

An aerial photograph of a large industrial or construction site. The terrain is mostly brown and sandy, with some green patches of vegetation. A winding road or path is visible, along with various structures and equipment. The text "Risk - Based Contaminated Land Investigation" is overlaid on the image in a large, yellow, stylized font with a black outline and a halftone pattern.

**Risk - Based  
Contaminated Land  
Investigation**

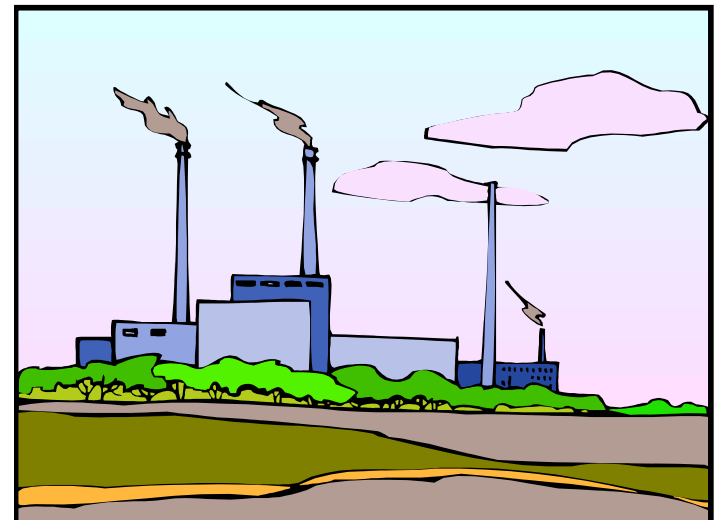
**1GS312 CONTAMINATED LAND  
1GS418 FUNDAMENTALS OF CONTAMINATED LAND**

**SCHOOL OF EARTH & ENVIRONMENTAL SCIENCES**

**Risk - Based Contaminated Land Investigation  
Part 1**

## Overview

- Contaminated land investigation
- Gas and vapour investigation
- Remediation and reclamation methodologies



## *Contaminated Land Investigation*

- Risk - Based approach to contaminated land
- Hazard identification
- Hazard assessment
- Risk estimation
- Risk evaluation
- Risk control / management
- Risk-based contaminated land investigation & assessment
- Risk management context
- **Source - Pathway - Target**



## *Purpose of Investigation*

- Determine nature & extent of any **contamination**
- Identify any **hazards** posed by the contamination
- Identify & describe **sources, pathways & targets**
- Allow assessment of current & potential **risks**
- Determine whether **remedial action** is needed

“ Inform decisions on the:

- nature
- extent
- performance requirements of any remedial works “



## *Purpose of Investigation*

- Aspects to be considered during the investigation of contaminated sites:
  - Contamination
  - Geology
  - Hydrogeology
  - Pathways & receptors
  - Geotechnical



## ***Risk Management Contexts***

- Purchase, transfer or divestment of land & property
- Funding, insurance or valuation activities
- Establishment of potential legal liabilities by site owner or occupier
- Land redevelopment
- Implementation of environmental & public health legislation

**Caveat Emptor**

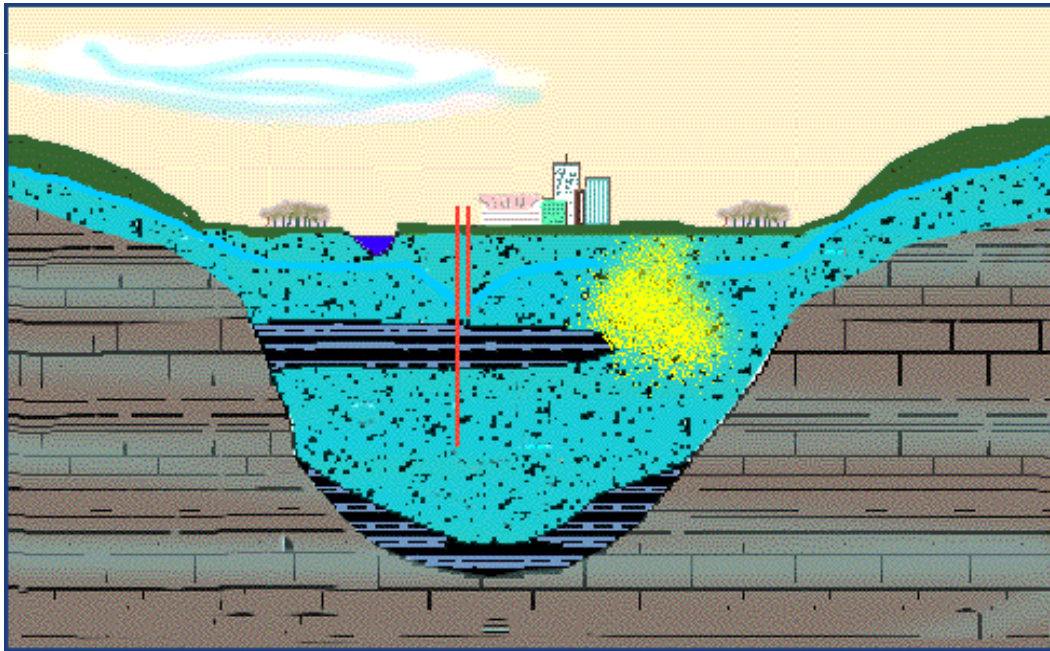
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**“Buyer Beware”**



