



**TECHNOLOGY AND RESEARCH GROUP**

**TWENTY-FIRST ANNUAL REPORT  
2023**

## **Introduction by the TRG Chair**

CL:AIRE's Technology and Research Group (TRG) had another busy year in 2023, reviewing four bulletins and four industry reports. These outputs were on topics such as the reuse of excavated materials, risk assessment, sustainable remediation, natural source zone depletion and emerging contaminants and illustrate the breadth of CL:AIRE's work.

I know that the CL:AIRE Board and Management Team greatly appreciate the time and effort taken by the TRG members in ensuring the quality of CL:AIRE products. In fact they consider the TRG fundamental to maintaining and enhancing CL:AIRE's reputation and supporting the development of the organisation.

I would like to express my personal thanks to the TRG members and their employers for their contributions.

There were no changes to the main TRG membership in 2023, although we did welcome two new Early Career Professionals to the group - Lottie Harold from Arup and Kirsty Tolley from RSK Geosciences. Many thanks to Jessica Shaw, Arcadis, Daniel Simons, Soilfix and Leigh Ward, AtkinsRéalis who completed their two-year period at the end of 2023.

This document is in two parts - the first gives background to the important role of the TRG within CL:AIRE, whilst the second details its activities during 2023.

The Annual Report is written for CL:AIRE's Members and the wider industry and aims to demonstrate the value of the TRG to CL:AIRE's activities and CL:AIRE's reputation across the world.

Kim Baines  
May 2024

# **BACKGROUND TO CL:AIRE AND THE TRG**

## **INTRODUCTION**

CL:AIRE is an environmental organisation, established in 1999, to improve standards and efficiency in the brownfield regeneration industry. CL:AIRE's status as an independent organisation allows it to appraise and disseminate knowledge on innovation and good practice. Thus increasing confidence across the industry, which is driving forward effective and sustainable reuse of land. This is recognised both in the UK and worldwide with CL:AIRE's profile continuing to grow.

CL:AIRE consists of a team of professionals who carry out its daily activities, supported by a Board of Trustees, an advisory group – the Technology and Research Group (TRG) and a number of task groups comprising industry representatives from CL:AIRE member organisations. The TRG plays a key role in CL:AIRE's work, supporting CL:AIRE on issues associated with technology development and sustainable land reuse, peer review of technical publications and resources, and offering strategic review and steering functions for all CL:AIRE's activities. The TRG also offers several positions for early career professionals, which enables fact-track awareness to emerging industry issues and access to experienced practitioners for mentoring support.

Appendix 1 describes the wide range of activities that CL:AIRE undertook in 2023.

## **THE TRG PROCESSES**

The work of the TRG is facilitated through regular meetings, email correspondence and telephone calls. The CL:AIRE team focuses the input of the TRG to ensure the expertise of the group has the greatest impact. The TRG comprises high calibre renowned professionals who are expert in policy, legislation and regulatory guidance as well as in the practicalities of managing and regenerating brownfield sites and the sustainable reuse of land. The TRG expertise adds real value by ensuring CL:AIRE activities are consistent with UK policy, legal requirements and good practices and are of sound scientific and technical quality. The independent review provided by the TRG ensures transparency and accountability of CL:AIRE activities.

## **TRG MEMBERS**

Members of the TRG are selected on account of their skills and expertise to give CL:AIRE an extensive breadth of intellectual and experiential support across its scope of work. This is tracked using a skills matrix which is regularly updated to ensure all aspects of CL:AIRE's activities are covered. Biographies of current TRG members are given in Appendix 2. 2023 TRG members are listed below:

Chair: Kim Baines – International Atomic Energy Agency

Deputy Chair: Liz Gray – Ramboll

Bob Barnes – Environment Agency

Simon Burr – CampbellReith

Ruth Chippendale – Shell

Max Coleman – Caltech

Steve Edgar – Vertase FLI

Mark Hodson – University of York

Seamus Lefroy-Brooks – LBH GEO

Edward Lewis – Northern Ireland Environment Agency

Sarah Poulton – Natural Resources Wales

Mike Rivett – GroundH2O plus Ltd

Steven Thornton – University of Sheffield

Karen Young – Jacobs

**Early Career Professional TRG Members**

Lottie Harold – Arup

Jessica Shaw – Arcadis

Daniel Simons – Soilfix

Kirsty Tolley – RSK Geosciences

Leigh Ward – Atkins

# THE 2023 ANNUAL REPORT

## 1. TRG ACTIVITIES

### 1.1 TRG Meetings

During 2023, two TRG meetings were held by videoconference and one TRG meeting was held in person in Reading.

### 1.2 CL:AIRE Resources Reviewed

#### 1.2.1 *Bulletins*

TRG members completed the review of four bulletins which were published in 2023:

- Guidance Bulletin 3 - A summary of the Definition of Waste: Development Industry Code of Practice
- SuRF-UK Bulletin 6 - How sustainable remediation concepts align with ISO 14001:2015 environmental management systems
- SuRF-UK Bulletin 7 - Introduction to sustainable remediation
- Technical Bulletin 22 - An overview of the uses of PFAS to assist with identification of sites of concern

#### 1.2.2 *Technical Reports*

TRG members reviewed the following four technical reports in 2023 (see Appendix 1 for more details):

- Category 4 Screening Level Report: trans-1,2-dichloroethene
- Concawe Report: Case studies and analysis of sustainable remediation techniques and technologies
- Natural Source Zone Depletion (NSZD) guidance
- Definition of Waste: Development Industry Code of Practice (version 3)

The current list of all CL:AIRE resources is provided in Appendix 3.

### 1.3 Other Activities

In addition to the above activities the TRG were asked to comment on, or contribute to, many of CL:AIRE's initiatives (listed in Appendix 1). Further contributions included the following:

- Reviewed Frequently Asked Questions on colliery spoil; golf courses; stockpiles; and materials use on receiver sites, all in relation to the Definition of Waste: Development Industry Code of Practice
- Reviewed questions for 2024 Qualified Person assessment
- Reviewed content ideas for new PFAS publications
- Reviewed training content for practical aspects of ground gas, vapour and water monitoring & sampling

## 2. A LOOK AHEAD TO 2024

In 2024, the TRG will be reviewing bulletins, guidance reports, industry reports, webinars, eLearning modules and outputs from the industry initiatives CL:AIRE is involved in, as well as contributing strategic review, support and steering functions for all CL:AIRE's activities.

## CL:AIRE's Activities 2023

### 1. Industry Initiatives

#### **The National Brownfield Forum & National Quality Mark Scheme**

The National Brownfield Forum was set up in July 2011, originally established by Department for Communities and Local Government (DCLG<sup>1</sup>) and Department for Environment, Food and Rural Affairs (Defra). The aim of the Forum is to promote the sustainable use of land. It brings together private and public sector organisations to take an open and forward-looking strategic overview of current and future land use issues. The Forum considers UK-wide issues and references overseas experience where appropriate. Representation of organisations on the Forum is kept under review, and seeks to represent a broad spectrum of interests.

