Press Release: UK SME's in €14 million European research project on site clean-up using nanotechnology

r^3 environmental technology ltd, Land Quality Management Ltd (LQM) and CL:AIRE are part of a consortium of 28 organisations from across Europe who have won a €14 million research project to investigate how nanoscale particles can be used to treat environmental pollution in the subsurface (soil and groundwater). The project is called NanoRem - which translates directly into its ambitious key objective: Taking nanotechnological remediation processes from lab scale to end user applications for the restoration of a clean environment.

NanoRem will harness nanoremediation for *in situ* treatment of soils in the saturated zone and groundwater. The world leading technologies it is developing will benefit a wide range of users in the environmental sector of the EU and beyond, including environmental consultants and contractors, site owners and managers and regulators. The main aims of the project are:

1. Identification of the most appropriate nanoremediation technological approaches to achieve a step change in practical remediation performance,
2. Development of lower cost production techniques and production at commercial scales,
3. Determination of the mobility and migration potential of nanoparticles in the subsurface, and relating these both to their potential usefulness and also their potential to cause harm,
4. Development of a comprehensive set of tools to monitor practical nanoremediation performance and determine the fate of nanoparticles,
5. Dialogue with key stakeholder and interest groups to ensure that the work meets real needs and agree its most sustainable and appropriate uses, balancing benefits against risks,
6. Carrying out a series of full scale applications in several European countries to provide realistic cost, performance, fate, and transport findings.

Professor Paul Bardos, director of r3 environmental technology ltd said: "We are delighted to have been part of the winning team for this research. Nanoremediation has tremendous potential to deliver more efficient means of dealing with pollution and extending the range of problems that we can actually treat. However, this promise has to be dealt with cautiously given the worries that people can have about nanotechnology. The applications must always be effective, beneficial and sustainable and not cause any undue risks in their own right. r3 is a small specialist research consultancy and we are proud to be able to contribute to science and policy development work at a European level."

Nicola Harries of the UK independent environmental charity Contaminated Land: Applications in Real Environments – CL:AIRE went on to say: "This is a major project which will have a profound influence on the policy and management of brownfield and contaminated land across Europe in future years. We are excited in being part of the research team by helping to promote the knowledge developed within the project."

LQM's Judith Nathanail commented that "Deployment risk assessments will focus on the hazard posed by fugitive nanoparticles. NanoRem will focus on the use of nanoparticles for remediation of dissolved phase contaminants. Future research can build on this and consider the applicability and effectiveness of nanoremediation in dealing with source remediation and indeed remediation above the water table."

The scale of land pollution in the EU is very large. In August 2007, the European Environment Agency (EEA) estimated that potentially polluting activities may have occurred at nearly three million sites across Europe. It has been recently suggested that soil deterioration (including from contamination) costs Europe an estimated €38 billion a year (DNR & EEB 2011).

In 2007 the projected world market by 2010 for environmental nanotechnologies was suggested to be approximately $6 billion (Joint Research Centre (JRC) Ispra 2007) across several sectors, of which remediation was thought to represent the fastest growing area. However, this market failed to materialise at this scale so far. Gaps in knowledge and a perception of relatively high treatment costs have led to rather limited practical use of nanoremediation. Concerns have also been raised by a number of national risk-benefit studies in several countries.

The current circumstances reflect an unrealised potential for nanoremediation in contaminated land restoration, both in terms of potentially facilitating a greater return of land and aquifers to a usable state, and in terms of the development of nanotechnology products and services in the environmental sector. NanoRem is designed to unlock this potential and so support both the appropriate use of nanotechnology in restoring land and aquifer resources and the development of the knowledge-based economy at a world leading level for the benefit of a wide range of users in the EU environmental sector.

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Notes.

1. r^3 environmental technology ltd was founded in 1997 and moved to Reading in 2002. It has been involved in a number of major brownfield and contaminated land projects and initiatives in the UK, across Europe and further afield including with NATO and USA organisations. For example, r3 manages a major information portal on soil and water information, eugris.info which has thousands of members and receives as many as 20,000 visits a week. r^3 has important links with the University of Reading and the University of Nottingham, where Paul Bardos is a visiting professor, and the University of Brighton where he is a full professor.

2.. CL:AIRE is a small independent, environmental charity established in 1999 to raise standards and develop and promote good practice in the development and clean-up of brownfield and contaminated land. It does this by being one of the UK's leading brownfield and contaminated land information providers. It has extensive links within government, regulators, government agencies, professional bodies and industry groups. By engaging with its stakeholders this has enabled it to develop a number of industry wide initiatives such as Sustainable Remediation Forum and Definition of Waste: Development Industry Code of Practice. CL:AIRE has developed an extensive library of publications of which many are freely available and all independently peer reviewed to ensure transparency and objectivity. It runs training courses, conferences and workshops and recently launched on-line e-learning. Further information on CL:AIRE is available at www.claire.co.uk

3 LQM is a specialist environmental consultancy that is known worldwide for its cutting edge approach to solving difficult land contaminated challenges. It has pioneered sector led initiatives to generate risk assessment tools. LQM runs face to face and online courses at all levels from beginner to advanced master classes. LQM also publishes industry standard guidance, reports and books. Further information is available at www.lqm.co.uk or follow us on Twitter (@lqmtweets).

