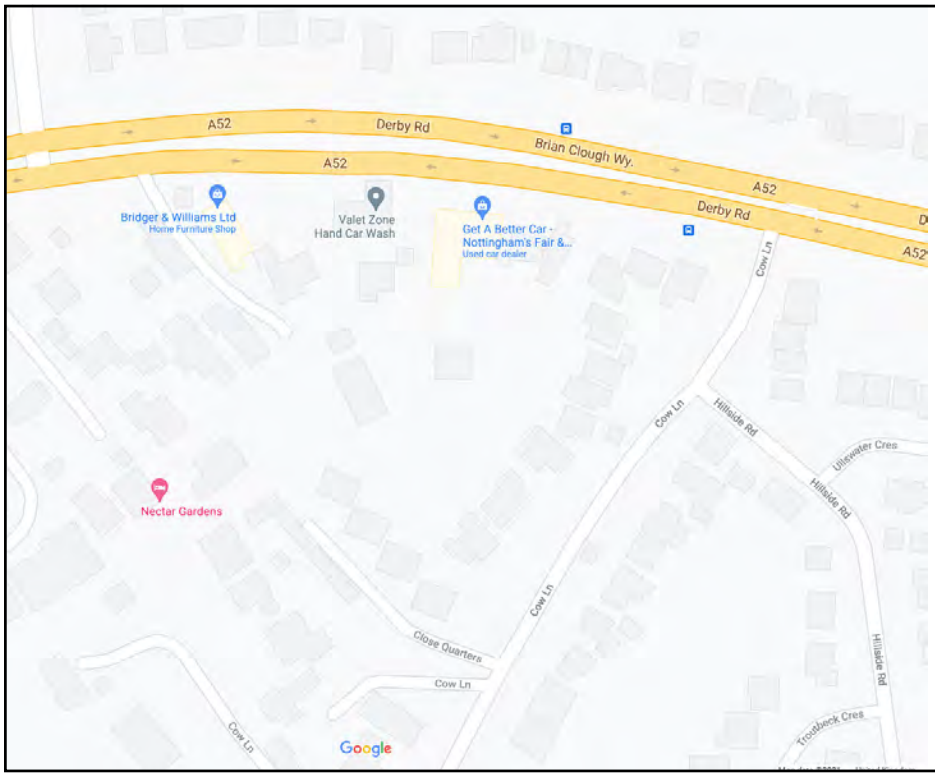
https://www.google.co.uk/maps/@52.9380225,-1.2390769,3a,75y,154.66h,90t/data=!3m7!1e1!3m5!1sP7kJjJ7QxK5OQlxucAMr1g!2e0!6shttps:%2F%2Fstreetviewpixels-pa.googleapis.com%2Fv1%2Fthumbnail%3Fpanoid%3DP7kJjJ7QxK5OQlxucAMr1g%26cb_client%3Dmaps_sv.tactile.gps%26w%3D203%26h%3D100%26yaw%3D164.07184%26pitch%3D0%26thumbfov%3D100!7i13312!8i6656

www.lqm.co.uk



- Site Location

www.lqm.co.uk



- Blank Plan

www.lqm.co.uk

Sound science: Defensible decisions

Location Information

- Bramcote Hills Garage, Derby Road, Inham Nook, Bramcote Hills, Bramcote, Nottinghamshire, East Midlands, England, NG9 3GX, United Kingdom
- Grid Reference SK 51251 38092
- Grid Reference (6 figure) SK512380
- X (Easting) : 451251
- Y (Northing) : 338092
- Latitude : 52.937783
- Longitude : -1.2388802
- Postcode: NG9 3GW
- https://gridreferencefinder.com?gr=SK5125138092|Point_s_D|1&t=Point%20D&v=r

www.lqm.co.uk

Sound science: Defensible decisions

Pause the Video

What are the current uses of the site?

Can you guess what former uses might be?

What is the geology at the site

- http://mapapps.bgs.ac.uk/geologyofbritain/home.html

What is the aquifer classification

- https://magic.defra.gov.uk/magicmap.aspx

Can you see any surface water features nearby

- Google maps /OS map

www.lqm.co.uk

Sound science: Defensible decisions

Session 5

The Conceptual Site Model

A CONCEPTUAL SITE MODEL (CSM) IS…

- *a **description** and/or **representation** of the site, incorporating*
  - *what is **known** about the **ground** and **groundwater** conditions;*
  - *the actual and potential **contamination**;*
  - *the **physical conditions** and **environmental setting**;*
  - *the receptors; and potential pathway **linkages** between contamination sources and receptors".*

BS10175

+ uncertainties

LCRM on CSMs

- A conceptual site model is a representation of the characteristics of the site. It shows the possible relationships between contaminants, pathways and receptors.

- It will form the basis of your initial assessment and all future decisions as you progress through LCRM.

Part 2A statutory guidance on CSMs

- The process of risk assessment involves understanding the risks presented by land, and the associated uncertainties. In practice, this understanding is usually developed and communicated in the form of a "**conceptual model**".
- The record of determination should include ….
  - a relevant conceptual model comprising text, plans, cross sections, photographs and tables as necessary in the interests of making the description understandable to the layperson

CM = PART OF GREENLEAVES “FORMULATE PROBLEM”