CL:AIRE acts as the secretariat for the Forum on a voluntary basis with all notes from the meeting being made publicly available from CL:AIRE's website at [www.claire.co.uk/brownfieldforum](http://www.claire.co.uk/brownfieldforum).

The National Quality Mark Scheme (NQMS) for land affected by contamination is a scheme that has been developed by the Forum to provide visible identification of documents that have been checked for quality by a Suitably Qualified and experienced Person (SQP). It provides increased confidence and improved quality of submissions made under regulatory regimes, particularly planning applications, related to previously used land.

The NQMS was launched in January 2017 and CL:AIRE acts as the administrator. More information can be found via [www.claire.co.uk/nqms](http://www.claire.co.uk/nqms).

#### **The Definition of Waste: Development Industry Code of Practice (DoW CoP)**

The DoW CoP is an initiative to improve the sustainable development of land through the reuse of materials generated at a site. The DoW CoP provides a clear, consistent and streamlined process which enables the legitimate reuse of excavated materials on-site or their movement between sites with a significantly reduced regulatory burden. In many instances the DoW CoP can provide an alternative to Environmental Permits or Waste Exemptions when seeking to reuse excavated materials.

CL:AIRE administers the DoW CoP declaration process and Qualified Person Register, and provides the Qualified Person training course.

CL:AIRE also keeps a register of materials and services which may fall within the DoWCoP. It aims to link material holders with service providers or organisations requiring materials in order to make the process of finding project partners an easier and quicker process.

In 2023, CL:AIRE published an updated version of Guidance Bulletin 3 "A summary of the Definition of Waste: Development Industry Code of Practice", along with several new Frequently Asked Questions. A new version of the DoW CoP is being developed in collaboration with the Environment Agency.

The dedicated website for this initiative is: [www.claire.co.uk/projects-and-initiatives/dow-cop](http://www.claire.co.uk/projects-and-initiatives/dow-cop)

#### **Asbestos in Soil**

The Asbestos in Soil and Construction & Demolition Materials – Joint Industry Working Group (Asbestos in Soil JIWG for short) was established in November 2011 after the Environmental Industries Commission (EIC) and CL:AIRE formally joined forces and then invited a wide range of both private and public sector organisations that are all looking to work together to meet the

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<sup>1</sup> now Department for Levelling Up, Housing and Communities (DLUHC)

challenges posed by asbestos in soil. In 2016 CL:AIRE published the Asbestos in Soil JIWG guidance titled “Control of Asbestos Regulations 2012: Interpretation for Managing and Working with Asbestos in Soil and Construction & Demolition materials: Industry Guidance (shortened name CAR-SOIL™)”.

A key part of this project now involves developing and delivering training for all practitioners working with asbestos in soil and construction & demolition materials.

The dedicated website for this project is: [www.claire.co.uk/asbestos](http://www.claire.co.uk/asbestos)

### **SuRF-UK & SuRF-International**

SuRF-UK is the UKs Sustainable Remediation Forum – an initiative set up to progress the understanding of sustainable remediation in the UK. CL:AIRE is the secretariat for SuRF-UK.

In 2023, CL:AIRE published SuRF-UK Bulletin 6 “How sustainable remediation concepts align with ISO 14001:2015 environmental management systems” and SuRF-UK Bulletin 7 “Introduction to sustainable remediation”.

All SuRF-UK publications can be found on its dedicated web page: [www.claire.co.uk/surfuk](http://www.claire.co.uk/surfuk)

CL:AIRE also continues to perform the secretariat function for the International Sustainable Remediation Forum (SURF) meetings. The chairs of the International SURF and associated partners meet twice a year to share progress and learning amongst the different networks and develop opportunities for collaboration ([www.claire.co.uk/surfinternational](http://www.claire.co.uk/surfinternational)).

### **Gas Protection Verification Accreditation Scheme**

In 2021, CL:AIRE, with the support of an industry working group, launched the Gas Protection Verification Accreditation Scheme (GPVS). The scheme seeks to raise standards in membrane inspection, verification and reporting and provide all stakeholders involved in land contamination management with enough confidence that risks associated with ground gases have been adequately managed ([www.claire.co.uk/gpvs](http://www.claire.co.uk/gpvs)).

## **2. UK Projects & Publications**

### **Water and Land Library (WALL)**

The objective of WALL is to make freely available a comprehensive listing of links to water and land references, both past and present, produced by respected industry publishers including the Environment Agency, Association of Geotechnical and Geoenvironmental Specialists (AGS), Building Research Establishment (BRE), Construction Industry Research and Information Association (CIRIA), National House-Building Council (NHBC), CL:AIRE and others.

In 2023, WALL continued to grow in terms of usage and number of references listed.

Industry professionals can access WALL by going to [www.claire.co.uk/wall](http://www.claire.co.uk/wall). CL:AIRE actively seeks to grow WALL by asking relevant organisations and professionals visiting the site to fill in a feedback form to identify further documents to be included.

### **Category 4 Screening Level (C4SL) Project**

Soil and Groundwater Technology Association (SAGTA) is leading a collaborative industry initiative to develop twenty C4SLs for a range of contaminants which have been selected following a consultative process choosing the contaminants which would be most useful to industry. The project is being delivered by a consortium of partners and CL:AIRE is acting as project manager supported by Simon Firth (Firth Consultants Ltd) and Naomi Earl (Freelance Consultant).

A report on *trans*-1,2-dichloroethene was reviewed in 2023 and will be published in early 2024 along with the *cis*-1,2-dichloroethene report. All reports can be downloaded from the dedicated project website: [www.claire.co.uk/c4sl](http://www.claire.co.uk/c4sl)

### **Defra Construction Code of Practice for the Sustainable Use of Soils on Construction Sites**

In 2023, CL:AIRE worked with a small group of experts to update the above Code of Practice. It is with Defra for review and publication.

### **Monitored Natural Attenuation (MNA) Guidance**

CL:AIRE is working with a small group of industry experts to update the 2000 MNA guidance document for publication in 2024.

### **Natural Source Zone Depletion (NSZD) Guidance**

CL:AIRE is working with Geosyntec to write new technical guidance on NSZD, which will sit alongside the MNA guidance. The new guidance will be published in 2024.

### **P20/Remedial Target Methodology (RTM)**

CL:AIRE worked with a small number of industry experts and the Environment Agency to update the P20/RTM spreadsheet and guidance. It is with the Environment Agency for review and publication.

### **Legacy Wastes in the Coastal Zone: Environmental Risks and Management Futures**

Starting in January 2020, the legacy wastes project is a four-year research project funded by the Natural Environment Research Council (NERC). It brings together expertise in waste management, freshwater and seawater geochemistry, geomorphology, hydrology, ecology and environmental policy to provide a multi-scale assessment of the risks posed by municipal and mineral-rich legacy wastes in the coastal zone and provide a framework for their effective future management.