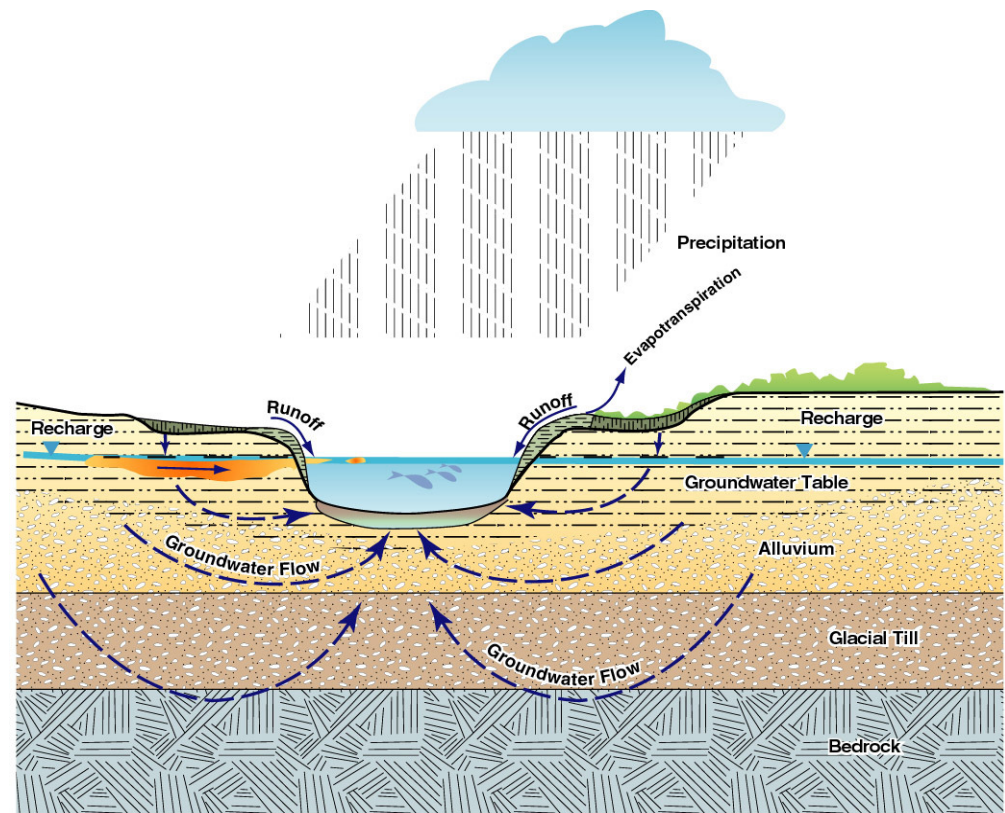
## *Effective Risk Assessment*

- Contamination



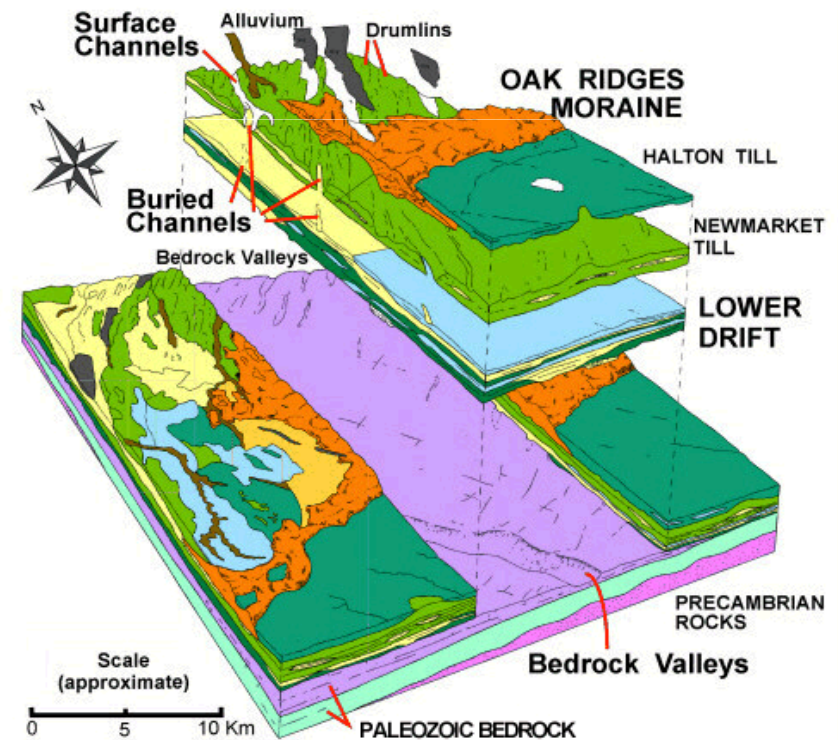
## Effective Risk Assessment

- Hydrological & hydrogeological regimes