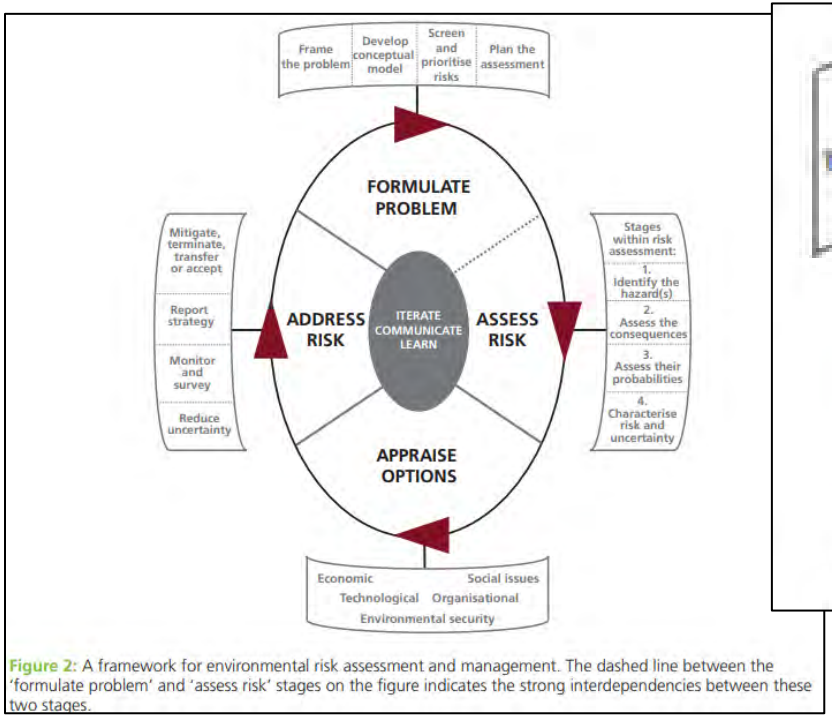
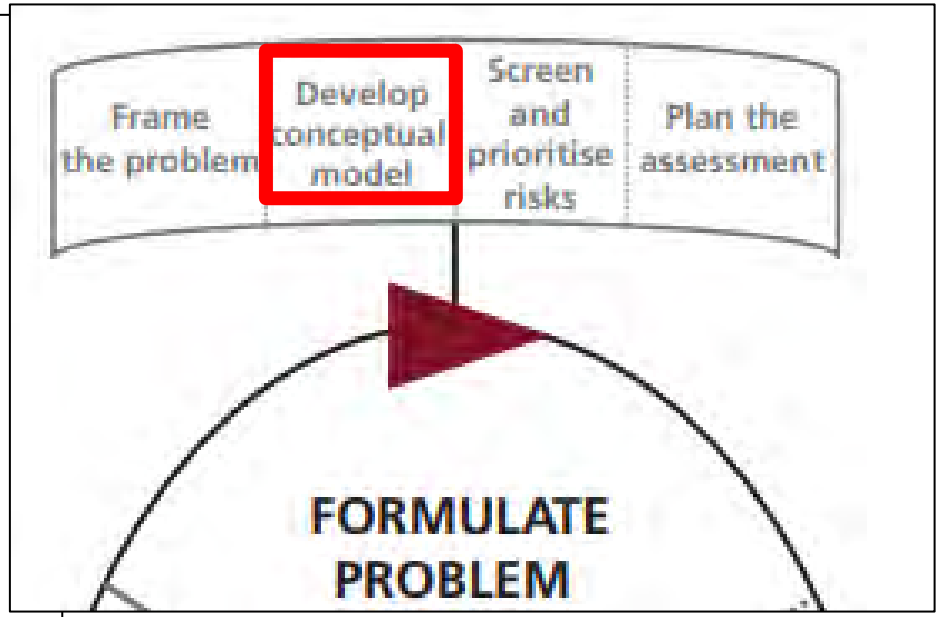


Figure 2: A framework for environmental risk assessment and management. The dashed line between the ‘formulate problem’ and ‘assess risk’ stages on the figure indicates the strong interdependencies between these two stages.



LCRM – CSM

- You can present a CSM in different ways, such as a:
  - written description of the site
  - tabular or matrix description
  - drawing or other diagrammatic illustration
  - You may combine one or more of these formats.
- You must show:
  - contaminant linkages - presence and relationship between contaminants, pathways and receptors
  - the subsurface - geology and hydrogeology
  - more detailed information as it becomes available such as complex flow regimes and soluble transport mechanisms
- You can use the CSM to work out and show:
  - the characteristics of the site
  - what risks may result
  - uncertainties and gaps in information and any further assessment needed to address them
  - As you progress through the risk management process, you will have to refine and update the CSM.

BS10175 on CSMs

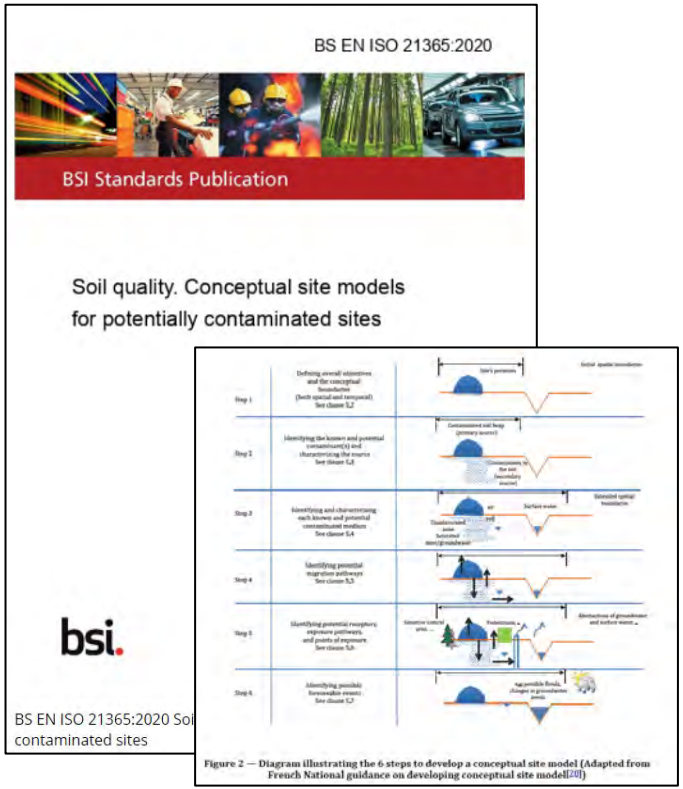
- Emphasises importance of the conceptual model in the investigation of land contamination
- The process of investigation is characterised as one that seeks to reduce the uncertainty in the conceptual model

BS10175:2011+A2:2017 Investigation of Potentially Contaminated Sites Code of Practice

BS 18400 ON CSMS

- 18400-104
  - Whatever the purpose of the investigation, a **sound conceptual site model** is required.
  - (embraces) all information relevant to the objectives of the investigation
  - presented in narrative, pictorial, tabular, or a combination of forms
- 18400-203
  - Leads…to the formulation of **contamination-related hypotheses**

BS EN ISO 21365:2020
Soil quality. Conceptual site models for potentially contaminated sites



- synthesis of all relevant information
- recognition of uncertainties
- iterative and dynamic approach
- Includes consideration of possible foreseeable events
  - Floods
  - Water Table changes

BS EN ISO 21365:2020
Soil quality. Conceptual site models for potentially contaminated sites

"A good conceptual site model ensures that subsequent site decisions are the right ones"

https://shop.bsigroup.com/products/soil-quality-conceptual-site-models-for-potentially-contaminated-sites/standard

- synthesis of all relevant information
- recognition of uncertainties
- iterative and dynamic approach
- Includes consideration of possible foreseeable events
  - Floods
  - Water Table changes

Sound science: Defensible decisions

What does it do?