The project has also been approved by the CL:AIRE TRG as CL:AIRE Research Project RP27. Find more details on the project website: <https://research.ncl.ac.uk/legacywastes/>

### **Interdisciplinary Circular Economy Centre for Mineral-based Construction Materials (ICEC-MCM)**

CL:AIRE is supporting ICEC-MCM, led by University College London. The ICEC-MCM launched in early 2021 and aims to develop systems and technologies for more efficient use and recovery of mineral resources.

## **3. European Projects**

### **Enhanced and Innovative *In Situ* Biotechnologies for Contaminated Land Remediation (EiCLaR) – [www.eiclar.org](http://www.eiclar.org)**

CL:AIRE is part of a EU and China consortium called EiCLaR composed of thirteen EU and five Chinese partners. Led by the University of Lyon, the four-year project started in early 2021 and will develop scientific and technical innovations for *in situ* bioremediation technologies. CL:AIRE is involved in delivering the knowledge transfer activities.



## **Reconstructed Soils from Waste (ReCon Soil) - [www.claire.co.uk/projects-and-initiatives/recon-soil](http://www.claire.co.uk/projects-and-initiatives/recon-soil)**

The ReCon Soil project, supported by the European Regional Development Fund via the Interreg France (Channel) England programme, ran from April 2021 until June 2023. The project studied the potential reuse of surplus materials from the construction industry.

### **Concawe Case Studies**

In 2023, CL:AIRE and r3 environmental technology completed a Concawe project to compile case studies of sustainable remediation techniques and technologies and provide a cross-comparison analysis to help practitioners compare these case studies to their own projects. The report is available to download on the Concawe website at [www.concawe.eu](http://www.concawe.eu) and the ten individual case studies from the [CL:AIRE website](http://CL:AIRE website).

## **4. Training**

In 2023, CL:AIRE continued to provide a mixture of classroom-based and online training on the following topics:

- Definition of Waste Code of Practice (DoW CoP) – classroom
- Non-Licensed Work including NNLW for Land Professionals – classroom
- Asbestos in Soil and Construction & Demolition Materials CAR-SOIL™ – classroom
- Verification of Gas Protection Systems – classroom
- Introduction to Controlled Waters Detailed Quantitative Risk Assessment – classroom
- Introduction to Human Health Quantitative Risk Assessment – classroom
- Practical Aspects of Ground Gas, Vapour and Water Monitoring & Sampling – classroom
- Statistics for Comparing Soil Contamination Data to a Critical Concentration – virtual
- Good Practice for Risk Assessment for Coal Mine Gas Emissions – virtual
- Soil and Groundwater Risk Assessment – eLearning
- Sustainable Remediation – eLearning
- Introduction to Brownfield Site Investigation – eLearning
- Asbestos Awareness for Land Professionals – full & refresher – eLearning

CL:AIRE is also developing further modules in new areas, which will be launched in 2024.

## **5. Membership Development**

CL:AIRE's membership was approximately 110 organisations in 2023, most listed on the CL:AIRE website.

## TRG MEMBER BIOGRAPHIES (CURRENT)

### **Dr Kim Baines, International Atomic Energy Agency (Chair)**

Kim is an Environmental Remediation Specialist leading international projects at the IAEA currently focused on the characterisation and stewardship of radioactive land contamination. The scope of sites is broad ranging from uranium mining and milling sites, to early nuclear research sites through to nuclear accident sites. Prior to her current position, Kim worked for the Nuclear Decommissioning Authority (NDA) as Strategic Authority for Land Quality Management and Land Use. Kim was responsible for developing the NDA's approach to the Site End State and which has included providing technical support to the Winfrith and Dounreay sites. Prior to her position with the NDA, Kim worked for 16 years in the nuclear and redevelopment industries on the remediation of contaminated land.

Kim was the sponsor for NDA R&D within the field of Land Quality. Kim successfully chaired the Nuclear Industry Land Quality Group for 5 years seeing membership increase to include all but one of the UK nuclear site licence operators. Kim has facilitated the working relationship between the regulators and industry within the nuclear sector. This has enabled the successful development and implementation of regulator guidance for the management of decommissioning wastes and land contamination (Guidance on Requirements for Release of Nuclear Sites from Radioactive Substance Regulation "GRR").

Kim has also worked extensively on non-nuclear brownfield sites ranging from petrol stations, to gas works to coal mining sites. Kim's specialism for several years was human health and controlled water risk assessment and the development of remedial strategies.

### **Liz Gray, Ramboll (Deputy chair)**

Liz is an advocate for bringing excavated materials into the spotlight during the planning phase of a project to maximise reuse and sustainability benefits. She has worked with industry over the last 16 years to improve resource efficiency in construction including the application of the DoWCoP to large infrastructure and multi-phase projects. She co-authored the inaugural IEMA guidance on the assessment of materials and waste in Environmental Impact Assessment and leads on materials and waste assessments in EIA for road, rail, housing and NSIP schemes, including those submitted for Development Consent Orders and Transport Works Act Orders.

Liz is a Qualified Person under DoWCoP and delivers DoWCoP training courses as a trainer for CL:AIRE. With a background in land contamination, Liz's experience encompasses waste and resource management, due diligence, environmental management and management systems, compliance/assurance auditing and reporting and training development and delivery.

### **Bob Barnes, Environment Agency**

Bob has worked for the Environment Agency for over 30 years. For 8 years he worked as the groundwater and contaminated land technical specialist for the Agency's Hampshire and the Isle of Wight operational area. Following this he joined the then National Groundwater and Contaminated Land Centre, now part of the Environment and Business Directorate of the Agency where he resides as a Principal Scientist within the Chief Scientist's Group.

Over the past 20+ years, in addition to acting as the technical assessor for end-of-waste applications with the potential to impact land and groundwater quality, he has undertaken waste research and developed technical guidance on all aspects of managing land contamination and supported operational colleagues' site investigations in the field.

### **Simon Burr, CampbellReith**

Simon has been working in the environmental consultancy field since 1993, with specialisation in contaminated land risk assessment, investigation and remediation at a senior project management level. He has been responsible for a large number of regeneration projects and manages a number of client portfolios. He is a registered Specialist in Land Condition (SiLC) and as a member of SoBRA was one of their representatives at the government consultation concerning the revisions to contaminated land statutory guidance. He was also a member of SoBRA's sub-committee which developed the accreditation scheme for contaminated land risk assessors.

As Partner for CampbellReith's London Land Quality department, Simon manages the development of their human health, groundwater and ground gas risk assessment capabilities. As well as responsibility for managing and delivering the environmental work of CampbellReith he has developed the waste soils assessment services and manages the production of Materials Management Plans across the practice to enable appropriate reuse of waste soils across their projects. He has also undertaken technical assessments and ground gas assessments for CampbellReith's landfill projects to enable their development.