4. Nanoremediation describes the use of very small particles (called nanoparticles) to treat or even destroy contaminants in soil or groundwater. There is no accepted international definition of a "nanoparticle". However, in general it describes a particle having one or more dimensions of 100 nanometres or less. A nanometre is one thousand millionth of a metre, which can be written as 10^{-9} *m*. A single human hair is likely to have a diameter of 50,000 to 100,000 nanometres. This would mean that perhaps as many as 1,000 nanoparticles made of iron could fit across a single hair, depending on how the nanoparticle was made.

5. A short summary of the NanoRem project is detailed below and further information can be found on the project website www.nanorem.eu

NanoRem is designed to unlock the potential of nanoremediation and so support both the appropriate use of nanotechnology in restoring land and aquifer resources and the development of the knowledge-based economy at a world leading level for the benefit of a wide range of users in the EU environmental sector. NanoRem uniquely takes a holistic approach to examining how the potential for nanoremediation can be

developed and applied in practice, to enhance a stronger development of nanoremediation markets and applications in the EU. NanoRem's ambitious objectives are:

1) Identification of the most appropriate nanoremediation technological approaches to achieve a step change in practical remediation performance. Development of lower cost production techniques and production at commercially relevant scales, also for large scale applications.
2) Determination of the mobility and migration potential of nanoparticles in the subsurface, and their potential to cause harm, focusing on the nanoparticle types most likely to be adopted into practical use in the EU.
3) Development of a comprehensive tool box for field scale observation of nanoremediation performance and determination of the fate of nanoparticles in the subsurface, including analytical methods, field measurement devices, decision support and numerical tools.
4) Dissemination and dialogue with key stakeholder interests to ensure that research, development and demonstration meets end-user and regulatory requirements and information and knowledge is shared widely across the EU.
5) Provide applications at representative scales including field sites to validate cost, performance, fate, and transport findings. The NanoRem consortium is multidisciplinary, cross-sectoral and transnational. It includes 28 partners from 13 countries organized in 11 work packages. The consortium includes 18 of the leading nanoremediation research groups in the EU, 10 industry and service providers (8 small and medium-sized enterprises) and one organisation with policy and regulatory interest.

The NanoRem project has a value of approximately €14 million and will take place from February 2013 to January 2017. It has 28 partners from 13 countries, including universities, research institutions, and private companies. The consortium is co-ordinated by the VEGAS team (Research Facility for Subsurface Remediation) from University of Stuttgart in Germany, which has more than 17 years of relevant experience in research and development of remediation technologies and is also involved in running this European FP7 project dealing with nano-remediation technology development.

28 project partners and their websites are as follows.

Partner name	**Country**	**Web link**
University of Stuttgart (VEGAS)	DE	www.vegas.uni-stuttgart.de
Karlsruhe Institute for Technology	DE	www.kit.edu
Solvay (Schweiz) AG	CH	www.solvay.com
Helmholtz-Zentrum für Umweltforschung GmbH - UFZ	DE	www.ufz.de
Ben-Gurion University of the Negev	IL	in.bgu.ac.il
Fundació CTM Centre Tecnològic	ES	www.ctm.com.es
University of Vienna	AT	www.univie.ac.at
University of Manchester	UK	www.manchester.ac.uk
Fundacion Tecnalia Research & Innovation	ES	www.tecnalia.com
Helmholtz Zentrum München	DE	www.helmholtz-muenchen.de
Bioforsk	NO	www.bioforsk.no
Technical University of Liberec	CZ	www.tul.cz
Norwegian University of Life Sciences	NO	www.umb.no
Aquatest	CZ	www.aquatest.cz
Palacký University in Olomouc	CZ	www.upol.cz
Centre National de la Recherche Scientifique	FR	www.cnrs.fr
Politecnico di Torino	IT	www.polito.it
Geoplano Consultores, S.A.	PT	www.geoplano.pt
Technical University of Denmark	DK	www.dtu.dk
Stichting Deltares	NL	www.deltares.nl
r^3 environmental technology ltd	UK	www.r3environmental.com
Land Quality Management Ltd (LQM)	UK	www.lqm.co.uk
Contaminated Land: Applications in Real Environments (CL:AIRE)	UK	www.claire.co.uk
Nano Iron, s.r.o.	CZ	www.nanoiron.cz
Golder Associates GmbH	DE	www.golder.com

Bureau de Recherches Géologiques et Minières	FR	www.brgm.fr
Industrie Anlagen Betriebsgesellschaft mbH, IABG	DE	www.iabg.de
UVR-FIA GmbH	DE	www.uvr-fia.de

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2. JRC, 2007. Report from the Workshop on Nanotechnologies for Environmental Remediation. JRC Ispra 16-17 April 2007. David Rickerby and Mark Morrison. www.nanowerk.com/nanotechnology/reports/reportpdf/report101.pdf
3. Bardos, P., Bone. B., Elliott, D., Hartog, N., Henstock, J. and Nathanail, P. (2011) A Risk/Benefit Approach to the Application of Iron Nanoparticles for the Remediation of Contaminated Sites in the Environment. Defra Research Project Final Report. Defra Project Code: CB0440. http://randd.defra.gov.uk/Default.aspx?Menu=Menu&Module=More&Location=None&Completed=0&ProjectID=17502