  - Surface & ground water



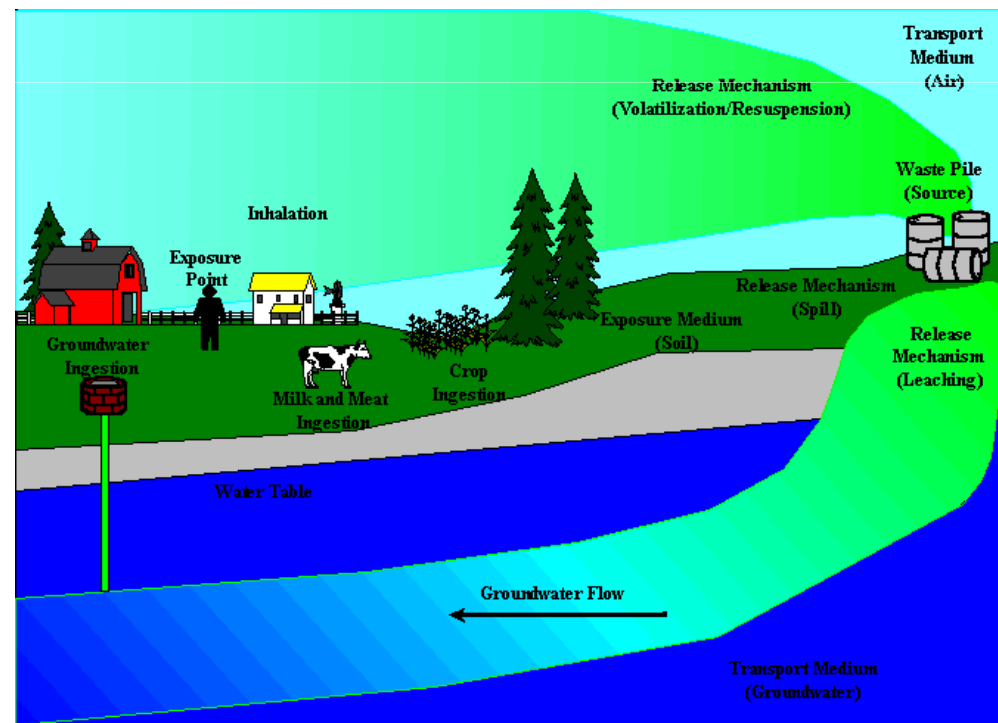
## Effective Risk Assessment

- Geotechnical properties & geological setting
  - Site model
  - Ground model
  - Geoframework