### **Ruth Chippendale, Shell**

Ruth is Senior Program Manager within the Shell Soil & Groundwater Solutions team. In this role she is accountable for supporting Shell businesses in the UK in managing soil and groundwater risks, primarily across a nationwide portfolio of retail petrol stations.

Ruth is a contaminated land professional with over 25 years' experience. She has a geology and hydrogeology background and is a Chartered Geologist, Chartered Environmentalist and Full Member of IEMA. Before joining Shell, Ruth's early career was spent within environmental consultancy where she participated in, and led, teams delivering site investigation, risk assessment and remediation services. The first phase of her Shell career was spent in Shell Global Solutions in the UK, undertaking technical assurance and regulatory advocacy work for sites across Europe and beyond, and later taking on a combined team leadership and technical role. More recently she broadened her experience to cover a wider environmental remit in upstream oil and gas outside the UK, working in operations in Gabon, Australia and Qatar, before returning to live and work in the UK in 2020. She currently chairs the Soil, Waste and Groundwater committee at the Energy Institute.

### **Professor Max Coleman, Caltech and Emeritus Professor of Sedimentology, University of Reading**

Max's current work focuses on searching for life outside the Earth but he has more than 20 years' experience of research in contaminated land and water. His main personal research interests are in the interaction of microbial populations with sedimentary systems and environmental geochemistry and he is continuing work on contamination problems, especially natural attenuation approaches. His career as a research scientist has been split equally between employment in government, industrial and academic sectors.

As well as pure research, Max has applied multidisciplinary, fundamental scientific research to elicit solutions to practical problems in petroleum exploration and production, environmental pollution, radioactive waste storage and forensic science. He has written more than 140 publications mainly in stable isotope chemistry and its applications to geochemistry, hydrochemistry and microbial processes.

### **Steve Edgar, Vertase FLI**

The Managing Director of Vertase FLI, Steve guides the business and the team through the more challenging remediation sites the UK has to offer. He initially cut his teeth as a geologist for a consultancy working on a variety of remediation projects in the nineties during the founding years of the remediation industry. He has spent most of his career in remediation

contracting, designing and implementing *in situ* and *ex situ* remediation projects on sites ranging in size and complexity from petrol forecourts to tar and chemical processing plants, landfills.

As well as his technical background he also has significant experience of the regulatory, finance, planning and other drivers behind brownfield redevelopment. He has tackled some of the trickiest sites remediation wise, in the UK and for some of the most demanding clients. Professionally he has a passion for good science coupled with practicality which stands him and Vertase FLI in good stead within the industry.

### **Professor Mark Hodson, University of York**

Mark is a professor of environmental geochemistry and mineralogy at the University of York. His current research interests cover three interrelated strands: water-rock interactions, remediation of contaminated land and earthworm ecology. His remediation work has focused on the use of soil amendments to immobilise inorganic contaminants *in situ* and assisted phytoremediation. He has also carried out work on the chemistry of acid mine drainage, contaminant bioavailability and the response of soil organisms to contamination.

Mark was a member of the Earth Systems and Environmental Sciences REF2014 and REF2021 subpanels, acting as subpanel chair for REF2021. He currently acts as a panel Chair for Natural Environment Research Council grant schemes.

### **Seamus Lefroy-Brooks, LBHGEO**

Seamus is multi-chartered as a Civil Engineer, Geologist and Environmentalist and is a UK Registered Ground Engineering Adviser under the RoGEP scheme. He has worked as a consultant for over 40 years and is a past chair of both the AGS and the Land Forum/National Brownfield Forum. He was also a founding committee member of SoBRA. He assisted Defra with the Part 2A statutory revisions and was one of the twelve experts appointed to the government's National Expert Panel for Land Contamination. He is now chair of the National Brownfield Forum's Professional Standards Committee leading the initiative to deliver the National Quality Mark Scheme for the management of land affected by contamination.

Seamus has been significantly involved in the management of asbestos in soils risk. He is a member of the JIWG and served on WG2 of the HSE CFM, being named recently for assisting HSE with the update to HSG248. He has also sat on various CIRIA and BSI steering groups and is notably one of the authors of the present BS4845 relating to landfill gas. He is an active member of the IES land community.

Seamus is a QP, SQP and a SiLC. Through his firm, LBHGEO, he works as a consultant to government, land owners, developers and regulators alike and endeavours to bring an experienced and practical eye to the solution of all manner of ground-related problems.

### **Edward Lewis, Northern Ireland Environment Agency**

Edward has a BA and MA in Earth Sciences from St Hugh's College, Oxford University and a Ph.D and DIC in Environmental Engineering from Imperial College, London.

Edward has 9 years' experience as a consultant Contaminant Hydrogeologist working for Atkins Ltd in Birmingham. His main experience during this time was in the fields of land contamination and landfill risk assessment. He also worked on a number of flood defence schemes. He is experienced in the use of most of the risk assessment software packages and technical requirements associated with groundwater/environmental risk assessment in the UK.

Since 2012 Edward has been at the Northern Ireland Environment Agency as a Senior Scientific Officer in the Land and Groundwater Team (LGWT). The principal work streams in

the LGWT relate to land contamination addressed through the planning regime. He also provides hydrogeological and land contamination advice to colleagues across a range of teams with regard to groundwater resourcing, mining, cemeteries, end of waste applications and landfill risk assessments. He has been involved in a number of projects for the NIEA including the assessment of risks associated with the absence of Part III of the Waste and Contaminated Land (NI) Order 1997 in the province of Northern Ireland and the on-going Mobuoy Road remediation project.

#### **Sarah Poulton, Natural Resources Wales**

Sarah is an Environmental Hydrogeologist with 9 years' experience in the field of Remediation Engineering, working on a variety of contaminated land and groundwater projects across the UK. Sarah has recently started a new role as a Lead Specialist Advisor in Hydrogeology for Natural Resources Wales; in her role, she provides an expert technical lead on Hydrogeology and helps manage the preparation of internal policy, programmes and guidance. She leads on, and project manages, specific and complex hydrogeological issues and projects. Previously, she was a Principal Remediation Consultant and Project Manager, with a strong technical focus primarily in Controlled Water Risk Assessment.

Sarah is a Chartered Environmentalist (CEnv) through the Institution of Environmental Sciences, and a full member of RemSoc where she also helped develop and now leads the Early Careers Practitioners subgroup; a platform that she uses to deliver remediation and brownfield land focussed information aimed specifically at those within the 5-10 years of their career. She was invited by the IES to join a Working Group focussed on Land Condition, with the principle purpose of developing evidence-led policy on land management. Through this, she helped in the production of the document " Sustainable, healthy and resilient: Practice-based approaches to land and soil management".

#### **Dr Michael Rivett, GroundH<sub>2</sub>O plus Ltd**

Michael is a contaminant hydrogeologist with over 35 years of groundwater experience gained mostly in the university sector. He is founding director of GroundH<sub>2</sub>O plus Ltd based in Birmingham since 2016. His research-oriented background allows his company specialisation in research-oriented contaminant hydrogeological assessment and technical review of groundwater contamination issues of concern to a variety of sectors, including contaminated land, nuclear, energy-development, water-industry and developing world sectors.

