How can industry help sustainable groundwater management?

Annemieke Nijhof, TAUW, The Netherlands

Groundwater needs to be “owned”. If there is no owner there is no responsibility or continuity from the past into the future. Although in most countries the ‘use’ of groundwater is regulated, there is no single organization that feels responsible for sustainable groundwater management. So no-one is responsible for the asset from the past into the future. Yes there are regulatory controls on the here and now, but the subsurface will face ever growing resource demands. In the Netherlands, examples of this are the growing use of groundwater for heat storage; and the growing demand for underground space.

Somebody needs to be planning for the future to provide a strategy for sustainable groundwater management going forwards to reconcile conflicting demands, and to ensure that any possible impacts are mitigated. At the moment this role seems to be vacant, because nobody appears to own the groundwater. NICOLE’s Baden Baden meeting implied that this was a widespread problem across Member States. Of course a lot of money has been spent on groundwater. But perhaps we do not want to be blamed by future generations for putting large amounts of money into remediation without securing long term maintenance.

Yet we do have examples of sustainable resource management. In the Netherlands water management has a long history. The crucial factor for water management is that the water boards are responsible for water safety, management and quality. They have the right to tax the stakeholders to pay for long term investments and maintenance that are needed. Water boards are oriented to work over the long term in a systematic way. Unfortunately, their responsibilities do not include groundwater. There is no continuous funding system for managing the groundwater system.

In my opinion this cannot continue to be the case in the future. As the level of use of the subsurface and of groundwater increases, it will become necessary that there will be one party that manages the groundwater and underground. Their job will be to make sure that the quality of our aquifers is sustainably managed.

Industry and service providers have a key role to play and a big stake in all of this. Industry is a consumer of groundwater resources, and has also been a polluter. As such it has made large investments in remediation. Effective groundwater management is the key to the future economic prosperity of both industry and the service providers who assist them. Therefore both groups need to challenge public authorities to take long term responsibility and ownership for sustainable groundwater management.

I have the responsibility for long term groundwater business strategy for TAUW. But, I feel a responsibility for sustainable groundwater management too.

I hope that you do as well.
Mercury Contaminated Sites. Mercury is a priority hazardous substance being subjected to a phase out. In this context, the Council and the European Parliament adopted on 22.10.2008 the regulation on the banning of export and the requirement for the safe storage of metallic mercury (regulation (EC) No 1102/2008). The export ban is in place since 15 March 2011. Mercury uses will only be allowed in strictly controlled cases.

In the last decade and in the years to come many industrial activities using mercury were or will be closed. Those sites will have to be investigated for mercury contaminations and could require further management measures to control health and environmental risks. As well as its use in chlor-alkali plants, many other industrial activities have involved mercury compounds like wood impregnation, oil and natural gas production, batteries manufacture and recycling, other manufacturing activities (thermometers, electrical switches, -lamps), and mercury based catalysts.

Mercury has properties (liquid metal, surface tension, vapour pressure) that make it unique in the world of contaminants. This workshop will explore state of the art strategies, techniques and technologies for the management of such sites while minimising risk and maximising sustainability.

Meetings of the Industry Subgroup, Service Providers Group and several NICOLE Working Groups will also take place.

Spring 2013:
The first NICOLE network meeting of 2013 will look at green and sustainable remediation and will take place in Portugal, on 12-14 June 2013.

Autumn 2013:
The Autumn 2013 NICOLE network meeting will be a workshop on liability and will be held in Belgium. The date will be announced in the course of 2013.

See postings on www.nicole.org.
**Perspectives from USA and China**

**Items of interest from the May 2012 Battelle conference**

**Sarah MacKay, Chair of Service Providers subgroup**

Battelle was primarily a technical conference and focus was on such topics as innovation in site characterization methods, chemical oxidation and reduction, and bioremediation enhancements, how to improve delivery, and how to optimize active remediation systems.

The green/sustainable remediation and vapour intrusion sessions were the most attended, with the breakout sessions on the state of green and sustainable remediation being some of the more well attended. The key take home message interpreted from the sustainable remediation sessions were that green/sustainable remediation concepts should not play rolls in remedy selection, but instead green concepts should only be applied to remedy implementation. This was the regulatory view.

Speakers from industry, commercial businesses and other areas have been pushing for the consideration of sustainability earlier in the remedy selection process with the added benefit of reducing the life cycle cost of the remedy. However, the regulatory stance against this view continues. Overall, however, it was felt that in the US, the buzz over sustainable remediation has died down somewhat compared to two years ago.

There was also increased regulatory focus on vapour intrusion, which is driving remediation/mitigation at many sites. The regulatory driven sessions were excellent – being well driven, and possibly more well attended than the science driven sessions.

On the science side abiotic reduction was the most popular. There were many talks and posters on ZVI case studies and interesting research on use of other metals and minerals as reductants. Encouraging research using in-situ microcosm studies demonstrated complete degradation of chlorobenzenes by concurrent reductive and oxidative pathways.

**Developments in China: Soil-Rem2012 and Site-Rem 2012**

**Mengfang Chen, Institute of Soil Science, China**

The 4th International Conference on Soil Pollution and Remediation (SoilRem2012) and the 2nd International Workshop on Site Remediation (SiteRem2012) were successfully held between September 23rd and 26th 2012 at Yantai City, China.

The conference opening session was chaired by Prof. Mengfang Chen of the Institute of Soil Science, Chinese Academy of Sciences (ISSAS), while Prof. Yongming Luo, chairman of the organizing committee and the acting director of Yantai Institute of Coastal Zone Research, Prof. Mengfang Chen of ISSAS, Prof. Paul Bardos representing UK CL:AIRE and from Brighton University and r³ Environmental Technology Ltd, Prof. Paul Nathanail of Nottingham University gave key note presentations at the plenary session.