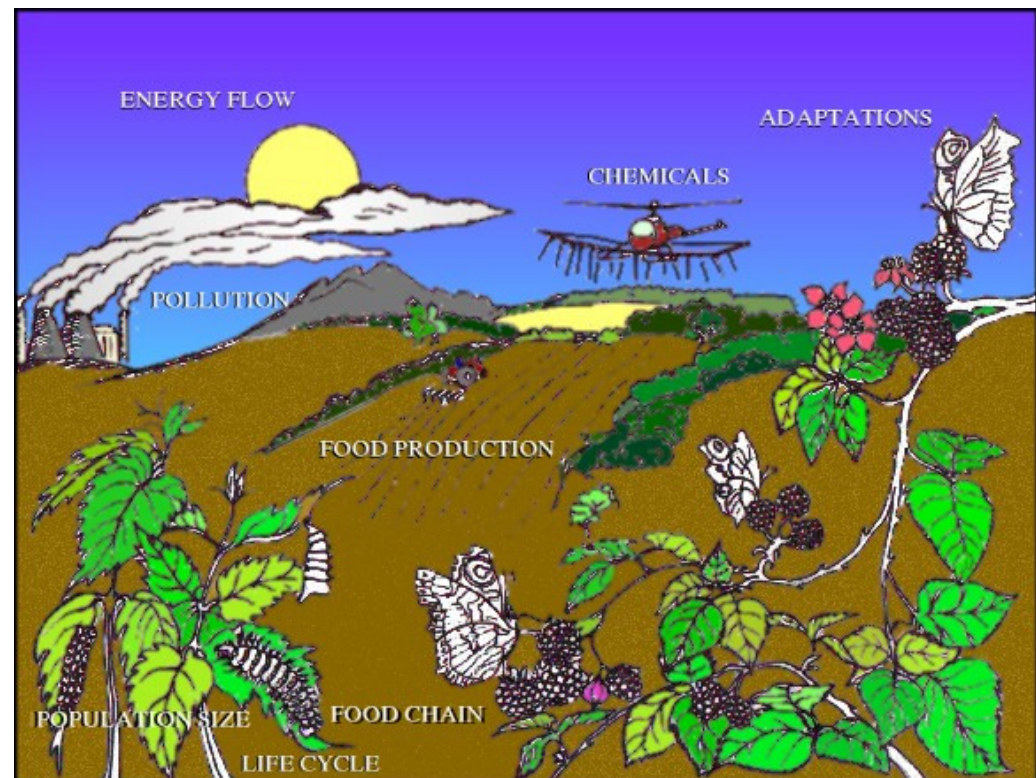
## Effective Risk Assessment

- Present & future targets & pathways



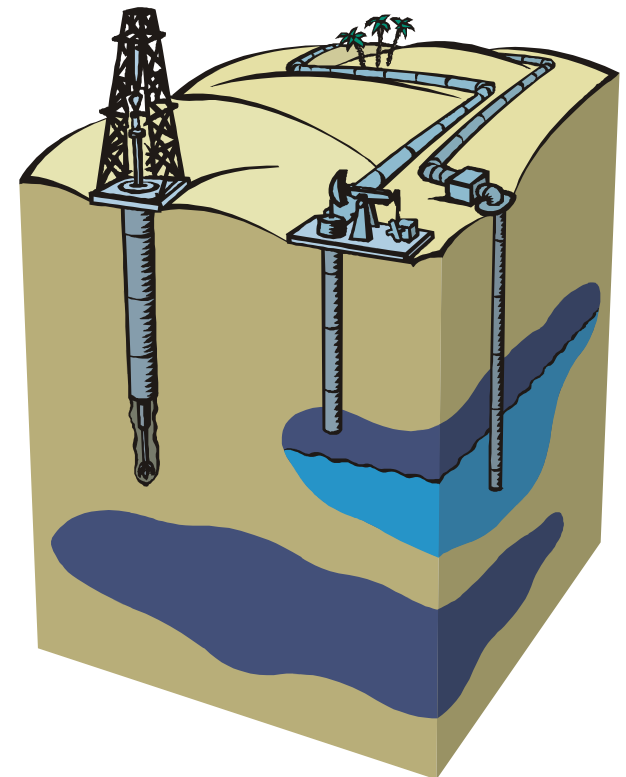
## Effective Risk Assessment

- Ecological assessment on some sites



## *Primary Objectives*

- Determine the nature & extent of any contamination present
  - i.e. The hazard **SOURCE**
- Characterise the host media
  - i.e. the **PATHWAYS**
- Understand the nature of the potential **TARGETS**
- Understand the relationships between the source & the effects (risks)
- Inform appropriate management & remediation decisions