Michael has a significant track record of published research and projects working with industry on organic contaminants, L/DNAPLs, radiological contamination, shale gas exploitation, groundwater – surface-water interactions, urban contaminated land, highway de-icing salt impacts, and groundwater sustainability. He has developing world groundwater experience gained through his 2016-21 part-time Research Fellowship position with the University of Strathclyde on their Malawi project.

Michael has previously served as Chair of the British Chapter of the International Association of Hydrogeologists and Chair of the Hydrogeological Group of the Geological Society. He has edited or authored several publications with CL:AIRE including the 'LNAPL handbook' and their recent Technical Bulletin on Natural Source Zone Depletion. He has served on the TRG since 2008.

#### **Professor Steve Thornton, University of Sheffield**

Steve is Professor of Environmental Engineering Science within the Groundwater Protection and Restoration Group at the University of Sheffield. He has over 25 years' experience in contaminant hydrogeology, with particular interest in the application of natural attenuation for pollution management, monitoring techniques and performance assessment of natural attenuation at field scale and *in situ* / engineered bioremediation.

Steve's current research involves field, laboratory and modelling studies on the natural attenuation and treatment of organic contaminants, petroleum hydrocarbons and ether oxygenates in groundwater, development of electrokinetic methods for enhanced bioremediation, development of reactive barrier design concepts for waste disposal sites and measures to support sustainable agriculture. He led the EU Marie Skłodowska-Curie Innovative Training Network, INSPIRATION, on the theme of managing soil and groundwater impacts from agriculture, and before that led the EU Marie Curie Initial Training network, ADVOCATE, on sustainable *in situ* remediation.

Steve is an Associate Editor of the international journal Ground Water and a Visiting Professor in the College of Water Sciences at Beijing Normal University in China and AGH University of Science and Technology in Poland.

**Karen Young, Jacobs UK Ltd**

Karen is a Senior Associate Director and Head of Discipline for the Jacobs UK and Europe land quality team. She has over 20 years of experience in contaminated land assessment, firstly as a regulator with Salford City Council and then Warrington Borough Council before becoming an environmental consultant with Jacobs. She has experience in contaminated land assessment, environmental impact assessment and materials management plans and has worked on a wide range of projects including the Avenue Coking Works remediation, numerous Environment Agency flood defence schemes and major infrastructure projects including Wylfa Newydd, Heathrow Expansion and HS2.

Karen has experience of applying the DoWCoP to major infrastructure schemes, in particular HS2 on behalf of ALIGN JV, and as part of this project has worked closely with CL:AIRE and the Environment Agency to develop a framework approach to applying materials management plans to large-scale, long-running projects.

## EARLY CAREER PROFESSIONAL TRG MEMBER BIOGRAPHIES (CURRENT)

### **Hebah Abdel-Hady, Arcadis**

Hebah is a Senior Geoenvironmental Consultant at Arcadis specialising in Contaminated Land Risk Assessment with over 7 years' experience. Based in Glasgow, Hebah has worked on sites across the UK in a wide variety of public and private sectors including oil and gas, energy, highways, and agrochemical. Hebah is accredited by SoBRA as a Registered Risk Assessor in controlled waters and human health and is a fellow of the Geological Society of London. Currently, Hebah conducts Detailed Quantitative Risk Assessments, including the assessment of sites under Part 2A. In addition to her core role, Hebah sits on the SoBRA Early Careers Subgroup to drive technical knowledge accessibility within the brownfield risk assessment community. Hebah was awarded Best Early Career Brownfield Professional at the Brownfield Awards in 2023.

### **Lottie Harold, Arup**

Lottie is a Geoenvironmental Engineer with three years' experience in contaminated land and an academic background in environmental geosciences. Lottie is also a member of the Geological Society Contaminated Land Group committee and the CIWEM Early Careers Network steering group.

At Arup, Lottie has gained a range of experience whilst undertaking desk-based and site-based roles, including in ground investigations, risk assessment, materials management, and ground energy feasibility studies. Lottie has been involved in several investigations of PFAS contamination and has developed internal assessment criteria to guide future remediation. Lottie has a keen interest in applying digital skills such as programming and GIS to geoenvironmental schemes, and has generated tools to automate workflows, manage large datasets and increase project efficiency.

### **Patrick Moore, Wardell Armstrong**

Patrick is a Principal Geoenvironmental Engineer at Wardell Armstrong with over seven years' experience in the in geoenvironmental consultancy work including contaminated land, hydrogeological and ground conditions assessments. Additionally, Patrick has over four years' experience in the exploration and mining industry, having worked as a geologist on metalliferous and non-metalliferous projects. Patrick currently serves as member of the Geological Society of London Contaminated Land Group committee.

Prior to joining Wardell Armstrong, Patrick worked for a small consultancy facilitating, supervising and verification of enabling and remedial works on brownfield sites as well as undertaking desk-based studies through to scoping, costing and supervision of ground investigation works for groundwater abstraction and ground source heating schemes. In his current role with Wardell Armstrong, Patrick is involved in managing small to large-scale projects including ground investigation works across a range of greenfield and brownfield sites, and the subsequent preparation of reports such as factual and interpretative Ground Investigation Reports, Remediation Strategies and Material Management Plans. Patrick also has experience in detailed quantitative risk assessments, environmental impact assessments and waste classification works.

### **Kirsty Tolley, RSK Geosciences**

Kirsty is a Principal Geoenvironmental Consultant at RSK Geosciences with over seven years' experience of geoenvironmental consultancy, focussing on contaminated land projects. She is a Chartered Environmentalist through the Institution of Environmental Sciences, a CL:AIRE Qualified Person and is accredited by SoBRA as a Registered Risk Assessor in Human Health and Permanent Gases.

Her role involves routinely undertaking desk studies and preliminary risk assessments and subsequently scoping, costing, undertaking and project managing a range of site investigations on both greenfield and brownfield sites. She is experienced in generic quantitative risk assessment and the supervision and validation of remedial works.

Kirsty was awarded Best Early Career Brownfield Professional at the 2022 Brownfield Briefing Awards and is a committee member of SoBRA's Early Careers subgroup.