Dr. Dominique Darmendrail of Common Forum on Contaminated Land in Europe, Paul van Riet of NICOLE, and Lida Tan of USEPA were also invited to give stimulating presentations.

This was followed by 61 presentations in six parallel sessions including Environmental Processes, Fate and Transport of Soil Pollutants, Environmental Site Investigation and Risk assessment, Chemical Speciation, Bioavailability and Ecotoxicology, Land Management Policy and Remediation Market, Phytoremediation of Heavy Metal Polluted Soils, Physicochemical Remediation Technology for Metals, Bioremediation of Organic Pollutants in Soil and Physicochemical Remediation Technologies for VOCs and SVOCs.

There were a total of 252 attendees from 14 countries including China, USA, UK, Netherlands, France, Japan, Czech Republic, Italy, Switzerland, Malaysia, Thailand, South Korea, South Africa and New Zealand. This conference provided a platform that promotes greater industrial collaborations and academic exchanges in this fast emerging brownfield regeneration market in China.

A notable development from the conference was the release of Health and Environmental Risk Assessment Software (HERA) by Prof. Mengfang Chen of ISSAS for undertaking soil and groundwater risk assessment of contaminated land in China. Unlike similar models in USA and the UK, HERA model was developed using Microsoft Visual Studios C# programming language and can be used for Chinese specific exposure calculations.
The meeting in Rotterdam gave us a renewed opportunity to review the challenges of managing soil and groundwater management at infrastructural and industrial sites. The objective of this workshop was to examine the complex and dynamic arena in which infrastructural works must operate and manage contaminated land challenges. Infrastructural facilities, include airports, railroad lines, power transmission grids and other utilities companies operate within a complex landscape of environmental regulations, responsibilities and liabilities. There are multiple owners, users, operators, and stakeholders involved with infrastructure.

“Classical” site boundaries are not always apparent. These sites may also have many potential sources of land contamination, and the sources may be mobile.

The key conclusions from this meeting were that:

- The manner in which contaminated land management is viewed and organised is changing for these sites. There is more routine incorporation of contaminated land investigation in real property and asset management.

- The ‘multiple’ facetted aspect of large infrastructural sites affects not just soil, but also other compartments, such as air and water. Some managers of contaminated land are increasingly faced with a need to monitor overall effect on the environment, including biodiversity. This trend is changing traditional industrial land management and remediation, and has started to even give rise to policies surrounding climate change and land management.

- Contaminated land in infrastructural settings has continued in use over many events, ‘giving rise to complex cross-boundary situations which makes liabilities hard to determine. An example solution to this problem was suggested by the Port of Rotterdam. Here operators in an industrial zone have shared a system of cash contribution to a remediation programme for aquifers. The scheme is operated by the Municipality. Industrial property users remain responsible for the soil remediation at their own sites, while the management of the contaminated groundwater plumes, falling in the sub-soil, becomes a joint or shared responsibility particularly where there are instances of cross-boundary contamination.

A notable feature was the incorporation of social and eco-system considerations in remedial solutions. An ecosystem services based approach to managing the industrial contaminated land projects might be an interesting concept for NICOLE and its members to consider, perhaps in the context of “sustainable remediation”.

Water in contaminated land management

Lida Schelwald-van der Kley, NICOLE

Baden Baden, June 2012

Baden-Baden proved to be the perfect setting for a meeting on water issues in contaminated land management. Lately there has been growing attention within companies for water stewardship. Companies depend on a reliable supply of water for their operations and realise the need to ‘safeguard’ the valuable water resources on and near their plants.

A shift is taking place from a stand-alone soil clean-up to integrated soil-water management. There is also changing focus from dealing with historic to a focus on present and future benefits of a good quality of soil and water. Industry is playing an important role in a transition to sustainable soil and water management. New strategies are being developed and implemented to reduce water footprint, minimising water losses and re-using water, which has a direct bearing on groundwater remediation.

There is increasing interest in “green designs”, such as combining ground water remediation and subsurface energy storage, or phytohydraulic plume management by using trees (“pump and tree”). Reducing water footprint helps companies both reduce costs and possible future risks (such as shortage and quality).

A number of presentations emphasized the importance of stakeholder involvement for integrated groundwater management. A lack of clear ownership of groundwater resources may be a barrier to interest in their preservation and remediation. A possible legal solution that was presented to overcome this problem might be to link groundwater to ownership. Considering the groundwater as private property also paves the way for tax exemption or deductions for clean-up costs.

Creative thinking and a regulatory system that is flexible to allow for alternative solutions can lead to more sustainable approaches for integrated soil and water management. The soil-water interface has been proven to serve as natural reactive barrier for (ground) water contaminant degradation.
Industry Subgroup

Paul van Riet, ISG Chair
Lida Schelwald-van der Kley, ISG Secretary

After our last update in August 2011, the NICOLE Industry Subgroup (ISG) met twice, first in November 2011 in Rotterdam and most recently, in June 2012 in Baden-Baden. In Rotterdam we welcomed SBNS (Dutch Railways) as a new member.

On both occasions regulatory issues were high on the agenda. Thanks to our good relationship with the Common Forum, a network of European regulators, NICOLE is well informed of new developments in the preparation of EU regulations and their national implementation. Anja Sinke, our ISG representative for the Common Forum, keeps us informed of some recent developments.

It has been good to learn that most countries have now adopted a risk based approach for dealing with soil contaminates. An interesting observation came from Denmark. They had investigated the economic value of dealing with soil contamination. A main conclusion was that the effect of a site being identified as “potentially contaminated” was enormous and the economic value did not recover even after a full remediation.