- Main driver of risk assessment process
- Revised during each phase as more information becomes available
- A representation of relevant information relating to contamination on a particular site
- Identifies (potential) sources, pathways and receptors
- Identifies possible/significant contaminant linkages
- States remaining uncertainties
- Communication aid / summary of complex reports

Contents of CSM

- Description of site and surrounding area including past, current and future uses of site
- State context:
  - Legal, Contractual, Stage of risk assessment process
- Geology, hydrology and hydrogeology
- Contaminant Linkages:
  - Potential sources (contaminative activity e.g. fuel tank)
  - Potential contaminants
  - Potential pathways
  - Potential receptors
- Assumptions and uncertainties

Assumptions and uncertainties

- Always present!
- Need to be considered when making risk management decisions and assessing ‘significance’ of risks
- Target of further investigation
- Will change throughout the process
- Examples:
  - Contaminants is suspected, but its nature, location, concentration and mobility is unknown
  - Condition of effluent treatment pond and its impact on groundwater and lagoon are not known
  - The extent, thickness and nature of made ground at the Site has not been characterised.

A good conceptual site model should …

- Clearly communicate the facts, linkages and uncertainties
- Be site-specific (presentation will vary)
- Should include table/text summary of details site history, geology…. plus:
  - Graphics to understand 3D features of site
    - plan (top down view of the site),
    - cross section (vertical distribution of geology, water table, NAPL, plumes)
- May benefit from graphics representing linkages:
  - Matrix & network diagrams
- Text

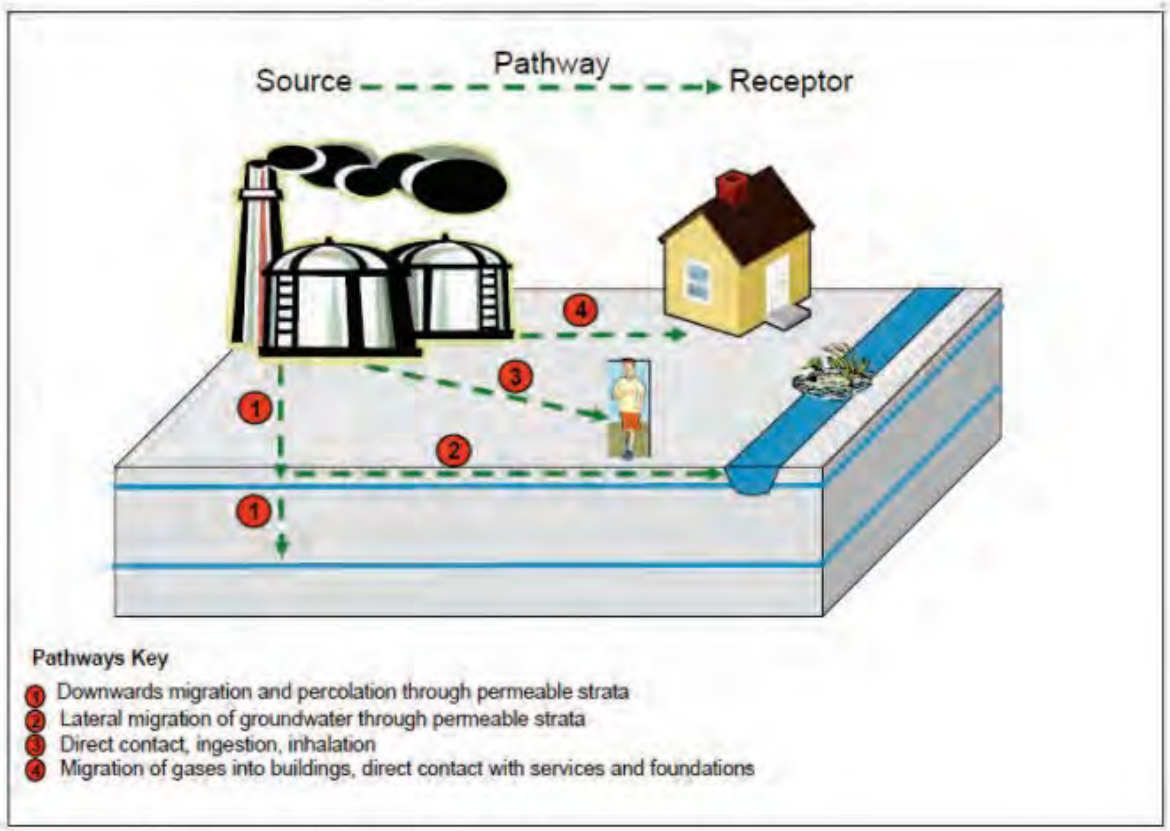
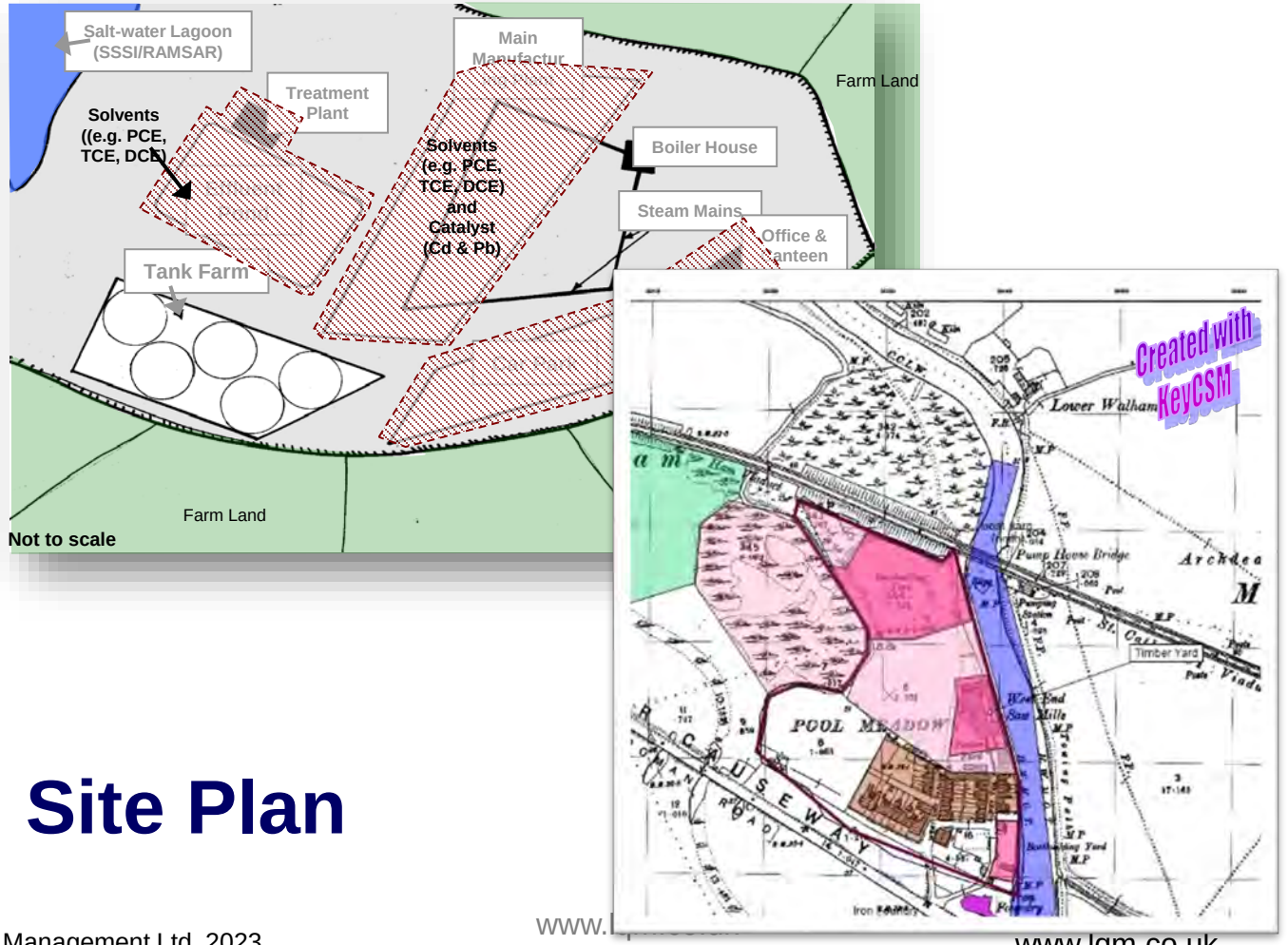
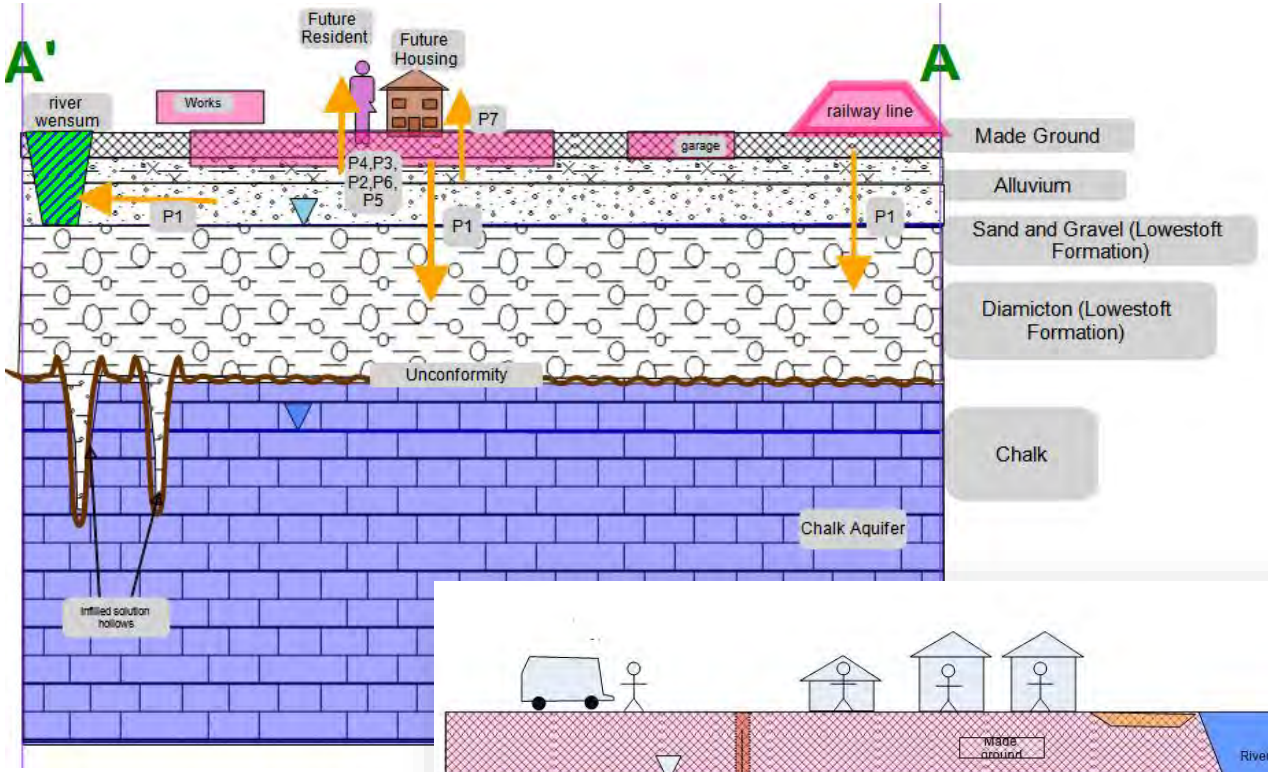


