

# ThS E3 Sustainable use of the subsurface

## SUSTAINABLE AND GREEN REMEDIATION – GLOBAL UPDATE

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### Abstract

A number of networks worldwide are debating how to achieve sustainable development when remediating or regenerating damaged sites or land area. These include established national initiatives such as SURF in the USA, SuRF-UK, SuRF-NL, SuRF-ANZ and SURF-Canada as well as newer initiatives in other countries, e.g. Italy, Brazil and China. The two major European stakeholder networks, NICOLE and COMMON FORUM, are also active in this field. There is a remarkable degree of consensus across these initiatives about what a vision “sustainable remediation” might be. In broad terms concepts of sustainable remediation are based on the achievement of a net benefit overall across a range of environmental, economic and social concerns that are judged to be representative of sustainability.

### 1 Introduction

In the past decade or so management of historically contaminated land has largely been based on prevention of unacceptable risks to human health and the environment, to ensure a site is ‘fit for use’, i.e. achieves suitability for beneficial uses. More recently, interest has been shown in including sustainability as a decision-making criterion. Sustainability concerns include the environmental, social, and economic consequences of risk management activities themselves, and also the opportunities for wider benefit beyond achievement of risk-reduction goals alone.

Sustainable remediation covers a wider range of sustainability impacts and benefits; and also, for a number of the groups, extends to ideas of sustainable regeneration (e.g. UK) sustainable land use (e.g. UK) and sustainable soil management (e.g. NL). A related concept is “green remediation” being advanced by the US Environmental Protection Agency (US EPA), which focuses on minimizing or mitigating the environmental impacts of remediation activities in mature site clean-up programs and regulatory frameworks, such as CERCLA, where social and economic factors are considered already.

Sustainable remediation has become an area of intense development across the world. Public and Private Sector organisations have become involved in a number of projects and networks intended to improve remediation practice and make it more sustainable. Table 1 lists most of the initiatives currently taking place. Table 1 also lists several initiatives connected with the wider concept of “sustainable regeneration” which relates to brownfields rehabilitation.

### 2. Sustainable Remediation

Table 2 summarises existing working definitions of sustainable remediation (and sustainable regeneration). . In broad terms concepts of sustainable remediation are based on the achievement of a net benefit overall across a range of environmental, economic and social concerns that are judged to be representative of sustainability. There is also a developing consensus that what

sustainability encompasses is highly site specific and depends on opinions from a range of stakeholders with interests in a particular site. As such sustainability is subjective rather objectively quantifiable. However, while sustainability is not capable of direct measurement, there is general agreement that it is possible to assess sustainability on a site specific basis, compare possible rehabilitation options, and monitor sustainability “performance” once a chosen option is implemented.

**Table 1: Example networks, projects and standards work in sustainable remediation and sustainable brownfield regeneration (updated from Bardos *et al.* 2011 and HOMBRE 2013)**