We were also notified that the draft Soil framework Directive (SFD), which has been “on hold” for many years now, may again be put on the EU political agenda. The Common Forum has published an alternative text for the EU Soil Framework Directive agreed by its members. This is available from their website (www.commonforum.eu). They urged NICOLE to formulate a position on this version. We decided to do so.

As the legislative environment for soil and groundwater in Europe is complex, there are many more Directives to keep track of. One of them is the Industrial Emissions Directive (IED). This Directive is in its implementation stage. An issue still of concern is the guidance on baselines, which will be legally binding for all Member States. We decided to work together with the Common Forum on a questionnaire for Member States on the transposition of the IED.

The NICOLE Industry group also decided that it would be worthwhile to have the NICOLE Regulatory Working Group focus on the implementation and interpretation of EU Directives at Member State level. The Regulatory WG could also give technical input to upcoming legislation. As most of our ISG members have sites in different European States, they notice that interpretation of Soil Directives, from a national to a regional and local level, may vary considerably. This situation often requires giving guidance and advice to regional and local authorities. This is not something that can be changed overnight, but good guidance may help to improve this situation.

And last but certainly not least, the ISG contributed in a constructive manner, together with the SPG to the discussion on the future of NICOLE. More on this important issue on Page 7.

Service Provider’s Subgroup

Elze-Lia Visser-Westerweele, SPG Secretary

Over the last year SPG held two well attended meetings. At the November 2011 SPG meeting in Rotterdam the group discussed the need for good quality NICOLE workshops twice a year and the options for NICOLE involvement in EU projects. In spring 2012 in Baden-Baden SPG elected its new Vice chairperson out of two excellent candidates. Because Olivier Maurer (CH2M Hill) has shifted his horizons from Europe to South America Sarah MacKay (WSP, UK) succeeded him in Baden-Baden as SPG’s chairperson six months ahead of schedule. Arthur de Groof (Grontmij, Netherlands) was elected the new vice-chairperson over Marianne Blom (ENVIRON, Netherlands). Laurent Bakker (TAUW, Netherlands) will extend his tenure as NICOLE SG Vice Chair, meaning that the SPG will be represented in the NICOLE Steering Group by Laurent, Sarah and Arthur.

SPG Member MAVA’s View on the Technology Award One Year On

The NICOLE Technology Award in 2011 created a European platform resulting in a fast dissemination of the EnISSA technology.

Thanks to the award, potential clients have increased confidence in the significant added value of our new technology. Secondly, thanks to the European scale of NICOLE, EnISSA was able to cross the Belgian borders and grow to be an international service provider. Projects have been carried out in Belgium, France and the Netherlands, with prospects developing in the UK, Israel and Hungary.

Projects have shown that EnISSA can be a valuable tool in very different contaminant situations going from classic CVOC’s and BTEX up to MTBE or even MIBK and hexane.

Within the European CityChlor project, a comparison of EnISSA with traditional soil sampling technologies demonstrated the strengths of EnISSA. These results were presented at Battelle 2012 and CSME 2012.

Client feedback has stimulated MAVA to improve their service which has led to:

- A new visualisation for reporting,
- MIP combined with CPT measurements
- Work on a new calibration procedure

• A broad spectrum of measurable contaminants.

Initiatives such as the NICOLE technology award are crucial for successful implementation of new and promising technologies within a “by authority’s proven technology” market. Therefore, many thanks to NICOLE for this initiative and to our clients for their confidence; both gave a significant boost to the success of EnISSA! More information & reference projects on the new website: www.EnISSA.com.

Read about the 2012 winners on Page 12
Progress in the NICOLE Working Groups

Regulatory Working Group

Johan De Fraye, CH2M-HILL, UK

NICOLE’s Regulatory Working Group (RWG) had its kick-off meeting during the recent Baden-Baden workshop. The meeting was attended by 33 NICOLE members demonstrating the wide interest developing regulations have in the NICOLE community.

The RWG’s main goal is to be the focal point for all regulatory and guidance issues with regard to the managing of contaminated land, both at a European Union level and at a local country level. In that sense the RWG replaces the former Soil, Waste and Groundwater Working Groups. It was felt that combining all regulatory know how in NICOLE in one working group increased efficiency and centralized expertise in one group.

The core organisation of the RWG has a chair (Johan De Fraye, CH2M Hill), a secretary (Elze-Lia Visser, SPG secretary) and EU wide sub-group leaders: groundwater: Wouter Gevaerts, ARCADIS; ISO/CEN standards: Laurent Bakker, TAUW; Soil: Lucia Buvé, Umicore.

The RWG intends to issue two types of deliverables:

1. Impact paper: for internal member distribution only - describes the impact of a new development, be it a new piece of legislation proposed by an authority, or a change to an existing proposal or regulation – maximum five pages (template to be the same every time)

2. Position paper: for external distribution – provides NICOLE’s view on proposed legislation with an aim to clarify impacts, propose alternatives (where feasible), elucidate contradictions, etc. – ideally just one page for maximum impact.

During the kick-off meeting it was decided to start working on two important issues: the revised draft EU Soil Framework Directive (SFD) and the national transposition of the EU Industrial Emissions Directive (IED).

With regard to the SFD the Common Forum of national environmental authorities has prepared a revised version of this draft directive with an aim to re-launch the debate around its implementation. NICOLE intends to issue a position paper with regard to this revised version. Lucia Buvé has prepared a draft position paper and RWG members have been requested to present their comments. After this the RWG core leadership team will finalize and present the result to NICOLE’s Steering Group for final review.

The IED was published in 2010. It replaces the IPPC Directive and regulates major industrial facilities’ environmental impact. New in the directive is a soil component with a specific requirement to establish a baseline of soil and groundwater conditions at the start of operations or at renewal of the permit. The main provisions are as follows.