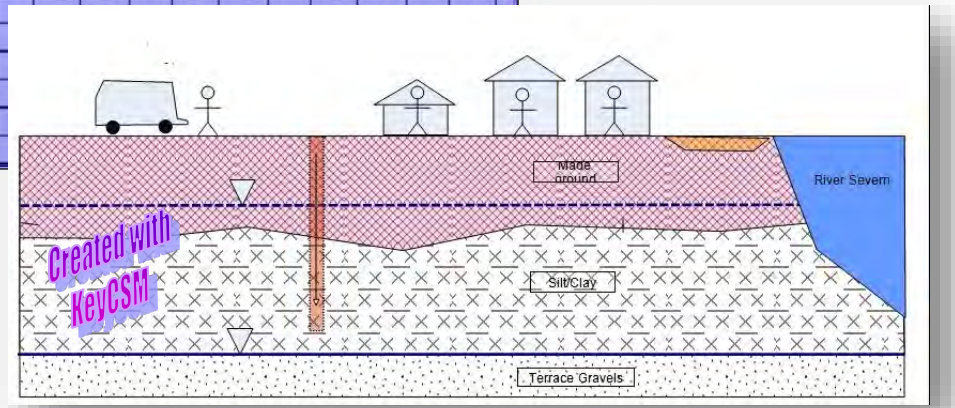
Figure 1 – Significant harm and significant pollution

https://www.sepa.org.uk/media/28315/water-pollution-arising-from-land-containing-chemical-contaminants.pdf



