NanoRem Case Study Sustainability Assessment: Extended Summary – Questions and Answers

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Executive Summary

This document provides an overview of the report “NanoRem Case Study Sustainability Assessment Background and Workbook”. The full report has two broad purposes: to provide a background and NanoRem context for sustainable remediation and to provide a procedure to carry out a qualitative sustainability assessment of the nanoremediation technologies to be used at the field test sites.

This extended summary is intended to be used by the field test teams and associated stakeholder groups as an aid to understanding the background to and procedures developed for carrying out a qualitative sustainability assessment. It is presented as a series of key questions and answers relating to the NanoRem approach to sustainability assessment with relevant sections of the full report cited in the answers. Flow charts are included to help visualise the assessment process.

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1 Introduction and Aim

NanoRem (*Taking Nanotechnological Remediation Processes from Lab Scale to End User Applications for the Restoration of a Clean Environment*) is a research project, funded through the European Commission's Framework 7 research programme. NanoRem focuses on facilitating practical, safe, economic and exploitable nanotechnology for *in situ* remediation. This is being undertaken in parallel with developing a comprehensive understanding of the environmental risk-benefit for the use of nanoparticles (NPs), market demand, overall sustainability, and stakeholder perceptions.

NanoRem has set itself the goal of achieving a step change in the development and use of nanoremediation technology in Europe. To reach this goal depends not only on the creation of new research information, but also on the transfer of information to remediation practitioners and encouraging their use of that information. Its strategy to achieve this aim depends on three strands working together in an integrated way:

1. Providing evidence that addresses crucial gaps in knowledge about nanoparticles and their properties (in particular related to fate, transport and ecological impacts): observations of the behaviour of nanoparticles in-ground during practical trials; and well documented and independently scrutinised case studies of field scale deployments.
2. Ensuring the quality of this evidence, and ensuring that any applications in the field are seen as robust tests, both in the national jurisdiction where they are taking place and at a European level. This will be achieved by:
    - Subjecting evidence to review and scrutiny by an independent project advisory board and the various European stakeholder networks involved with contaminated land management
    - Providing transparent approaches to the assessment of deployment risks in NanoRem case studies that are firmly supported by existing evidence and can be broadly regarded as best available practice for decision making on a pan-European basis (and not just the national jurisdiction of where a trial takes place)
    - Providing at least a qualitative understanding of the life cycle impacts of the production of NPs used in NanoRem case studies *and a qualitative sustainability assessment of the nanoremediation used, benchmarked against at least one possible alternative remediation strategy*.
3. Communicating the evidence and developing shared conclusions.

A workbook has been produced under Work Package 8 that addresses the task to provide *a qualitative sustainability assessment of the nanoremediation used benchmarked against at least one possible alternative remediation strategy*. The goal of the workbook is to provide a basis for assessing the sustainability of nanoremediation at selected field test sites.

This document provides an overview of the report "NanoRem Case Study Sustainability Assessment Background and Workbook". The full report has two broad purposes: to provide a background and NanoRem context for sustainable remediation and to provide a procedure to carry out a qualitative sustainability assessment of the nanoremediation technologies to be used at the field tests.

This extended summary is intended to be used by the field test site teams and associated stakeholder groups as an aid to understanding the background to and procedures developed for carrying out a qualitative sustainability assessment. It is presented as a series of key questions and answers relating to the NanoRem approach to sustainability assessment with relevant sections of the full report cited in the answers. Flow charts are included to help visualise the assessment process.

2 Background Questions

Why is sustainability assessment being carried out for field test sites?

In the past decade or so, a risk-based approach to the management of historically contaminated land has developed, based on the prevention of unacceptable risks to human health and the environment, to ensure a site is 'fit for use'. More recently, interest has been shown in integrating sustainability as a decision-making criterion; to select a remediation approach that achieves a balanced net benefit when considering wider environmental, economic and social impacts. Sustainable remediation has become an area of intense development across the world, with public and private sector organisations involved in a number of projects and networks intended to improve remediation practice and make it more sustainable. Indeed, NICOLE[1] and the COMMON FORUM[2] published a joint position statement on "Risk-informed and Sustainable Remediation" in 2013 to promote the integration of risk-based and sustainable land management across Europe.

The findings of the sustainability assessments being carried out for the field tests will form a unique resource that can benefit any technology providers, site owners, regulators and consultants who are involved in future nanoremediation projects by informing them of the potential benefits and challenges associated with the application of this technology. NanoRem also provides an opportunity to apply the work produced by key networks in Europe to the sustainability assessment of such an emerging technology.

See Section 1 of "NanoRem Case Study Sustainability Assessment Background and Workbook"

Has the NanoRem workbook been based on existing, peer-reviewed work?

The NanoRem workbook is based on recognised good practice from European and UK networks:

- NICOLE published a 4-page "roadmap" to sustainable remediation in 2011 to promote the incorporation of sustainability assessment into risk-based land management (available from www.nicole.org),
- SuRF-UK[3] published a framework for assessing the sustainability of soil and groundwater remediation. This framework is supported by further guidance, including supporting information on project framing and carrying out a qualitative sustainability assessment, (available from www.claire.co.uk/surfuk).

The frameworks are intended to be applied alongside the risk-based land management approach that is adopted throughout Europe.

NanoRem will use the NICOLE description of sustainable remediation and will apply the SuRF UK methodology for sustainability assessment.

See Sections 2.1 to 2.3 of "NanoRem Case Study Sustainability Assessment Background and Workbook"

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[1] NICOLE is a leading forum on contaminated land management in Europe, promoting co-operation between industry, academia and service providers on the development and application of sustainable technologies.