- Art. 22.2: Where the activity involves the use, production or release of relevant hazardous substances and having regard to the possibility of soil and groundwater contamination at the site of the installation, the operator shall prepare and submit to the competent authority a baseline report before starting operation of an installation or before a permit for an installation is updated for the first time after 7 January 2013. The baseline report shall contain the information necessary to determine the state of soil & groundwater contamination so as to make a quantified comparison with the state upon definitive cessation of activities ...

- Art. 22.3 “Upon definitive cessation of the activities, the operator shall assess the state of soil and groundwater contamination by relevant hazardous substances used, produced or released by the installation. Where the installation has caused significant pollution of soil or groundwater by relevant hazardous substances compared to the state established in the baseline report referred to in paragraph 2, the operator shall take the necessary measures to address that pollution so as to return the site to that state.”

EU Member States are required to transpose the majority of articles into national law by 7 January 2013. Since Member States have quite some room for interpretation as to how they will apply the directive’s provisions the RWG thought it useful to capture the current thinking in those Member States and prepare an impact paper summarising the issues and explaining implications of IED transposition to NICOLE members by December 2012.

Mercury Working Group

Roger Jacquet, Solvay, Belgium

Mercury is listed as a priority hazardous substance and its use is being largely phased out across the EU under Regulation (EC) No 1102/2008. Hence over the last decade and in the years to come many industrial activities using mercury were or will be closed, such as chlor-alkali plants and a range of other manufacturing activities (thermometers, electrical switches, lamps). These sites will need site investigation and potentially management measures.

Mercury has properties (liquid metal, surface tension, vapour pressure) that make it unique in the world of contaminants. The Mercury WG in NICOLE has been established to collate and share experiences about mercury site management. The first tangible output from this will be the workshop on Mercury planned later in the year (see Page 2). The Mercury WG has been very successful in sharing experience and practice between different “problem-holders” and also with service providers. The WG is gradually building up enough shared knowledge to develop NICOLE guidance for supporting sustainable risk based management at mercury contaminated sites. This could take the form of a position paper or a booklet (like the NICOLE risk communication booklet) and will be a second WG deliverable.
Taking NICOLE forward

ISG / SPG secretariats

In 2005 NICOLE consulted its ISG and SPG members by means of a questionnaire on a number of aims and topics, intended to realign NICOLE for the future. Today, it can be concluded that many of these aims have been achieved and the underlying activities have been realized or are ongoing.

The questions at hand are if these aims are still valid and how NICOLE can contribute to achieve the aims of its members? NICOLE organised a dialogue with its members on 13 June 2012 during the NICOLE Workshop in Baden-Baden, Germany.

Most of the aims are still valued by members. Special focus should be on participation in EU policy making by providing technical input, sharing of knowledge and stimulating the acceptance of promising technologies. The scope of NICOLE should stay on issues related to contaminated land management. A central theme that came forward from the dialogue is: marketing of NICOLE’s excellence, both internally and externally.

NICOLE could put more effort in this, in order to make stakeholders (like colleagues, clients, new members, and Brussels) better aware of the (technical) expertise of the NICOLE network and the potential help NICOLE could supply: “NICOLE, be good and tell it!” Ideas to contribute to the aims of NICOLE were debated by the members in groups. In general the activities of the network are highly appreciated. Some of the additional activities or issues mentioned in the debate are improving the internal and external communication, e.g. by producing showcases, presenting NICOLE at events, using the NICOLE logo (proud member of NICOLE), creating more network opportunities and establishing a platform for PhD’s.

Of course budget should be made available for more marketing and other identified activities. Potential financial mechanisms for more budget, that could be further explored, include sponsoring of workshops, attracting more members, making the website self-sustaining, and if possible generate money from it. A flavour of the meeting was presented by Laurent Bakker in the General Assembly following the strategy dialogue. The General Assembly suggested getting advice from a PR/Marketing consultant on how to achieve NICOLE’s aims and to install a core group to follow up the actions coming from this debate.

Sustainable Remediation Working Group

Sarah MacKay, WSP, UK

In early 2012 the Sustainable Remediation Working Group published its supporting guidance for the 2010 NICOLE Sustainable Remediation Road Map. This guidance is outlined below.

Since then the WG has been running a project to capture case studies where the NICOLE Road Map for sustainable remediation has been applied. This was part of the original project aims around communication – capturing the evidence base within our community to encourage and inform usage of sustainable remediation principles within our networks. A number of these case studies will be presented at a special session at the Sustainable Remediation conference in Vienna in November, where the speakers will be allowed time to explore some of the issues in applying the Road Map for sustainable remediation in some depth.

In addition, we are hoping to present the results of a wider set of case studies and examples in a short meeting alongside the NICOLE technical meeting in Brussels in December. At the moment, this is foreseen as the final meeting of the Sustainable Remediation Working Group, as our current work draws to an end. However, we hope to continue the promotion of Sustainable Remediation both within and externally to the NICOLE networks by ad-hoc activities of our community.

The Sustainable Remediation Guidance from NICOLE

In September 2010, NICOLE’s SRWG published a Road Map to Sustainable Remediation (SR). The SRWG has now published supporting information that provides the background context and the technical details for the roadmap as a series of four supporting interrelated guidance documents. Together with the road map, this series are provided to the professional community with the objective of assisting any stakeholder involved in a contaminated land management project, of any size, in the implementation of sustainability into their project.

- The “Road Map for Sustainable Remediation”. A concise four-page document that introduces NICOLE’s vision of SR and the necessary steps and principles to implement a successful, sustainable remediation project. This was finalised and published in September 2010.
- An introductory document describing the context of the Working Group and its outputs
- The document “Integrating Risk Assessment and Sustainable Remediation” focuses primarily on the challenges of integrating sustainability into a risk-based approach and presents NICOLE’s position on this topic.
- The document “Economics and Tools” reviews the economic aspects associated with SR and provides an overview of tools available on the market to assist with such analysis, as of December 2010.
- The “Sustainable Remediation Indicators” document provides guidance on how to measure the Sustainability of a SR project, and on the indicators that are currently being considered as of May 2011.