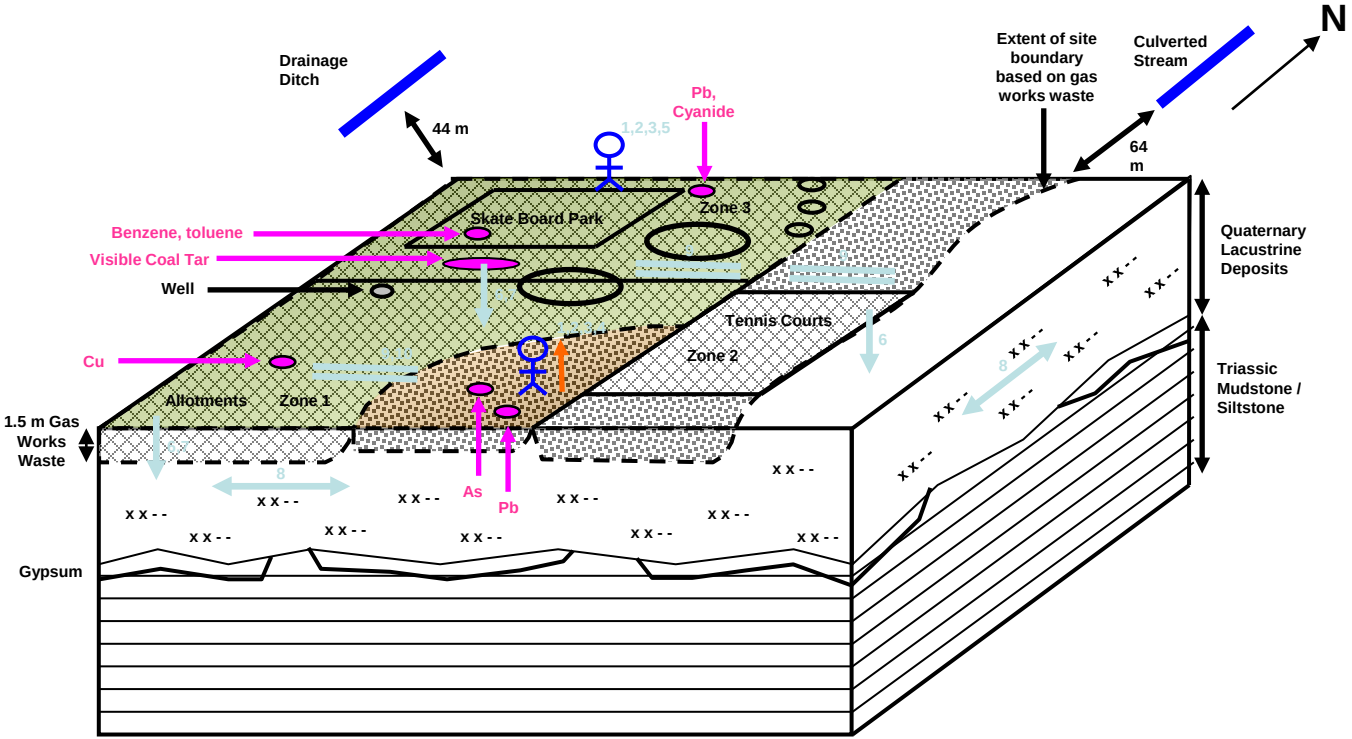
Site Plan





Cross Section

3D Conceptual Site Model

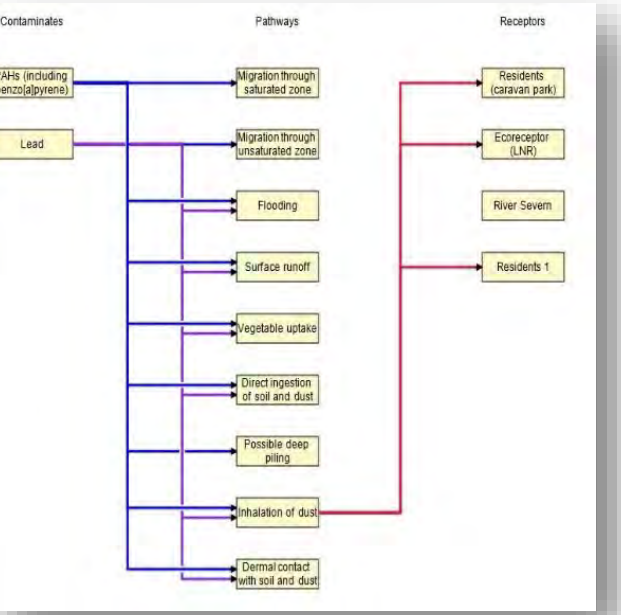


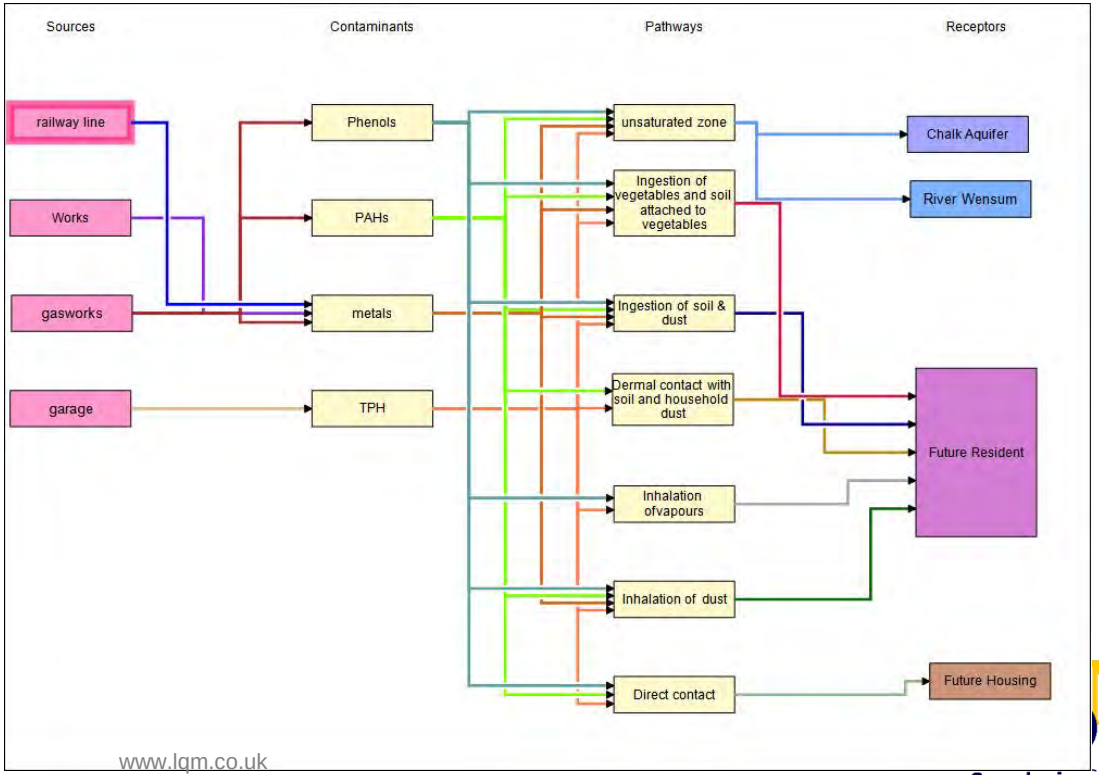
A site

www.lqm.co.uk

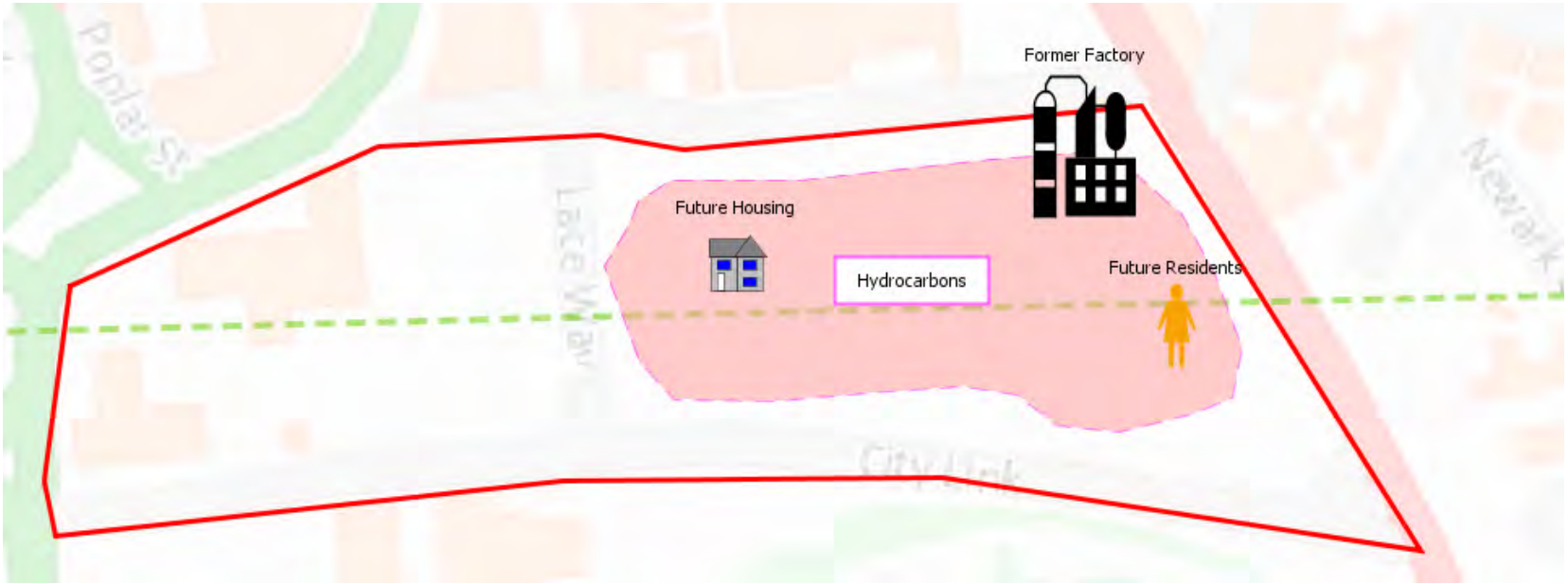
Sound science: Defensible decisions

Network Diagrams

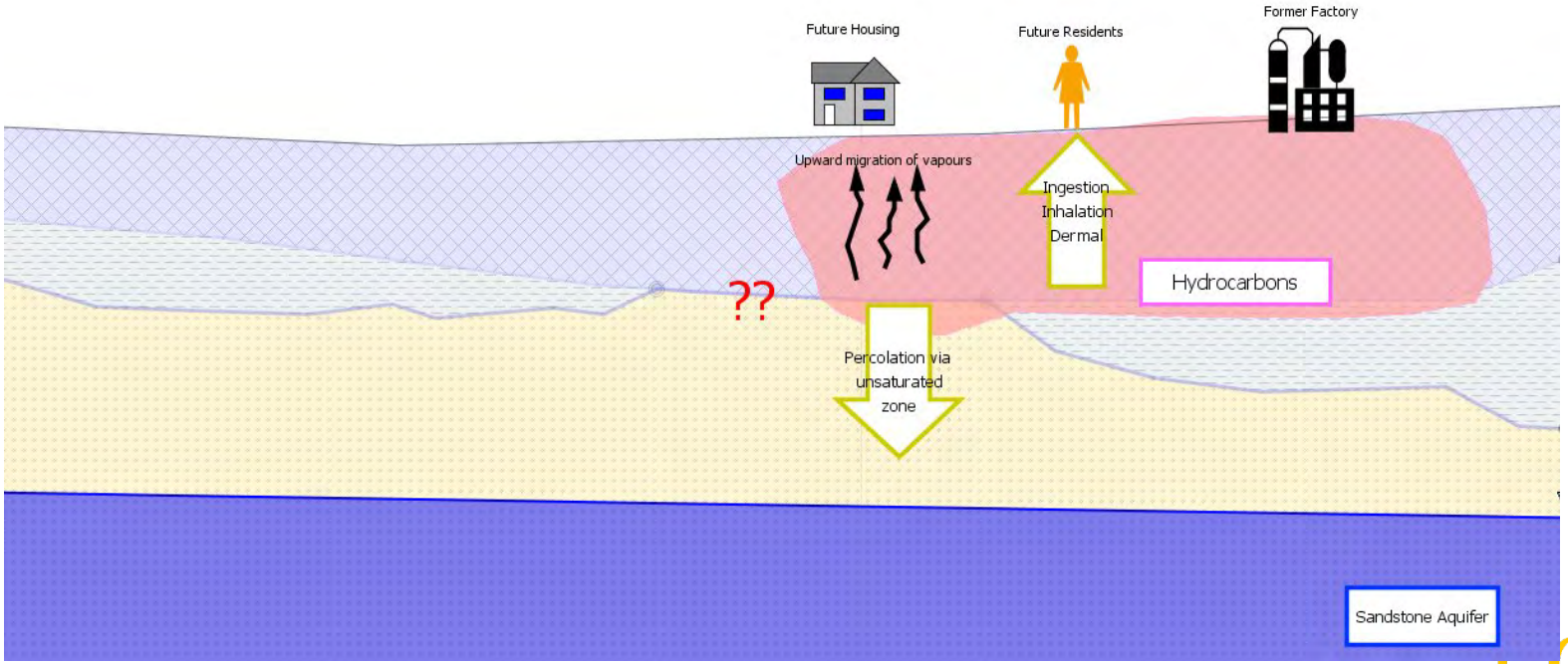




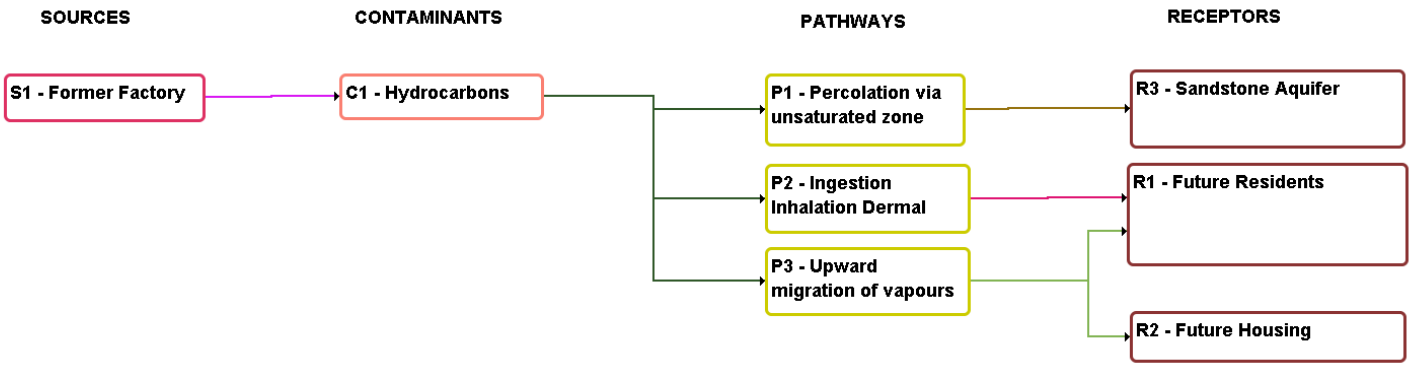
CSM Plan View



CSM Cross Section



CSM Network



Matrices (various possibilities)

	Future residents	River Avon	Chalk	SSSI
DRO	Ing, Inh, Der, Veg	Unsat zone	Unsat zone	Sat zone
TCE	Inh	No	Unsat zone	No

Matrices (various possibilities)

Source	Contaminant	Pathway	Receptor
Diesel tank	Diesel Range Organics (DRO)	Ingestion	Future residents
Diesel tank	DRO	Dermal uptake	Future residents
Diesel tank	DRO	Inhalation vapours	Future residents