Name	Type, geographical coverage and dates	Key activities, outputs and web links
<b>Europe</b>		
CABERNET	EU FP5 funded project 2002-4, continuing as an informal EU expert network.	The Network’s aim is to enhance the rehabilitation of brownfield sites within the context of sustainable development, by sharing experiences from across Europe, providing new tools and management strategies and a framework for coordinated research activities Join the CABERNET group on <a href="http://www.linkedin.com">www.linkedin.com</a>
COMMON FORUM	Current EU network, regulator led	Developing a technical paper on the linkage of sustainability with risk based land management, and working on a joint position statement on sustainable remediation with NICOLE, both outputs expected in 2013 <a href="http://www.commonforum.eu">www.commonforum.eu</a>
EURODEMO+	EU FP6 funded Project 2005-7, continuing as an informal network EURODEMO+ from 2007	EURODEMO collated demonstrations of remediation technologies. Its outputs included suggestions on considering remediation technology sustainability. Activities continue under EURODEMO+ which led to the <i>Sustainable Remediation</i> conference in Vienna, November 2012. Proceedings for this will move to <a href="http://www.eugris.info">www.eugris.info</a> from 2014. <i>EURODEMO 2007</i> <a href="http://www.eurodemo.info">www.eurodemo.info</a>
EC RESCUE	EU FP5 funded Project 2003-5, later developed by the REVIT project.	EC RESCUE developed a toolkit to support the sustainable regeneration of Brownfield land, including guidance on sustainability assessment techniques <i>RESCUE, 2003, 2004, 2005</i> <a href="http://www.rescue-europe.com">www.rescue-europe.com</a> and <a href="http://www.revit-nweurope.org">www.revit-nweurope.org</a>
NICOLE Sustainable Remediation Working Group	EU network, industry and business led. Working group established in 2008, concluding 2013.	NICOLE is a European Network of service providers, problem owners and academic organisations. It has a Sustainable Remediation Working Group whose main output has been a Road Map in 2010 and supporting guidance in 2012 on integrating risk assessment and sustainable remediation; economics and tools and sustainable remediation indicators. The Working Group is currently collating case studies (for publication in 2013) and working with the Common Forum on a Joint Position Statement on Sustainable Remediation. The intention is to launch this at NICOLE’s 2013 Lisbon workshop on sustainable and green remediation. <a href="http://www.nicole.org">www.nicole.org</a> NICOLE 2010 and 2012
SAFIRA project, Germany	German major research project output	This project developed a “Megasite Management Toolsuite MMT”, which is a software tool for consultants, authorities, and investors involved in the planning and assessment of revitalisation options for brownfields. <i>Downloadable software tool</i> <a href="http://www.safira-mmt.de">www.safira-mmt.de</a>

Name	Type, geographical coverage and dates	Key activities, outputs and web links
SuRF-Italy	Informal Italian network from 2012	SuRF-Italy is an informal cross-sectoral network and had its first workshop at RemTech Italy <sup>1</sup> (September 2012). It is currently seeking to develop a baseline understanding of sustainable remediation status in Italy and opportunities for developing an Italy Forum
SuRF-NL	Informal Dutch network from 2011	The SuRF-NL network includes consultants, regulators, industry, contractors and research institutes. Its scope is "sustainable soil management" which is broader than sustainable remediation. A White Paper was issued in 2011 and SURF is currently undertaking a series of workshops and case study reviews. <i>SURF-NL 2011</i> <a href="http://www.surf-nl.com">www.surf-nl.com</a> (release date mid 2013)
SuRF-UK	UK based projects, from 2007	SuRF-UK has a small steering group which includes consultants, academics, problem holders and regulator. To date SuRF-UK publications include the first "sustainable remediation framework" (2010) and guidance on sustainability indicators (2011) based on 15 overarching categories. It is currently publishing a series of case studies, developing guidance for assessors to help them undertake simple qualitative assessments and developing guidance on generic best management practices that can be applied to remediation projects. All of its work uses stakeholder workshops to ensure engagement with the whole of the sector. <i>CL:AIRE 2009; 2010; and 2011; Bardos et al. 2011</i> <a href="http://www.claire.co.uk/surfuk">www.claire.co.uk/surfuk</a>
UK SU:BRIM Project	Academic research project 2005-7.	SUBR:IM was a research consortium linking science, engineering and social science to address brownfield redevelopment. <i>CL:AIRE 2006, 2007a and b</i> <a href="http://www.subrim.org.uk">www.subrim.org.uk</a>
<b>North and South America<sup>2</sup></b>		
ASTM	US / international standards organisation working group	Formal cross-sectoral standards work item: WK23495 Standard Guide for Green and Sustainable Site Assessment and Clean-up, established March 2009. <a href="http://www.astm.org/WorkItems/WK23495.htm">http://www.astm.org/WorkItems/WK23495.htm</a>
ITRC, Interstate Technology & Regulatory Council	Public-private partnership producing technical reports USA and Canada	ITRC have a large working group reviewing "green and sustainable remediation" (GSR). Their report of 2011 describes the process of sustainable site decision making across three aspects: environmental, social, and economic. The report is intended to help state programs develop guidance and eventually formal GSR policy and may help some federal agencies that have not developed programs formulate a GSR policy. <i>ITRC 2011</i> <a href="http://www.itrcweb.org">www.itrcweb.org</a>
RELASC	Network	The Latin American Contaminated Site Network is a network of regulators and practitioners seeking to advance and exchange knowledge and the practice of sustainable land and groundwater management through prevention,