## **CL:AIRE RESOURCES**

### **Technology Demonstration Project (TDP) Reports and Bulletins**

- TDP1 - Remediation trial using low temperature thermal desorption to treat hydrocarbon-contaminated soil (2004)
- TDP2 - Remediation of Basford Gasworks using soil washing (2003)
- TDP3 - Design, installation and performance assessment of a zero valent iron permeable reactive barrier in Monkstown, Northern Ireland (2001)
- TDP4 - Slurry-phase bioreactor trial (2004)
- TDP5 - A Reducing and Alkalinity Producing System (RAPS) for passive treatment of acidic, aluminium rich mine waters (2005)
- TDP6 - Biopile field demonstration at the Avenue Coking Works (2004)
- TDP9 - Design, installation and performance assessment of an air sparge curtain system (2004)
- TDP12 - Bioremediation of the Coke Works and Former Colliery at Askern, Doncaster (2005)
- TDP13 - A permeable reactive barrier for remediation of extremely polluted groundwater associated with a highly pyritic abandoned colliery spoil heap (2006)
- TDP16 - Ex situ soil vapour extraction to remediate chlorinated hydrocarbons (2007)
- TDP17 - A biological sequential reactive barrier (SEREBAR): design, installation and performance at a former manufactured gas plant site in south west England (2008)
- TDP20 - Design and installation of a permeable reactive barrier to treat carbon disulphide contaminated groundwater (2009)
- TDP24 - Application of thermally enhanced soil vapour extraction (TESVE) to remediate the unsaturated zone at the Western Storage Area, Harwell (2010)
- TDP26 - In situ soil and groundwater decontamination using electric resistive heating technology (2008)
- TDP28 - In situ radio frequency heating (ISRFH) of hydrocarbon contaminated chalk at a former service station in Kent (2011)
- TDP30 - In situ 'deliverability' trials using calcium polysulphide to treat chromium contamination at Shawfield, Glasgow (2013)
- TDP31 - Demonstration of the Arvia™ process of adsorption coupled with electrochemical regeneration for the on-site, ex situ, decomposition of organic contaminants in groundwater (2013)

### **Research Project (RP) Reports**

- RP3 - Processes controlling the natural attenuation of fuel hydrocarbons and MTBE in the UK Chalk aquifer (2006)
- RP4 - Cost-effective investigation of contaminated land (2007)
- RP6 - Phytoextraction of Metals: Investigation of hyperaccumulation and field testing (2005)

### **Other CL:AIRE Bulletins**

#### **Technical Bulletins (TB)**

- TB1 - Introduction to an integrated approach to the investigation of fractured rock aquifers contaminated with non-aqueous phase liquids (2002)
- TB2 - Multilevel sampling systems (2002)
- TB3 - Principles and practice for the collection of representative groundwater samples (2008)

TB4 - Parameterisation of aquifer hydraulic properties: A contaminant hydrogeology perspective (2009)

TB5 - The use of geophysical investigation techniques in the assessment of contaminated land and groundwater (2007)

TB7 - Improving the reliability of contaminated land assessment using statistical methods: Part 1 (2004)

TB9 - Stabilisation/Solidification Treatment and Remediation: Part 1: Summary of the State of Practice Reports I-IV STARNET (2004)

TB11 - A practical guide to investigating DNAPL releases in the subsurface (2004)

TB12 - Statistical assessment of contaminated land: Some implications of the 'Mean Value Test' (2006)

TB13 - Understanding soil washing (2007)

TB14 - Treatment of chromium contamination and chromium ore processing residue (2007)

TB15 - Accounting for the groundwater-surface water interface in contaminated land assessments (2011)

TB16 - Complete continuous monitoring in underfloor voids (2017)

TB17 - Ground gas monitoring and 'worst-case' conditions (2018)

TB18 - Continuous ground-gas monitoring and the lines of evidence approach to risk assessment (2019)

TB19 - Managing risks and liabilities associated with per- and polyfluoroalkyl substances (PFASs) (2019)

TB20 - An introduction to Natural Source Zone Depletion at LNAPL sites (2019)

TB21 - The GroundWater Spatiotemporal Data Analysis Tool (GWSDAT) for groundwater quality analyses (2019)

TB22 - An overview of the uses of PFAS to assist with identification of sites of concern (2023)

### **Case Study Bulletins (CSB)**

CSB1 - Site characterisation in support of monitored natural attenuation of fuel hydrocarbons and MTBE in a chalk aquifer in Southern England (2002)

CSB2 - A constructed wetland to treat acid mine drainage from colliery spoils at Quaking Houses, County Durham (2002)

CSB3 - Portadown biological reactive barrier (2005)

CSB4 - Mine water treatment at Wheal Jane Tin Mine, Cornwall (2004)

CSB5 - Remediation trial at The Avenue using stabilisation/solidification and accelerated carbonation technology (2006)

CSB6 - Remediation trial at The Avenue using thermal treatment (2006)

CSB7 - Remediation trial at The Avenue using soil washing (2008)

CSB8 - Public affairs and communications on contaminated land projects (2007)

CSB9 - Remediation of a former landfill in Coventry: A practical application of the Definition of Waste: Development Industry Code of Practice in a cluster project (2011)

CSB10 - The development of risk based generic assessment criteria (GAC) for assessment of chronic human health risks from exposure to soil contaminants (2011)

CSB11 - Remediation of four sites in Northwest England: A successfully completed multi-site, multi-consultant cluster project (2013)

CSB12 - SEREBAR: A review of 11 years of operation (2018)

### **Research Bulletins (RB)**

- RB1 - Enhanced in situ bioremediation technique for manganese removal from mine waters (2003)
- RB2 - FIRS Ferric Iron Remediation and Stabilisation: a novel electrokinetic technique for soil remediation and engineering (2003)
- RB3 - Project SIREN: Research Projects (2006)
- RB4 - Project SIREN – Future Research Needs (2006)
- RB5 - Remediation of heavy metal pollution via bone meal amendments to soil: Field and laboratory trials (2007)
- RB6 - Results of a laboratory microcosm study to determine the potential for bioremediation of chlorinated solvent DNAPL source areas (2006)
- RB7 - Field Portable X-ray Fluorescence (FPXRF): A rapid and low cost alternative for measuring metals and metalloids in soils (2008)
- RB8 - Modelling approaches for assessing risks associated with petroleum hydrocarbon spills in the UK Chalk aquifer (2009)
- RB9 - Electrokinetic Ferric Iron Remediation and Stabilisation (FIRS) of hexavalent chromium contaminated soils: An ex situ field scale demonstration (2009)
- RB10 - Bioremediation of heavy hydrocarbons – reducing uncertainty in meeting risk-based targets: laboratory to field scale (2010)
- RB11 - Streamtube project overview: longitudinal transect assessment of the SABRE site DNAPL source zone (2010)
- RB12 - Modelling food-chain transfer of contaminants in soil to terrestrial ecological receptors (2010)
- RB13 - The utility of continuous monitoring in detection and prediction of "worst case" ground-gas concentration (2011)
- RB14 - Generic human-health assessment criteria for arsenic at former coking works sites (2011)
- RB15 - Generic human-health assessment criteria for benzo[a]pyrene at former coking works sites (2011)
- RB16 - Generic human-health assessment criteria for benzene at former coking works sites (2011)
- RB17 - A pragmatic approach to ground gas risk assessment (2012)
- RB18 - Prioritisation of abandoned non-coal mine impacts on the environment (2014)
- RB19 - Regeneration of Brownfield Land Using Sustainable Technologies (ROBUST) (2016)
- RB20 - Investigating the potential for biostimulation to remediate uranium-contaminated groundwater (2015)
- RB21 - Resource Recovery and Remediation of Alkaline Wastes (R3AW) (2019)