Factory	Trichloroethene (TCE)	Inhalation vapours	Future residents
Factory	TCE	Unsaturated zone	Chalk

Matrices (cont)

SPL	Pollutant	Pathway(s)	Receptor	Grounds for Determination
1	Heating oil (free phase and residual soil concentrations; localised aqueous phase hydrocarbons represent potential secondary sources)	Migration of petroleum hydrocarbon vapours from the sub surface into the property; subsequent inhalation of vapours within building	Humans (residents of Apple Tree House) and pet animals	Significant risk of significant harm
2		Migration of dissolved phase and potentially free phase heating oil into the Minor Aquifer, principally via existing water well	Minor Aquifer (groundwater within Mercia Mudstone)	Pollution of controlled waters

CSM… drives the risk assessment process

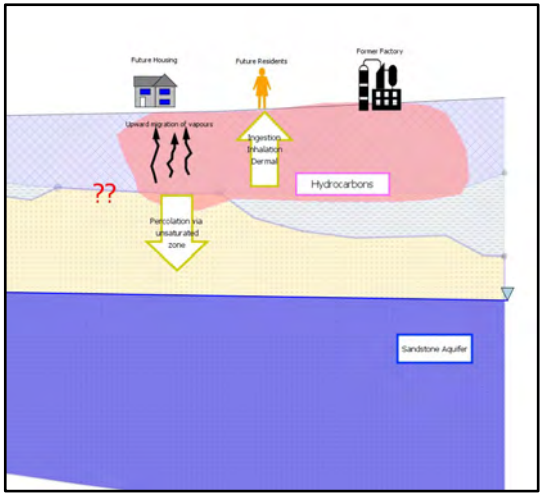