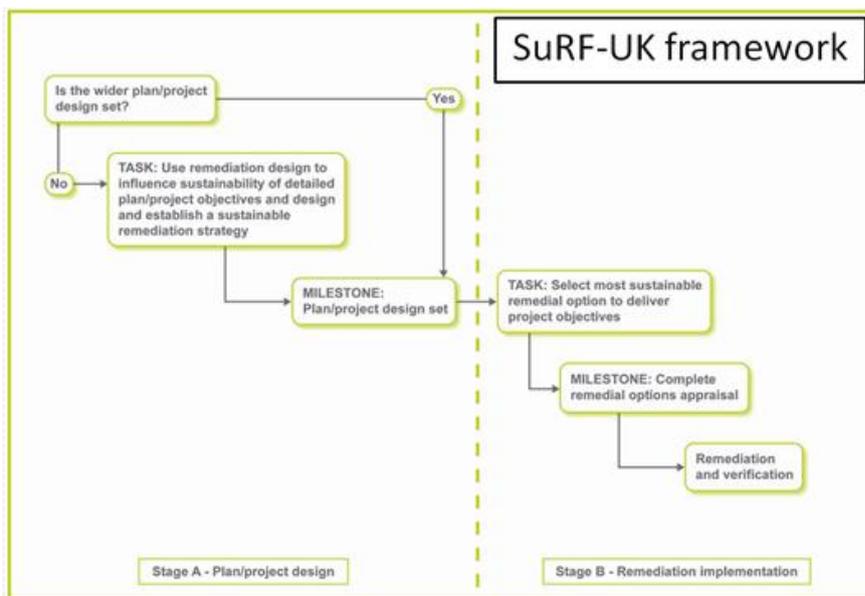
<sup>1</sup> [http://www.remtechexpo.com/index.php?view=details&id=162%3Agiornata-surf-trend-globali-per-la-ggreen-remediation-q-e-il-risanamento-sostenibile-esperienze-da-us&option=com\\_eventlist&Itemid=245&lang=en](http://www.remtechexpo.com/index.php?view=details&id=162%3Agiornata-surf-trend-globali-per-la-ggreen-remediation-q-e-il-risanamento-sostenibile-esperienze-da-us&option=com_eventlist&Itemid=245&lang=en)

<sup>2</sup> A large number of Public and Private Sector supported decision support tools including aspects of sustainability have been produced in the USA, for example, the Sustainable Remediation Tool, SRT. [www.afcee.af.mil/resources/technologytransfer/programsandinitiatives/sustainableremediation](http://www.afcee.af.mil/resources/technologytransfer/programsandinitiatives/sustainableremediation) and tools for the Department of Defense (US) [www.ert2.org/t2grsportal.drivers.aspx](http://www.ert2.org/t2grsportal.drivers.aspx).