Some of the key points from this guidance are as follows.

Site-specific quantitative risk assessment coupled with a risk management process that includes remediation options appraisal offers the best interim opportunity to integrate sustainable decision-making in parallel with risk assessment process and does not comprise the assumptions or quality of the risk assessment. Opportunities to improve sustainability are more constrained when conservative generic threshold values are used.

Tools to support sustainable remediation design are available. In the first instance, a relatively simple approach may be merited using qualitative tools that allow sustainability to be recognised and decisions recorded and documented. Further complexity can then be considered when the potential costs and benefits of remediation require more detailed analysis. Record keeping and reporting of SR decision making need to be made on a transparent basis, so that all of the considerations and assumptions underpinning the decision are clearly evident. The choice of indicators is highly site specific, and is also strongly related to the perspectives for the different stakeholders involved for any particular site.

The NICOLE Working Groups promote discussion of important issues in the contaminated land sector. NICOLE members take part in Working Groups covering a range of issues. If you wish to find out more, please contact, marlan.euser@deltares.nl
Emerging issues: nano-remediation and perfluorinated substances

NANOREM
Hans-Peter Koschitzky, VEGAS, Germany

NANOREM is a new project to support and develop the appropriate use of nanotechnology for contaminated land and brownfield remediation and management in Europe. It focuses on facilitating the practical, economic and exploitable nanotechnology for in situ remediation. So far gaps in knowledge and a perception of relatively high costs have led to rather limited practical use of nano-remediation. Moreover in some countries, the environmental use of nanoparticles (NPs) is seen as potentially hazardous, leading to precautionary and conservative regulatory positions. Questions have also been raised about the general sustainability of NP use in remediation.

NANOREM will identify which nano-remediation technological approaches might achieve a step-change in practical remediation performance. It will develop lower cost production techniques, tested at commercially relevant scales. It will also investigate the mobility and migration potential of nanoparticles in the subsurface, and their potential to cause harm. This will focus on the NP types most likely to be adopted into practical use in the EU. Based on this it will produce a comprehensive tool box for the design of nano-remediation operations, testing nano-remediation performance at field scale and determination of fate in the subsurface. NANOREM will include a comprehensive programme of engagement, dialogue and dissemination with key stakeholder interests to ensure that end-user and regulatory requirements are met. Information and knowledge will be shared widely across the Single Market so that advances in nano-remediation can be properly exploited. NANOREM will include tests at representative scales to validate cost, performance, and fate and transport findings.

NANOREM will be co-operating closely with NICOLE and COMMON FORUM. We are anxious to reach individual NICOLE members to learn from them. Our door is open and we look forward to hearing from you, in particular if you have an interest in linking a case study or a pilot to our project, or have particular concerns about risks or sustainability.

For further information please contact me directly: Koschitzky@iws.uni-stuttgart.de

Update on perfluoroalkyl compounds
Jason Conder, ENVIRON International, USA

Perfluoroalkyl compounds, such as perfluorooctane sulfonate (PFOS) and perfluorooctanoate (PFOA), have been used in a wide variety of ongoing and historical applications (waxes, coatings, fire repellents, surfactants, etc.). They have been routinely detected in the environment, wildlife and humans. Owing to their high water solubility and persistence, they are increasingly being identified as chemicals of concern at a wide variety of industrial sites. Since I first presented on these substances at NICOLE in 2010, developments have been rapid.

Germany intends to submit dossiers identifying PFOA as a substance of very high concern for authorization under REACH (Registration, Evaluation, Authorisation and Restriction of Chemical Substances). Designation of PFOA as a persistent, bioaccumulative, and toxic compound under REACH restricts on-going uses of PFOA, but also may indirectly affect contaminated site investigation and clean-up by resulting in additional concern regarding legacy sources present in soil, sediment, and water.

The US technical panel, “C8”, recently identified a probable link between exposure to PFOA and testicular and kidney cancer. If PFOA and other perfluoroalkyl compounds are more firmly associated with cancer, existing levels of acceptable exposure, which are calibrated to non-cancer effects, are likely to decrease. The likely result of this will be more stringent requirements for remediation.

New research articles on environmental fate and effect continue to appear on an almost weekly basis. In general, the scientific and regulatory communities are currently focusing on presence of these compounds in the environment. For example, the United States Environmental Protection Agency (USEPA) has called on many public water systems to monitor for PFOA from January 2013 through to December 2015. A comprehensive scientific review of perfluoroalkyl compounds in the environment was published by Buck et al. and is available for free download.

Perfluoroalkyl compounds such as PFOA and PFOS continue to be an emerging chemical of concern for scientific, regulatory, and regulated communities. The continued attention is likely to result in additional scrutiny at many contaminated industrial lands that produced or used products containing these compounds, especially sites that are near groundwater or surface water resources.

To learn more visit http://onlinelibrary.wiley.com/doi/10.1002/ieam.258/abstract and www.c8sciencepanel.org, or e-mail me at: jconder@environcorp.com.

Unintentional release of perfluorinated substances

Nano-iron field trial in the Czech republic (courtesy AQUATEST)
Activities during the last months on many Member States to have a European Council, in light of the desire of having failed to reach agreement in the Council and does constitute an exposure pathway to plant roots, microorganisms and soil animals. Over time, these elements can accumulate in the human food which may cause chronic diseases.