'….if you do not know what you should be looking for in a site investigation, you are not likely to find much of value' (Glossop 1968)

CSM = what is known + what is not known

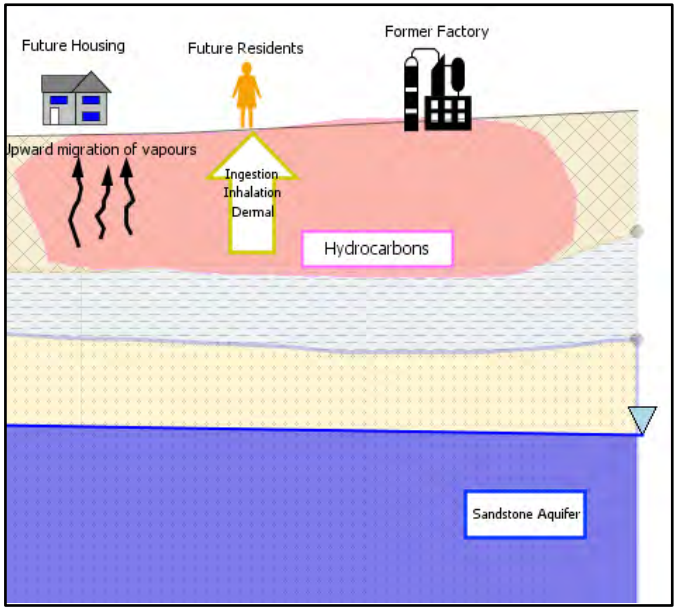
How is the CSM used?

- Aid design of next phase / further investigation
  - Target identified contaminant linkages at each stage
  - Reduce costs – only gathering important data
  - Locate knowledge gaps, uncertainty and assumptions
- Revised throughout the process (Phase 1, 2 or 3) as more information becomes available
- Basis for choosing mathematical models for RA - estimating amount of contaminant which reaches a receptor
- Aids selection of remediation alternatives and evaluating their effectiveness
- Demonstrate that all identified contaminant linkages have been dealt with
- Required by good practice guidance including CLR11, BS10175 *etc.*