Name	Type, geographical coverage and dates	Key activities, outputs and web links
		remediation and reuse of contaminated sites. Relasc collaborated organizing and presenting at the 2011 ICCL meeting and sponsored the participation of key thought leaders from several member countries. <a href="http://www.relasc.org">www.relasc.org</a>
Sustainable Remediation Forum (SURF)	Largely USA based since 2006	SURF was established in 2006. They published a white paper in 2009 and a framework, a metrics toolbox and a life cycle assessment guidance paper in 2011. Their new technical initiatives include creating a White Paper on global perspectives on sustainable remediation, preparing a paper considering the integration of sustainable remediation and redevelopment, developing a sustainable remediation resource index, exploring the need for a sustainable remediation rating system and guidance on water re-use. The communications and outreach committee are looking to expand the membership and form relationships with other organisations both nationally and internationally. <i>SURF 2009, Holland et al 2011</i> <a href="http://www.sustainableremediation.org">www.sustainableremediation.org</a>
SuRF-Brazil	Brazil, informal network since 2011	The Brazilian Sustainable Remediation Forum has over 30 members from a range of sectors. It has produced a “White paper” and has had some success in persuading regional legislatures to include sustainability considerations.
SuRF-Canada	Canada, since 2011	SURF-Canada is predominantly consultants and private industry and regulators at a federal but not provincial level. It has provided input to Environment Canada and Public Works Canada on a sustainable remediation strategy to be used in the management of contaminated Federal Facilities. SURF-Canada is developing a document outlining the context of sustainability remediation across Canadian environments and how this may be encouraged within the regulatory system. <a href="http://www.surfcanda.org">www.surfcanda.org</a>
USEPA Green Remediation	US EPA led protocol to improve the wider environmental performance of remediation	EPA has a clearly stated goal to continue cleaning up sites and advancing sustainable reuse to make our communities safer and healthier. EPA recently released the environmental footprint evaluation methodology and several new green remediation fact sheets such as Mining Sites and In Situ Thermal Technologies. <i>US EPA 2008, 2012</i> <a href="http://www.clu-in.org/greenremediation">www.clu-in.org/greenremediation</a>
<b>Asia</b>		
SuRF-China		The Chinese Academy of Sciences (Laboratory of Soil Environment and Pollution Remediation - ISSAS) has plans to establish a SURF China in 2013, in collaboration with the Chinese Soil and Groundwater Remediation Network (CSGR-NET).
<b>Australia and New Zealand</b>		
SuRF-Australia and New Zealand	SURF-ANZ was formed in 2009 as SURF- Australia but recently rebranded to SURF-ANZ to include Australia and New Zealand when they became a	SURF-ANZ exists to help promote the use of sustainable practices within Australia and New Zealand, in terms of environmental, economic and social indicators, during the remediation and development of contaminated land. It is a collaborative forum of industry, regulatory, academic and consultancy members. It has published a <i>draft</i> framework document and has working groups to identify remediation planning/tools relevant to Australian and New Zealand

Name	Type, geographical coverage and dates	Key activities, outputs and web links
	formal entity in March 2012.	practice. <i>SURF-Australia et al 2009</i> <a href="http://www.surfanz.com.au">www.surfanz.com.au</a>
<b>Africa</b> - Please see ICCL entry below		
<b>International</b>		
International Committee on Contaminated Land - ICCL	Parallel international regulators network allied to the COMMON FORUM	ICCL is discussing synergies between sustainability and risk based land management. Its 2013 meeting in Durban, South Africa, hosted by the South African Department of Environmental Affairs, includes a session on “green and sustainable remediation”. <a href="http://www.iccl.ch">www.iccl.ch</a>
International Standards Association - ISO	ISO/TC 190/SC 7, which deals with soil and site assessment issues	In 2012 this subcommittee established a new working group for the preparation of a new <i>informative</i> standard “Soil quality – Guidance on sustainable remediation” <a href="http://www.iso.org/iso/home/standards_development/list_of_iso_technical_committees/iso_technical_committee.htm?commid=54408">www.iso.org/iso/home/standards_development/list_of_iso_technical_committees/iso_technical_committee.htm?commid=54408</a>

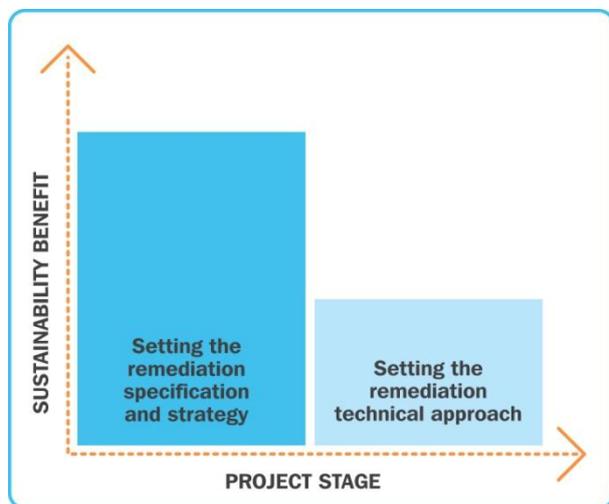
A number of underpinning principles also seem to be broadly accepted. The fundamental rationale for carrying out remediation work is to *manage risks*. If there are no risks there is no case for remediation, conversely the urgency of the need for remediation depends on the importance of the risks identified. **Sustainability cannot be used as a general excuse to avoid a necessary risk management action.** Sustainable remediation is therefore a process of finding the optimum means of managing risks. Several initiatives (e.g. SuRF-UK, NICOLE, SuRF-NL) emphasise the importance of considering sustainable remediation early in decision – making when design decisions are being made that set the boundaries for risk management. This is what SuRF-UK calls “Stage A”, as opposed to “Stage B” which is the selection of techniques or approaches best able to deliver sustainable outcomes for given risk management objectives (see Figure 1).