In the last 20 years, alternative gentle remediation technologies have been developed, these are based on the use of plants and their associated microbes. This approach, called phytoremediation, saves and improves the soil quality, is relatively cheap, non invasive and aesthetically appealing. During phytoremediation, the pollutants are either extracted from the soil by accumulation in the plant or stabilized in the soil which reduces the bioavailable fraction of the metals and thus decreases the associated risks of groundwater or food chain contamination. Although a lot of progress in the development of phytoremediation technologies has been achieved, their application as a practical site solution is still in its infancy, notably regarding the sustainability, the use of plant biomass as plant-based feedstock, the ecosystem services, and the socio-economic benefits.

A consortium of 17 partners (including 6 universities, 7 research institutes, 3 SMEs and one state authority) from 10 European countries (Austria, Belgium, Switzerland, Germany, Spain, France, Italy, Poland, Sweden, United Kingdom) is working together for four years (2011-2014) to further develop phytoremediation and make it ready for practical site application. This project entitled “Gentle remediation of trace element contaminated land – GREENLAND” (FP7-KBBE-266124; www.greenland-project.eu) is being coordinated by the University of Natural Resources and Life Sciences Vienna and supported by the European Commission.

Contamination by potentially toxic heavy metals is one of the major threats to soils. Metals cannot be degraded and remain in soil for decades or centuries, since they are partly strongly sorbed to the soil particles. A certain ‘labile’ fraction is present in the soil solution, and does constitute an exposure pathway to plant roots, microorganisms and soil animals. Over time, these elements can accumulate in the human food which may cause chronic diseases.

In the last 20 years, alternative gentle remediation technologies have been developed, these are based on the use of plants and their associated microbes. This approach, called phytoremediation, saves and improves the soil quality, is relatively cheap, non invasive and aesthetically appealing. During phytoremediation, the pollutants are either extracted from the soil by accumulation in the plant or stabilized in the soil which reduces the bioavailable fraction of the metals and thus decreases the associated risks of groundwater or food chain contamination. Although a lot of progress in the development of phytoremediation technologies has been achieved, their application as a practical site solution is still in its infancy, notably regarding the sustainability, the use of plant biomass as plant-based feedstock, the ecosystem services, and the socio-economic benefits.

A consortium of 17 partners (including 6 universities, 7 research institutes, 3 SMEs and one state authority) from 10 European countries (Austria, Belgium, Switzerland, Germany, Spain, France, Italy, Poland, Sweden, United Kingdom) is working together for four years (2011-2014) to further develop phytoremediation and make it ready for practical site application. This project entitled “Gentle remediation of trace element contaminated land – GREENLAND” (FP7-KBBE-266124; www.greenland-project.eu) is being coordinated by the University of Natural Resources and Life Sciences Vienna and supported by the European Commission.

The COMMON FORUM on Contaminated Land in the European Union, initiated in 1994, is a network of contaminated land policy makers and advisors from national ministries and Environment Agencies in EU Member States. The general objectives of COMMON FORUM are to develop strategies for the management and treatment of contaminated sites and for land recycling with respect to “sustainable resource protection” for contaminated land and groundwater.

The COMMON FORUM has focused its activities during the last months on European regulatory developments (in particular the Soil Framework Directive proposal, the Industrial Emissions Directive, the INSPIRE Directive or the new roadmap for resources efficiency) and on technical issues such as the development of a conceptual paper on sustainable land management.

Having failed to reach agreement in the European Council, in light of the desire of many Member States to have a Framework Directive for soil, and convinced that common grounds could be found. A “special task force” of COMMON FORUM members from some Member States was established in July 2010 during the Belgian Presidency. The task force discussed the reasons for not being able to reach agreement in Council and proposed amendments to the draft Directive. It developed an alternative proposal which was sent to EU representatives (DG ENV, Parliament rapporteurs, EU presidencies representatives) for further discussion. (www.commonforum.eu/SoilDirectiveAlternative.asp).

The COMMON FORUM has also been part of EU consultations on the baseline report requirements for the Industrial Emission Directive, the data format for soil issues for the INSPIRE Directive, and the DG Environment remediation market study for the soil protection strategy.

In parallel many European Countries have announced changes in their legal framework related to contaminated land management, this issue still being of concern in all European countries. The COMMON FORUM questionnaire on the current situation in European Member States is available in the questionnaire zone of the COMMON FORUM web site.

The COMMON FORUM and the International Committee on Contaminated Land (ICCL) presented in Washington DC (www.iccl.ch) the results of a detailed questionnaire on Mining Site Remediation and Reuse. The survey, completed by 18 countries / regions, covered technical, policy, legal, regulatory, financial and social issues. In order to strengthen collaboration with other stakeholders, an open workshop on the same issues was organised and in parallel for some 150 participants. The ICCL will meet next in October 2013 in South Africa.

The COMMON FORUM continued its collaboration with NICOLE, SNOWMAN and the other networks operating in this field (e.g. SEDNET on sediments, IMPEL – environment inspectorates). It also started discussion with World Bank and WHO on legacy polluted sites management and health issues. It plans to work with NICOLE on a joint position on “sustainable remediation”.

The CF welcomes participation from national ministries and agencies in all Member States. It also works closely with NICOLE and other stakeholder networks. Further information can be found at www.commonforum.eu or from me via: commonforum-secretariat@brgm.fr

The GREENLAND project
Markus Puschenreiter, BOKU, Austria


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AquaConSoil 2013
Wouter Gevaerts, ARCADIS, Belgium

Consoil has changed his name into AquaConsoil. The reason is that the conference will now also include some new topics: soil/groundwater to surface water interactions, and sediments. AquaConsoil keeps the ambition to remain the preeminent European conference in these fields, and seeks the participation of all stakeholders (authorities, scientists, consultants, problem owners and contractors).