### **Site Bulletins (SB)**

- SB1 - MNA Bulletin (2005)
- SB2 - SIREN (MNA) overview and description of projects (2005)
- SB3 - Coal Mine Sites for Targeted Remediation Research:- The CoSTaR Initiative (2006)

### **Guidance Bulletins (GB)**

- GB1 - Stabilisation/Solidification for the treatment of contaminated soil (2005)
- GB2 - Managing Japanese Knotweed on Development Sites: Code of Practice (2008)
- GB3 - A Summary of the Definition of Waste: Development Industry Code of Practice (2023)
- GB4 - Transport and Fate of LNAPL in the Subsurface (2015)

### **DoWCoP Bulletins (DoWCoP)**

DoWCoP1 - Implementing the waste hierarchy at the Thames Tideway Chambers Wharf site (2019)

### **Treatability Bulletins (TrB)**

TrB1 - Soil washing (2011)

TrB2 - Permeable reactive barriers (2011)

TrB3 - Chemical oxidation (2013)

### **INSPIRATION Bulletins (IB)**

IB1 - Use of a novel integrated passive flux sampler to monitor the spreading of solutes in groundwater (2020)

IB2 - Development of sensors for monitoring nitrate in groundwater (2019)

IB3 - The proportional contribution of nitrate sources in surface water in a mesoscale river catchment with a land-use gradient (2019)

IB4 - Micropollutants as tracers for anthropogenic impacts on groundwater quality and recharge sources on a local scale – the case study of Fehraltorf, Switzerland (2019)

IB5 - Geological consistency in self-optimising groundwater models using nested particle filters (2019)

IB6 - Analysing N sources and transformation processes in groundwater under agricultural areas (chalk aquifer, Belgium) (2019)

IB7 - Experimental quantification and kinetics of nitrate reduction potential by reduced species in soil samples obtained from sandy aquifers (2019)

IB8 - Bio-restoration of metal-contaminated soil using biochar to enhance the productivity of marginal land (2019)

IB9 - Developing biosensors to measure the bioavailability of heavy metals in soil remediation (2019)

IB10 - Investigating the effects of biochar and brown coal waste on productivity of maize (2019)

IB11 - A decision support tool to select media to mitigate nutrients in farm drainage water (2019)

IB12 - Indicators for the selection of filter media options for phosphorus recycling to agricultural soils (2019)

IB13 - Isotope techniques for the analysis of  $\delta^{18}\text{O}$  of inorganic phosphate within aquatic ecosystems (2019)

IB14 - Integrated use of meta-analytical data to identify management trade-offs on crop growth, soil quality and environmental quality in agriculture (2019)

IB15 - Identification of priority areas to target pesticide pollution mitigation measures (2019)

### **ADVOCATE Bulletins (AB)**

AB1 - Remediation of TCE contaminated groundwater using permeable reactive barriers (2014)

AB2 - Selecting reactive materials for permeable barriers to remediate groundwater contaminated with heavy metals and BTEX: batch and column experiments (2014)

AB3 - Enhancing bioremediation of groundwater by microbial interaction with a solid state electrode: proof-of-concept (2014)

AB4 - River flows and riparian vegetation dynamics (2014)

- AB5 - Balancing the Pillars of Technology Sustainability in Soil and Groundwater Remediation
- AB6 - Nitrogen biotransformation in horizontal subsurfaceflow constructed wetlands treating contaminated groundwater (2015)
- AB7 - Vadose zone characterisation at industrial contaminated sites (2015)
- AB8 - The plume fringe: a zone of increased potential for biodegradation in contaminant plumes (2015)
- AB9 - Delineating groundwater-surface water interaction (2015)
- AB10 - Dual C-Cl isotope analysis to distinguish processes affecting chlorinated ethenes at field scale (2015)
- AB11 - Water quality management on a catchment scale (2016)

### **NanoRem Bulletins (NanoRem)**

- NanoRem1 - Nanotechnology for Contaminated Land Remediation – Possibilities and Future Trends Resulting from the NanoRem Project (2016)
- NanoRem2 - Appropriate Use of Nanoremediation in Contaminated Land Management (2017)
- NanoRem3 - Generalised Guideline for Application of Nanoremediation (2017)
- NanoRem4 - A Guide to Nanoparticles for the Remediation of Contaminated Sites (2016)
- NanoRem5 - Development and Application of Analytical Methods for Monitoring Nanoparticles in Remediation (2017)
- NanoRem6 - Forecasting Nanoparticle Transport in Support of In Situ Groundwater Remediation (2017)
- NanoRem7 - NanoRem Pilot Site – Spolchemie I, Czech Republic: Nanoscale zero-valent iron remediation of chlorinated hydrocarbons (2017)
- NanoRem8 - NanoRem Pilot Site – Spolchemie II, Czech Republic: Remediation of BTEX compounds using Nano-Goethite (2017)
- NanoRem9 - NanoRem Pilot Site – Solvay, Switzerland: Nanoscale zero-valent iron remediation of chlorinated solvents (2017)
- NanoRem10 - NanoRem Pilot Site – Balassagyarmat, Hungary: In Situ Groundwater Remediation Using Carbo-Iron® Nanoparticles (2017)
- NanoRem11 - NanoRem Pilot Site – Neot Hovav, Israel: Transport of Iron Nanoparticles in Fractured Chalk (2017)
- NanoRem12 - NanoRem Pilot Site – Nitrastur, Spain: Remediation of Arsenic in Groundwater Using Nanoscale Zero-valent Iron (2017)

### **SABRE Bulletins (SAB)**

- SAB1 - Project SABRE (Source Area BioRemediation) – an Overview (2010)
- SAB2 - Site investigation techniques for DNAPL source and plume zone characterisation (2010)
- SAB3 - Results of laboratory column studies to determine the potential for bioremediation of chlorinated solvent DNAPL source areas (2010)
- SAB4 - Insights and modelling tools for designing and improving chlorinated solvent bioremediation applications (2010)
- SAB5 - Overview of the SABRE field tests (2010)
- SAB6 - Source Area DNAPL Bioremediation: performance monitoring and assessment (2012)