## ***Investigation Phases***

**1. Preliminary**  
Primary non - intrusive phase

**2. Exploratory**  
Limited intrusive phase

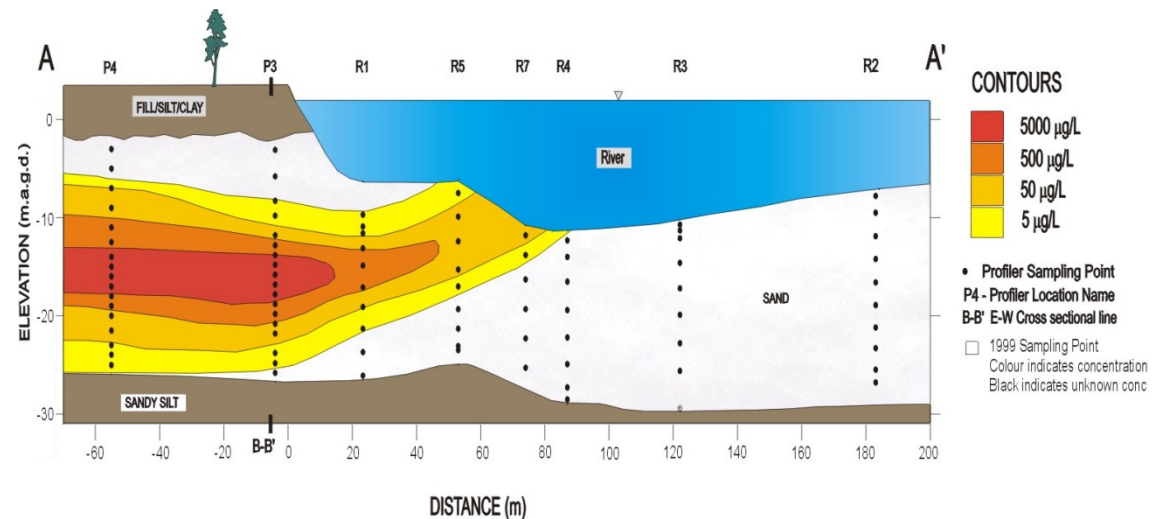
**3. Main or detailed phase**  
Dominated by intrusive ground  
investigation techniques

## ***Investigation Phases***

- **Phase I Investigation**
  - Preliminary investigation comprising desk study & site reconnaissance
- **Phase IIa Investigation**
  - Exploratory investigation e.g. Preliminary sampling, monitoring
- **Phase IIb Investigation**
  - Main investigation involving detailed on-site exploratory work
- **Phase IIc Investigation**
  - Supplementary investigations, the collection of additional site investigation data for specified purposes
- **Phase III Validation**
  - Testing for compliance & performance comprising on-going monitoring & validation of remedial action & post-treatment management

## Hypotheses Development

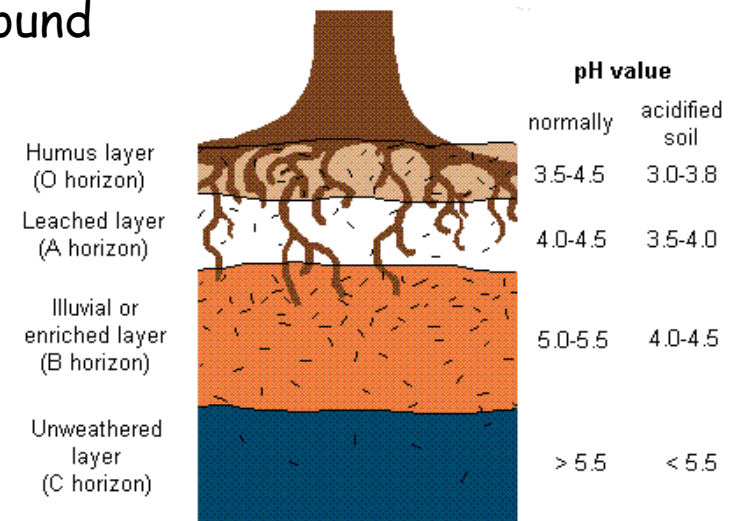
- Whether it is possible to draw conclusions about the probable distribution of contaminants
- Nature of the source & the manner in which the contamination has entered the soil
- Where in the soil or groundwater the contamination is likely to be found