The main conference themes are:
- Using functions of soil-water systems
- Soil and water resources management in water scarcity regions
- Assessment and monitoring
- Remediation technologies for soil, groundwater and sediment
- Concepts and policies

The conference will take place in Barcelona, Spain from 16 to 19 April 2013. More information can be found at www.aquaconsoil.org.

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Common Forum Update
Dominique Darmendrail, BRGM, France

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The future of bioremediation
Thomas Held, ARCADIS Deutschland GmbH, Rainer U. Meckenstock, Helmholtz Center Munich

Biodegradation was the first process used for in-situ remediation of subsurface contaminations. With the rise of chemical, physical and thermal technologies, bioremediation applications have receded somewhat.

The GOODWATER project is a recent initial training network (ITN) launched under and funded by the Framework 7 programme, www.helmholtz-muenchen.de/goodwater. It aimed to understand the key barriers to transferring bioremediation technologies form site to site. The project was led by Prof. Meckenstock at the Helmholtz Center Munich, Germany. It included partners from the Technical University of Denmark, Geological Survey of Denmark and Greenland, University of Leuven, Gent University, Flemish Institute for Technological Investigations (VITO), and a number of associated partners from industry.

15 PhD students investigated various bottlenecks of biodegradation processes. During its final workshop in March 2012, the PhD students and a number of invited researchers and biodegradation specialists discussed the future of biodegradation considering the bottlenecks identified (Figure 1). Only when these bottlenecks, i.e. limitations of biodegradation, which may differ from site to site, are identified, will we be able to address them specifically, in order to enhance biodegradation.

Microorganisms play key roles in the transformation and destruction of organic pollutants (i.e. mineralisation to CO₂) shown in Figure 2. A key limitation of biodegradation seems to be the bioavailability of the contaminants and of the electron acceptors or donors needed to support biodegradation. This might be problematic in contaminated, low permeable strata. Contaminants are usually hydrophobic and tend to be sorbed preferentially to the solid matrix. In addition, this fixed mass of the contaminants is present as NAPL droplets (residual saturation). Hence the dissolution kinetics of the contaminants is the rate limiting step in the removal of the NAPL. This limiting step applies to most in situ remediation technologies, not just bioremediation.

Interestingly it has recently become known that bacteria are able to express enzymes for a very large range of substrates under carbon limiting conditions. The use of natural carbon substrates and at the same time a number of low concentrated pollutants would reduce threshold concentrations for induction of metabolic enzymes, substrate utilization, and growth. This feature makes biodegradation very efficient in removing residual contaminants at low concentrations.

Although microorganisms exhibit an enormous metabolic potential, the right organisms may not always be present for a limited number of contaminants such as chlorinated solvents. We have observed that microorganisms able to aerobically degrade cis-1,2-dichloroethene (DCE) as sole carbon and energy source seems to be present only at some sites. Better known is the anaerobic reductive degradation of chloroethenes, in particular DCE. Anaerobic in situ biodegradation is widely used for chlorinated solvent problems. However, it has been found that the process can stall at DCE. It has been conjectured that this is because of a lack of members of the genus Dehalococcoides in the subsurface, and therefore bioaugmentation with Dehalococcoides is offered as a solution, to facilitate a complete dechlorination pathway. However, it remains unclear whether the stalling of dechlorination is because of the absence of facultative micro-organisms or because of some other cause.

New knowledge is enhancing the value of bioremediation. It can be considered as part of a treatment train also as a component of monitored natural attenuation. Future developments, especially in the area of bacterial ecology and genetics, may allow additional exploitation of microbial degradation processes. Better understanding of microbial features will allow more precise adjustment of the biogeochemical environment optimal for maximum degradation rates and possibly an extension of the spectrum of degradable contaminants.
PCE, a well-known DNAPL, to compare. Using STOMP, we modelled infiltration of DNAPL-behaviour of PCE and metallic mercury. First results suggest that there are significant differences between the behaviour of metallic mercury and PCE. The following table shows the main differences in properties between mercury and PCE.

Through our modelling we aim to address questions such as:

- What are the main controls on the risks of subsurface mercury DNAPL spreading?
- What controls the depth to which mercury may have infiltrated?
- Will there be any residual mercury left in the zone passed by the pure phase product?
- What will be the extent of lateral spreading and?
- What are the best possible ways to characterize and remediate a mercury contaminated site?

Using STOMP, we modelled infiltration of PCE, a well-known DNAPL, to compare the differences in behaviour between PCE and metallic mercury. The following table shows the main differences in properties between mercury and PCE.

Only a small amount of residual metallic mercury is present at the low permeable zone and almost no lateral spreading. Using insights from observations at field site where metallic mercury has infiltrated the soil as a DNAPL, a predictive model can be developed for the spreading of mercury in the subsurface and gives insight in the possible risk pathways, characterization approaches as well as remediation strategies.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Water</th>
<th>PCE</th>
<th>Mercury</th>
</tr>
</thead>
<tbody>
<tr>
<td>Density g/cm³</td>
<td>1</td>
<td>1.622</td>
<td>13.546</td>
</tr>
<tr>
<td>Viscosity mPa/s</td>
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<td>0.89</td>
<td>1.55</td>
</tr>
<tr>
<td>Interfacial tension</td>
<td>not applicable</td>
<td>44.4</td>
<td>375</td>
</tr>
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</table>

**NICOLE and International Soil Standards**

Frank Lamé, ISO/TC 190 Soil Quality & CEN/TC 345 Characterization of Soils

Standardization is the process of developing and maintaining standards – technical documents designed to be used as a rule, guideline or definition in order “to do something in a repeatable way according to consensus as found in the market”. Standards are developed nationally, on the European level (CEN-standards) as well as on the global level (ISO-standards). The process is channelled through the national standardization institutes (e.g. BSi, NEN, AFNOR, DIN).