**Figure 1 Diagrammatic representation of the SuRF-UK Framework (CL:AIRE 2010)**

Early decision making is seen as being able to deliver substantial sustainability “gains”, see Figure 2. This pro-active approach is most clearly predicated in a brownfield regeneration situation where different development decisions have different impacts on risk management needs, and a balanced approach across the regeneration process may optimise the overall value of a project and ensure satisfactory risk management. However, early decision making is also relevant for dealing with

problems at operational sites outside of a redevelopment context, where consideration of sustainability issues in setting risk-management strategy is likely to deliver greater benefits than applying those considerations only later to performance optimisation of a selected remedial technique. There is also a general view that assessments should begin simply, and only progress to more complex assessments where a simple approach does not reveal a generally agreed outcome. Work has recently been published which benchmarks decisions in a tiered framework and supports the use of simple appraisal techniques as being robust for less complex remediation projects (Smith and Kerrison, 2013). However, there is far less consensus about what precisely “sustainability” is in the context of remediation. Indeed, most of the existing definitions focus on the process of assessing sustainability of remedial options, rather than defining a utopian end-point. Mostly “sustainable remediation” or “sustainable regeneration” is discussed as an emergent property that results from the interaction of factors related to the site, project, options available, locality and stakeholders involved in the decision making process. Given the recognition that the most sustainable remedial solution may vary between sites, there is also a general view that decision-making and assessment need to be underpinned by some key principles, such as inclusiveness and transparency in reporting. These principles are of course doubly important where the sustainability assessment is to be used to justify a particular approach to another stakeholder such as a regulator. Stakeholders are unlikely to agree to something presented as an output from a “black box” or an assessment whose basis they fundamentally disagree with.



**Figure 2, NICOLE Road Map: Illustration of sustainability gain dependent on the stage of the project at which it is introduced (NICOLE 2012)**

**Table 2: Example descriptions and definitions of sustainable remediation and sustainable brownfield regeneration (updated from Bardos *et al.* 2011 and HOMBRE 2013)**

Name	Working definition of ‘sustainable remediation’ / ‘sustainable regeneration’
<b>Europe</b>	
EC RESCUE	“Sustainable brownfield regeneration” is “the management, rehabilitation and return to beneficial use of the brownfield land resource base in such a manner as to ensure the attainment and continued satisfaction of human needs for present and future generations in environmentally non-degrading, economically viable, institutionally robust and socially acceptable ways”. This definition is being taken forward by the EU FP7 project HOMBRE ( <a href="http://www.zerobrownfields.org">www.zerobrownfields.org</a> ).
EURODEMO+	“No formal definition, but proposes that sustainability can be assessed across a range of indicators, with eco-efficiency-indicators being particularly useful.
NICOLE Sustainable Remediation Working Group	A sustainable remediation project is one that represents the best solution when considering environmental, social and economic factors – as agreed by the stakeholders”.
SAFIRA project, Germany	MMT provides software tools to support the regeneration of megasites, including option appraisal, costing, project valuation and sustainability