Site Hydrostratigraphic Profile and Dissolved Naphthalene Plume (modified from Anthony 1998)

## Hypotheses Development

- **Depends on:**
  - Nature of the contaminants
  - Soil stratification
  - Soil / Fill characteristics
  - Depth to groundwater
  - How long contamination has been in the ground



## *S - P - T Chain – Pollutant Linkage*

- Need & scope for further work
- Precautions required before intrusive investigations can be undertaken
- **Need for any immediate or interim remedial work**
- Focusing of investigation on the hazards, pathways & targets of concern
- Any additional hazards, pollution or nuisance that might be generated by the investigation





## ***Risk or No Risk?***

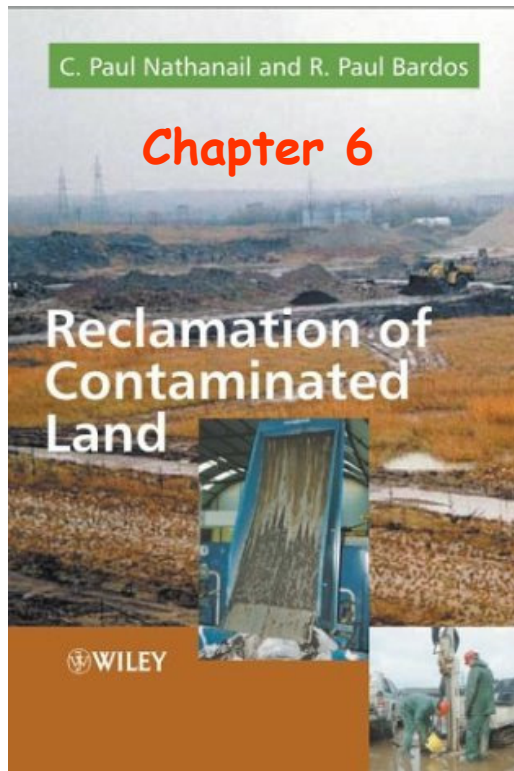


## *Supporting Text*

- ICE design and practice guides: **Contaminated land - investigation, assessment and remediation**, 2nd edition
- J. Strange,  
MEng, CEng, CEnv, MICE, MIEnvSc, Associate Director,  
Card Geotechnics Limited
- N. Langdon  
BEng, MSc, DIC, CEng, CEnv, FICE, FGS, Director,  
Card Geotechnics Limited



# Consolidation Work



**Welcome To GEOHAZARDS.INFO**  
A web site on all aspects of Applied Geosciences including Engineering Geology, Engineering Geomorphology and Geological Hazards  
CURRENTLY UNDER RECONSTRUCTION JUNE 2011

<ul style="list-style-type: none"> <li>CV &amp; Pubs</li> <li>Digital Images</li> <li>Conferences</li> <li>PhD</li> <li>Contamination</li> <li>Landslides</li> <li>Geohazards</li> <li>Quaternary</li> <li>Ground Models</li> <li>Dams</li> <li>RMA</li> <li>Risk Analysis</li> </ul>	<p><b>CV &amp; Personal Publications</b> Details of career experience and skills, publications and committee memberships.</p> <p><b>Digital Image Archive</b> Applied geoscience digital image resource.</p> <p><b>Conference Presentations</b> Presentations made at conferences, specialist meetings and training events.</p> <p><b>PhD</b> Intranet directory</p>
<b>Resources</b>	
<p><b>Contaminated Land Resources</b> Resources and links for the assessment and remediation of Brownfield sites and contaminated land.</p>	<p><b>Dam Engineering Resources</b> Resources and links for aspects of dam design and dam ground engineering.</p>
<p><b>Landslide &amp; Slope Instability Resources</b> Resources and links for all aspects of landslide geohazards and slope instability.</p>	<p><b>Risk Analysis Resources</b> Resources and links for geoscience risk analysis and assessment.</p>
<p><b>Geological Hazard Resources</b> Resources and links for volcanic, seismic, tsunami geohazards together with problematic ground conditions and engineering soils.</p>	<p><b>Rock Mass Classification Resources</b> Resources and links for rock mass classification schemes and procedures.</p>
<p><b>Quaternary Geology Resources</b> Resources and links for Quaternary Geology including glacial geomorphology, periglacial processes and Quaternary stratigraphy.</p>	<p><b>Resources</b> Resources and links for</p>