### **SUBR:IM Bulletins (SUB)**

- SUB1 - The role of the development industry in brownfield regeneration (2006)
- SUB2 - Uncovering the true impacts of remediation (2007)
- SUB3 - Climate change, pollutant linkage and brownfield regeneration (2007)
- SUB4 - Measuring sustainability: What's in a number? (2007)
- SUB5 - Avoiding future brownfield sites through design for deconstruction and the reuse of building components (2007)
- SUB6 - Communicating risk on contaminated sites: How best to engage with local residents (2007)
- SUB7 - Acid Tar Lagoons (2008)
- SUB8 - Community Engagement, Urban Regeneration, and Sustainability (2008)
- SUB9 - Quality in Land Remediation: Indicators and Protocols for Brownfield Land (2008)
- SUB10 - The Use of Compost in the Regeneration of Brownfield Land (2008)
- SUB11 - Integrated remediation, reclamation and greenspace creation on brownfield land (2009)
- SUB12 - SUBR:IM (Sustainable Urban Brownfield Regeneration: Integrated Management) - An overview (2009)

### **UK Sustainable Remediation Forum (SuRF-UK) Resources**

- SuRF-UK: A Review of Published Sustainability Indicator Sets: How applicable are they to contaminated land remediation indicator-set development? (2009)
- SuRF-UK: A Framework for Assessing the Sustainability of Soil and Groundwater Remediation (2010)
- SuRF-UK: Annex 1 - The SuRF-UK Indicator Set for Sustainable Remediation Assessment (2011)
- SuRF1 bulletin: Sustainability Assessment: Shell Terminal Facility, Madeira (2013)
- SuRF2 bulletin: Upper Heyford - Remediation Options Appraisal (2013)
- SuRF3 bulletin: Helpston Contaminated Land Project (2013)
- SuRF4 bulletin: Phase 3 outputs (2014)
- SuRF-UK: Sustainable Management Practices for Management of Land Contamination (2014)
- SuRF-UK, NICOLE: A Review of the Legal and Regulatory Basis for Sustainable Remediation in the European Union and the United Kingdom (2015)
- SuRF-UK: Certification of Sustainable Remediation Assessment (2019)
- SuRF-UK: Terms of Reference (2019)
- SuRF-UK: Supplementary Report 1 (SR1) of the SuRF-UK Framework: A General Approach to Sustainability Assessment for Use in Achieving Sustainable Remediation (2020)
- SuRF-UK: Supplementary Report (SR2) of the SuRF-UK Framework: Selection of Indicators/Criteria for Use in Sustainability Assessment for Achieving Sustainable Remediation (2020)
- Sustainable Management Practices for Management of Land Contamination (2021)
- SuRF-UK Tier 1 Sustainability Assessment tool version 2 (2021)
- SuRF5 bulletin: Resilience and Adaptation for Sustainable Remediation (2022)
- SuRF6 bulletin: How sustainable remediation concepts align with ISO 14001:2015 environmental management systems (2023)
- SuRF7 bulletin: Introduction to sustainable remediation (2023)

### **Concawe Bulletins**

- CON1 - Sustainable Remediation of a Former Vehicle Maintenance Facility for Mixed Use Development (2023)
- CON2 - Natural Source Zone Depletion Assessment: UK Large-Scale Field Case Study (2023)
- CON3 - Sustainable In Situ Thermal Remediation (2023)
- CON4 - Sunshine on the Tyne – Sustainable Hydrocarbon Remediation (2023)
- CON5 - Reactive Mat in Canal Catches Groundwater Contaminants (2023)
- CON6 - Sustainable Remediation of a Petrol Release in a Chalk Aquifer (2023)
- CON7 - Biosparge of Benzene and Orthodichlorobenzene in Groundwater: A Sustainable Remedy (2023)
- CON8 - Sheen Mitigation Using an Oleophilic Bio Barrier - A New and Sustainable Remediation Technique (2023)
- CON9 - Natural Source Zone Depletion in a Dismantled Petrol Station (2023)
- CON10 - Sustainability Assessment Case Study – Groundwater Remediation Close-Out (2023)

### **Other Publications**

- UK Trade & Investment/EISU & CL:AIRE Trade Guide (2006)
- CIEH & CL:AIRE Guidance on Comparing Soil Contamination Data with a Critical Concentration (2008)
- The Definition of Waste: Development Industry Code of Practice (2008)
- AGS, EIC & CL:AIRE Soil Generic Assessment Criteria for Human Health Risk Assessment (2010)
- Defra's "Contaminated Land Remediation Report" (2011)
- The Definition of Waste: Development Industry Code of Practice (2011)
- Defra's "A Risk/Benefit Approach to the Application of Iron Nanoparticles for the Remediation of Contaminated Sites in the Environment" (2012)
- Cluster Guide (2012)
- Gasworks Profiles (2014)
- An Illustrated Handbook of LNAPL Transport and Fate in the Subsurface (2014)
- Defra's "An Examination of Contaminated Land Sector Activity in England and Wales" (2015)
- Soil and Groundwater Remediation Technologies for Former Gasworks and Gasholder Sites (2015)
- Control of Asbestos Regulations 2012 - Interpretation for Managing and Working with Asbestos in Soil and Construction and Demolition Materials: Industry guidance (2016)
- Petroleum Hydrocarbons in Groundwater: Guidance on assessing petroleum hydrocarbons using existing hydrogeological risk assessment methodologies (2017)
- CL:AIRE 20<sup>th</sup> Anniversary Conference Special Publication (2020)
- Professional Guidance: Comparing Soil Contamination Data with a Critical Concentration (2020)
- Category 4 Screening Levels: Vinyl Chloride (2021)
- Category 4 Screening Levels: Tetrachloroethene (PCE) (2021)
- Category 4 Screening Levels: Trichloroethene (TCE) (2021)
- Good practice for risk assessment for coal mine gas emissions (2021)
- Category 4 Screening Levels: 1,2-dichloroethane (2022)

### **Podcasts & Webinars**

The SuRF-UK framework for sustainable remediation (2011)  
Continuous monitoring of ground-gas (2011)  
CL:AIRE DNAPL site characterisation webinar (2011)  
CL:AIRE DNAPL site remediation webinar (2011)  
Using quality compost webinar: Soil manufacture and improvement in brownfield regeneration (WRAP, 2011)  
Using quality compost webinar: Achieving successful biomass production on brownfield land (WRAP, 2011)  
CL:AIRE LNAPL Illustrated Handbook videos (2016)  
Screening Vapour Intrusion Risks at Petroleum Underground Storage Tank Sites webinar (2017)  
Verification of Gas Protection Measures webinar (2019)  
SuRF-UK Animation – Sustainable Remediation Explained (2019)  
CL:AIRE 20<sup>th</sup> Anniversary Conference Presentation videos (2019)  
Introduction to the Definition of Waste: Development Industry Code of Practice (2020)  
Gas Protection Verification Accreditation Scheme (2021)  
Category 4 Screening Levels Phase 2 (2021)  
Good Practice for Risk Assessment for Coal Mine Gas Emissions (2021)

### **eLearning Modules**

Remediation Technologies and Options Appraisal (2012)  
Asbestos in Soil Awareness (2018)  
Introduction to Brownfield Site Investigation (2021)  
Introduction to Soil and Groundwater Risk Assessment (2021)  
Sustainable Remediation Appraisal (2021)

**All of the Publications and Online Training are available from the CL:AIRE website.**