Example CSM – XS – end of RA

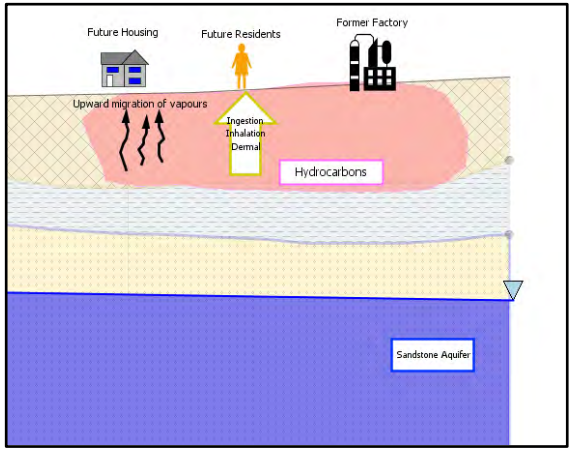


PRA - CSM

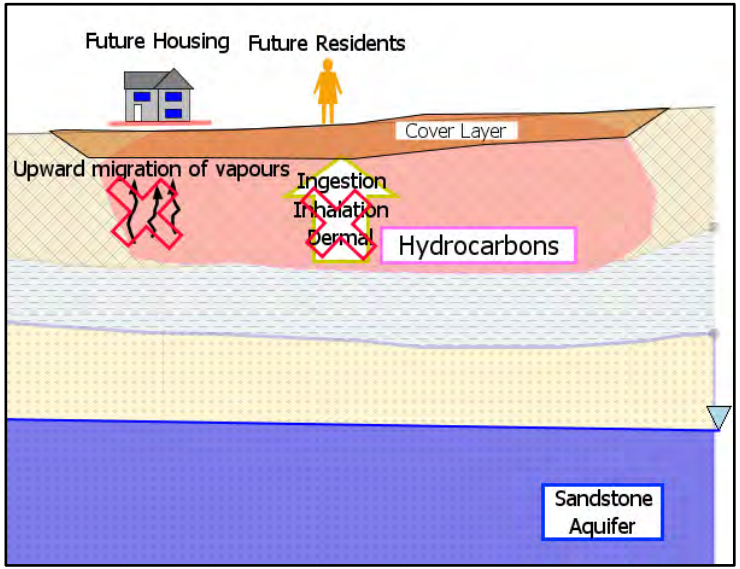


CSM after SI, Lab analyses, RA

demonstrably breaking RCLS

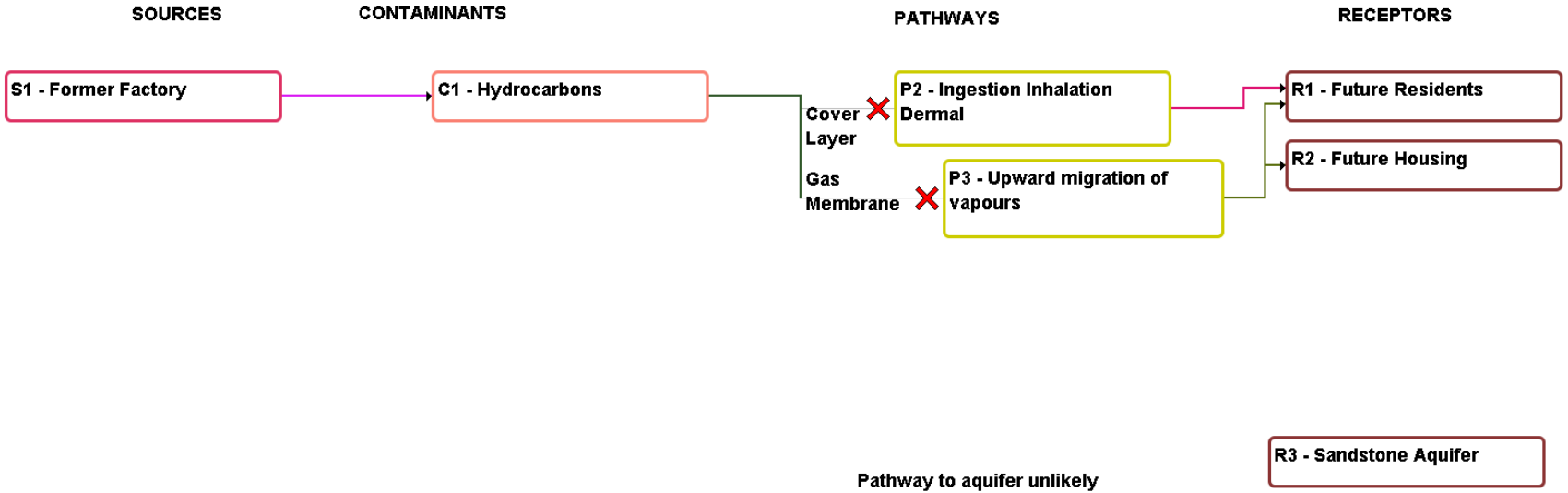


CSM after SI, Lab analyses, RA



CSM post remediation

demonstrably breaking RCLS



Sound science:
Defensible decisions

Rules for conceptual model development

- Start with the legal context
- Show sources of contamination; pathways & relevant receptors
- Display and justify the CONTAMINANT LINKAGES
- Use colour, greyscales, symbology and a Key
- Distinguish between past, current and future intended land uses
- Display the vertical dimension
- Include relevant ?? uncertainties ??
- Check consistency across plan, section, matrix, network views
- The CSM is a living document - update the CSM as more information becomes available
- Keep it simple – zone the site or sub-divide complex models

Subdivide CSM to aid clarity

Session 5a

www.lqm.co.uk

Practical - CSM

www.lqm.co.uk

ACTIVITY

- From PRA activity we know:
  - Current uses
    - Valet wash, repair garage
  - Former uses
    - Petrol station
  - Geology
    - Superficial: None
    - Bedrock: Sandstone
  - Aquifers
    - Principal Aquifer
  - Surface water
    - River Trent some distance to the south

www.lqm.co.uk

ACTIVITY

- Create a conceptual model of the Site
- In steps
  - We already know likely sources
  - Identify likely contaminants (DOE profile)
  - Identify likely receptors
  - Mark S C P R on plan and cross section
  - Create a network diagram

www.lqm.co.uk

ACTIVITY

Using the relevant DOE profile identify 4 possible sources of contamination

- https://www.claire.co.uk/information-centre/water-and-land-library-wall/41-water-and-land-library-wall/198-doe-industry-profiles

www.lqm.co.uk

ACTIVITY

Identify possible receptors

- Hint, consider scenario, information on aquifer, surface water

www.lqm.co.uk

ACTIVITY

Identify possible pathways

HINT – think about which pathways will go to which receptor

www.lqm.co.uk

ACTIVITY

Mark possible sources and receptors on site plan

www.lqm.co.uk

ACTIVITY

Sketch a geological cross section

Mark possible sources pathways and receptors on cross section

Don’t forget to mark line of cross section on plan view

www.lqm.co.uk

ACTIVITY

Create a network diagram/matrix/table of possible pollutant linkages

www.lqm.co.uk

Summary of Course

- Legislation
  - Planning
  - Part 2A
- Risk assessment
- Preliminary Risk Assessment
- Conceptual Site Model

www.lqm.co.uk

Sound science: Defensible decisions