Soil standards are developed on the global level in ISO/TC 190 ‘Soil Quality’. Although the name of the Committee might suggest otherwise, the definition of what should be considered as ‘good’ or ‘bad’ soil quality lies outside the domain of the TC. The TC does however describe the assessment and analytical methods necessary to determine the characteristics of soil, based on which a comparison with (national) soil quality standards can be made. Additionally, standards are being developed for newer, more ‘innovative’, techniques like field screening methods. These allow for a wider application of techniques and approaches but still with the confidence that ISO-standards provide. Furthermore, within the group of assessment methods, a wider range of procedures will be described in standards like sustainable land management and risk based remediation.

ISO standards are used on a voluntarily basis, however countries might decide to refer to ISO standards in their national soil policy and regulation, in which case the use of the methods becomes compulsory. This also applies to national or European standards. In addition, European standards have to be implemented by the European standardisation institutes, while in general the European Commission prefers to refer to European standards in European Directives.

The Soil Framework Directive will not be implemented soon; it seems at this point in time. Therefore a direct reference to European soil standards is not to be expected in the near future. However, at the same time the European standardization Technical Committee CEN/TC 345 ‘Characterization of soils’ is transferring a significant number of ISO-standards into European standards (EN-ISO-standards). As a consequence, comparable national standards have to be withdrawn by the national standardization institutes within Europe. Basically this implies that on a technical level, standardization and associated harmonisation is taking place despite the fact that there is no EU Soil Framework Directive.

The development of soil standards is a market driven consensus based process. This implies that all parties concerned are able to participate and can influence the development and maintenance of standards. Participating members in NICOLE (e.g. industries, consultants) have a direct interest in these developments. Standards are the technical instruments when making decisions with respect to the soil quality (e.g. assessment methods, sampling, analyses). Participation, through your national standardization institutes, is therefore of importance to you.

If more information is required on participation, please contact your national standardization institute, the Secretary of the ISO/TC 190 and CEN/TC 345; Saskia Schulten (saskia.schulten@nen.nl) or the Chairman (frank.lame@deltares.nl).

**STOP PRESS**: A proposal for a new work item on sustainable remediation was made to TC190 subcommittee 7 (which deals with soil and site assessment issues) when it meets in Helsinki in September 2012. Contact: Paul Nathanail, paul@lqm.co.uk
The 2012 NICOLE Technology Award Winners

NICOLE launched its 2012 Technology Award on “Innovative Solutions for Soil Monitoring” with the aim stimulating engineers and scientists to submit technical innovations that can contribute to an improved practice for contaminated land monitoring and verification of remediation performance. Entries were judged by a NICOLE jury based on their innovation, potential contribution to cost savings, technical applicability and plans for communication and market availability. The three winning entries received their prizes on 14 June 2012 at NICOLE’s 2012 spring workshop in Baden-Baden, Germany.

The 2012 Award was won by a project funded by the French Agency of Environment and Energy Management (ADEME) called Pollution Investigation by Trees (PIT). PIT is an International research project led by Environment International with HPC Envirotec, Sévêque Environnement, Cabinet Conseil Blondel, Exponent and Triassic Technology. Trees act as proxy-records of their current and past environmental exposures. These phytoforensic methods allow to delineate and map plumes, as well as to age date past pollution events. The project develops the use of phytoscreening and dendrochemical applications at polluted sites.

Second prize was awarded to the company Berghof (Tübingen, Germany) and the University of Stuttgart (VEGAS) in Germany for the Thermo-Flowmeter System. This is designed to detect vertical flow in ground water observation wells and to measure profiles of the hydraulic conductivity in aquifers.

The third prize was awarded to VITO and partners for a site and receptor specific risk management approach for groundwater pollution, called the Contaminant Mass Flux (CMF) approach. This uses in situ measurements of contaminant mass flux using the recently developed Passive Flux Meter technology.

Go to www.nicole.org for more about the 2012 Technology Award entries.

What is phytoscreening?

Phytoscreening is the use of plants to characterize polluted sites, using microsamples of trees’ outermost rings. Because roots do uptake contaminants from groundwater, soils and soil gases, as an integral of its rootball exposures. Sap transported contaminants are sampled with non-invasive tools, analysed with conventional methods, including GC MS for the organics, or ICP/MS versus EDXRF, though at much lower detection limits, most often by the ppt, as allowed by modern lab equipment. Dendrochemistry, or the chemistry of tree rings, relies on small cores, 1 cm in diameter, to document past environmental impacts at trees’ stands, over as many ring years as the trees and the cores allow. Prime benefit of dendrochemistry is to age-date past environmental impacts, and thus reconstruct site’s environmental history, including asynchronous releases, calculate effective plume migration, as is important in complex cases, including for litigation purposes.

The Thermo-Flowmeter System

The Thermo-Flowmeter System is designed to measure vertical velocity profiles in ground water wells. The system has a very high sensitivity, and is therefore designed to measure the relative hydraulic conductivity distribution in the subsurface as well as natural vertical flows occurring in wells, due to pressure gradients between different water bodies. In addition, if combined with a levelled sampling, concentration profiles can be obtained with the system.

Contaminant Mass Flux

The Contaminant Mass Flux (CMF) method is a risk management approach for contaminated land that considers contaminant mass flux measurements along control planes, and includes the derivation of a maximum allowed contaminant mass flux per control plane. Flux measurements are performed using Passive Flux Meter (PFM) technology. The PFM provides simultaneous in situ point measurements of a time-averaged contaminant mass flux and water flux. The device, with a suite of tracers, is placed in a monitoring well or borehole for a known exposure period, where it intercepts the groundwater flow and captures the contaminants. The proposed CMF method should lead to a more integrated and more controlled handling and management of soil and groundwater contamination in the near future.

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