Name	Working definition of 'sustainable remediation' / 'sustainable regeneration'
	appraisal. This includes a module for assessing different land use options for a contaminated site regarding their "level" of contribution to a sustainable development. Its basic idea is that the abstract notion of sustainability has to be adapted to a specific local situation in order to make its meaning clear. It makes use of 15 general and normative sustainability goals developed by Bleicher and Groß 2010
SuRF-Netherlands	"Sustainable soil and subsurface quality management is the practice of demonstrating in terms of environmental, economic and social indicators, that the benefits of the preferential approach are greater than the negative consequences, and that from appraisal to execution use is made of a transparent process
SuRF-UK	The practice of demonstrating, in terms of environmental, economic and social indicators, that the benefit of undertaking remediation is greater than its impact, and that the optimum remediation solution is selected through the use of a balanced decision-making process
UK SU:BRIM Project	SUBR:IM did not develop a formal definition of sustainable regeneration, but noted the wide amount of existing guidance on "sustainability indicators". It suggested that sustainability should be assessed on a site/project specific basis by a team of the stakeholders involved for each specific brownfield.
<b>North and South America</b>	
ASTM	The goal of the standard guide is to provide useful information on selecting best management practices that substantially improve all three sustainable aspects: environmental, economic, and social within the decision making process under various clean-up programs. The Standard Guide will include sections on selecting, measuring and documenting sustainable best management practices for a clean-up. The framework is designed to balance and maximize the short and long-term environmental, economic and social goals considered under various clean-up programs to the benefit of the stakeholders, while continuing to protect human health and the environment.
ITRC	"Green and sustainable remediation" is the site-specific employment of products, processes, technologies, and procedures that mitigate contaminant risk to receptors while making decisions that are cognizant of balancing community goals, economic impacts, and environmental effects.
Sustainable Remediation Forum (SURF)	"In fulfilling our obligations to remediate sites to be protective of human health and the environment we will embrace sustainable approaches to remediation that provide a net benefit to the environment"
SuRF Canada	"...considers the environmental, social, and economic impacts of a project to ensure an optimal outcome, while being protective of human and environmental health, both at a local level and for the larger community."
USEPA Green Remediation	"Green Remediation: The practice of considering all environmental effects of remedy implementation and incorporating options to maximize net environmental benefit of clean-up actions."
<b>Australia and New Zealand</b>	
SuRF-Australia and New Zealand	"A remediation solution selected through the use of a balanced decision making process that demonstrates, in terms of environmental, economic and social indicators, that the benefit of undertaking remediation is greater than any adverse effects" <i>Draft April 2011</i>

## Mapping Green Remediation to Sustainable Remediation

As a concept, definitions of sustainable remediation *encompass* (but extend beyond) green remediation, as defined in US EPA 2008. Green remediation is intended to reduce the demand placed on the environment during clean-up actions and to conserve natural resources. Green remediation anticipates that the major decision making elements setting the boundaries for

remediation action, including economic and social considerations, have already taken place. “Green remediation focuses on the environmental footprint of Superfund response actions. The broader realm of site sustainability examines environmental issues but also includes social and economic aspects that are typically addressed by site users and local or regional communities” (US EPA 2010). Hence green remediation is about improving the delivery of the remediation solution after the point at which a remedial solution is selected. It therefore maps with what SuRF-UK describes as Stage B (see Figure 1), and extends beyond it to consider operational optimisation. There are five core elements of green remediation: energy, air and atmosphere, water, land and ecosystems, materials and waste, which, unsurprisingly given its aims, map to the environmental element of sustainable development (Bardos *et al.* 2011B), and are similar to the five overarching environmental categories identified by SuRF-UK in the UK Sustainable Remediation Framework, set out in Table 3. Hence in broad terms green remediation “maps” to the environmental element of “Stage B” sustainable remediation decision-making. There may be much debate on points of final detail, but this is useful as a “rule of thumb”.

**Table 3: Overarching SuRF-UK Sustainable Remediation Considerations**

Environment	Social	Economic
Emissions to Air	Human health & safety	Direct economic costs & benefits
Soil and ground conditions	Ethics & equity	Indirect economic costs & benefits
Groundwater & surface water	Neighbourhoods & locality	Employment & employment capital
Ecology	Communities & community involvement	Induced economic costs & benefits
Natural resources & waste	Uncertainty & evidence	Project lifespan & flexibility

## Future Direction of Travel

Two major international conference events have recently taken place:

- The 2nd International Conference on Sustainable Remediation took place November 14 – 16, 2012 in Vienna, Austria
- SURF 21 - December 12-13, 2012 - Sustainable Remediation Around the World, took place in Washington DC

In addition a programme of webinars took place on US and EU Perspectives on Green and Sustainable Remediation via [www.cluin.org](http://www.cluin.org). Both NICOLE and the COMMON FORUM networks are planning meetings considering green and sustainable remediation in 2013, it will also be a theme of the next SITEREM conference in China, and a follow up to the Vienna meeting is being planned for 2014. This is a very active area of development and a number of key debates have emerged.

Sustainable regeneration and remediation are major themes in two EU FP7 research projects, which are collaborating to provide a more transparent approach to the valuation of projects and decision making in the context of achieving sustainable development:

- Greenland – looking at (low input, low impact) “gentle remediation” - [www.greenland-project.eu](http://www.greenland-project.eu)
- HOMBRE – looking at sustainable regeneration of brownfields, [www.zerobrownfields.eu](http://www.zerobrownfields.eu)

Publications related to sustainable remediation / sustainable regeneration decision making are expected from 2013 onwards via the project web sites.

## Continuing debates

### **Risk based vs. sustainability based decision making paradigms**

There has been some debate about the interconnections between risk based and sustainability based decision making paradigms for contaminated land management. The inclusion of sustainability in risk

based land management is nothing new, for example, it was partially considered by CLARINET project which concluded in 2001 (Vegter *et al.* 2002). A concern among some regulators and practitioners has been that sustainability arguments could bias risk based decisions toward “no action” remedies, with a contrary concern being an “over-design” of resource intensive remedial solutions when they are not risk based. An emerging consensus appears to be that risk assessment remains pre-eminent in identifying when remediation is necessary at a contaminated site, and in setting the end points and management strategy for a particular land-use. The likelihood of sustainable solutions increases if a site specific approach to risk assessment and risk management is used. Simplistic site “clean-up” objectives based on comparing site investigation data with generic soil and water quality endpoint criteria tend to reduce opportunities for sustainable remediation.

### **Green Remediation context**

EPA has a clearly stated goal to continue cleaning up sites and advancing sustainable reuse to make our communities safer and healthier. The triple bottom line sustainability concept (i.e. integration of social, economic and environmental goals through a holistic approach) is woven into their existing clean-up programs. For example with regard to social concerns, the underground storage tank program, implemented by EPA and US states, has a robust public engagement process including the use of a public participation assessment. This assessment may identify the major community concerns regarding the site; the citizens, officials, and groups in the area who are especially interested in the site; and the best means to provide information to the public for the purposes of obtaining public comment and input. Threats to public health, impacts to the economy, effects on property values, and aesthetics of the clean-up are just some of the community concerns EPA and state staff evaluate as part of this process. Another example is Superfund, which has had a community involvement policy since 1981 and employs nearly 100 Community Involvement Coordinators across the 10 regional offices. In addition, Superfund provides technical assistance (grants and services) to ensure communities are independently advised on challenging technical issues. The EPA believes that while it can always improve the awareness of the “social bottom line” in their clean-ups, it has identified many tools and approaches their programs can use, and they now have a system that works. Regarding the economic “bottom line,” economic revitalization extends well beyond the Brownfield program. All EPA clean-up programs now consider revitalization and sustainable reuse as a part of regular operations and factor in reasonably anticipated future land uses into final clean-up decisions. Regarding the environmental “bottom line,” the EPA recognizes that clean-up activities use energy, water and materials resources to achieve clean-up objectives and so creates an environmental footprint of its own. The purpose of green remediation and environmental footprinting is to mitigate these impacts.

### **How do we manage subjectivity?**

Consideration of “sustainability” in remediation or regeneration reflects arrange of “value-judgements” and is therefore subjective. These choices include: which concerns to consider; for example: which criteria / indicators will be considered; their relative importance; the way in which any comparisons or measurements might be integrated; the avoidance of duplicate considerations. There is some divergence in approach and this may be a cause of confusion and controversy, and create an impression of great complexity which is off-putting to market adoption of “sustainable remediation”. Sustainable remediation / regeneration frameworks or decision support tools therefore need to be based on means of providing a systematic, transparent and recordable process of making these choices, and they need to facilitate communication and exchange information during the assessment process (e.g. between different stakeholders).

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