[2] The COMMON FORUM on Contaminated Land is a network of contaminated land policy makers, regulators and technical advisors from Environment Authorities in European Union member states and European Free Trade Association countries.

[3] SuRF-UK is the UK Sustainable Remediation Forum; a collaboration of industry, regulators, academics and consultants established in 2007 to promote sustainable remediation assessment in the UK.

3 NanoRem Workbook Questions

What is involved in a sustainability assessment?

Using the NanoRem workbook, the procedure involves three stages:

1. *Preparation* - agreeing in advance how the sustainability assessment will be reported; who will be involved, and how communication will take place with other stakeholders.
2. *Definition* - providing a clearly defined assessment procedure, considering: objectives, boundaries, scope, method and uncertainty.
3. *Execution* - carrying out the assessment procedure defined with an appropriate level of dialogue and ensuring that the procedure, its findings and its underlying assumptions are clearly communicated to all relevant parties.

The three stages are illustrated in Figure 1.

As the decision to deploy nanoremediation has already been made at the NanoRem field test sites, the sustainability assessment being carried out is retrospective in nature. However, it is still considered a valuable exercise to document the views of key stakeholders involved in negotiating the NanoRem field tests on wider social, economic and environmental issues associated with deployment at the site.

See Section 3 of "NanoRem Case Study Sustainability Assessment Background and Workbook"

Who is involved in the assessment and what are their roles?

A number of key players will be involved in the assessment process. These players and their roles are discussed below:

Lead assessor: the lead assessor will be a NanoRem project partner, typically the consultant or contractor involved in the design of the field test. This person will have significant knowledge of the site and the project, and with the decision-making process that has led to nanoremediation being proposed for the field test. The lead assessor will carry out the initial project framing (preparation and definition) with the support of other NanoRem field test participants and an independent assessor. The lead assessor will also ensure that stakeholders are identified and engaged throughout the process, but in particular during its execution.

Independent assessor: an independent assessor will be nominated from either r^3 environmental technology or CL:AIRE – both NanoRem partners involved in delivery of this work package. The role of the independent assessor may vary from site to site, but can offer:

- Provision of the Workbook and associated documents and templates to the lead assessor
- Initial briefing on the NanoRem sustainability assessment procedure (e.g. using web-based technologies)
- Support on preparation and definition to the lead assessor
- Attendance at the execution of the sustainability assessment, to answer any queries arising
- Support on reporting the sustainability assessment outcomes.

In addition to site-specific support, the independent assessor will also take a view across all of the field test sustainability assessments to report on any common sustainability issues and themes, as well as points of difference that might be useful in a general sense for the future use of nanoremediation.

Other stakeholders: the stakeholder group may vary from site to site, depending on project circumstances, in particular the parties involved in or affected by the decision. A core stakeholder group will include the problem holder, service provider and regulator (environmental and planning). Other stakeholders to consider include:

- Site users (e.g. workers and visitors)
- Site neighbours (e.g. local communities, adjacent owners)
- Those with financial interests (e.g. bankers, insurers)
- Others (e.g. non-government organisations, local interest groups).

The stakeholder's role is to be actively involved in the decision-making process at as early a stage as possible, but in particular during execution of the NanoRem sustainability assessment.

See Section 2.4 of "NanoRem Case Study Sustainability Assessment Background and Workbook"

Why is it necessary to involve other stakeholders?

One of the key principles associated with sustainable remediation is that "remediation decisions should be made having regard to the views of stakeholders and following a clear process within which they may participate". Stakeholders may benefit from or be impacted by a remediation project and opinions may therefore be variable. A balanced decision may not be reached if the outcome is skewed by the selection of like-minded stakeholders.

As sustainability assessment is a subjective process it is desirable that the views and opinions of other stakeholders with an interest or influence in the site and/or the project can be captured and reflected in the assessment outcomes. In the absence of objective assessment, establishing such a wider, balanced opinion across a range of views is an important part of the process for achieving a reliable outcome.

See Section 4 of "NanoRem Case Study Sustainability Assessment Background and Workbook"

What criteria is nanoremediation being assessed against?

The NanoRem sustainability assessments will be assessed against the indicator sets developed to support the SuRF-UK framework. Five overarching indicators are identified for each of environment, economic and social "pillars" or "elements" of sustainability.

See Table 2 of "NanoRem Case Study Sustainability Assessment Background and Workbook"

What other approaches/technologies is nanoremediation being compared to?

Given the subjectivity of a qualitative sustainability assessment it is proposed to compare the nanoremediation technology used at a field test site against a "no intervention" scenario. In addition, at least one remediation alternative will be evaluated. This alternative will be selected by the local field test team, either as being a feasible treatment alternative or one that has previously been used at the site.

4 The Sustainability Assessment Procedure Questions

What does project preparation involve?

Adequate planning and preparation are needed to provide a clear specification for the sustainability assessment to be undertaken. There are a number of steps to be completed to successfully plan for the assessment, namely:

- To describe the decision requirement (why is assessment being carried out, involved parties, communication)
- To describe the project (project objectives, remediation options being compared)
- To describe the constraints (site-specific, e.g. time or budget limits, regulation/compliance, physical constraints)
- To consider the reporting requirements (planning and reporting, who to involve and when, resolving conflicts, reporting template).

See Section 5.1 of "NanoRem Case Study Sustainability Assessment Background and Workbook"

What does project definition involve?

The project definition aims to reach a clear definition of the sustainability assessment approach that is to be undertaken and transparently reported and communicated to all relevant parties. This will reduce the potential for disagreement at the end of the assessment, or at least document where disagreements could not be resolved. It uses the outputs of the preparation stage as a starting point and includes five steps dealing with:

- Objectives (objectives of the sustainability assessment)
- Boundaries (describe spatial, temporal and system boundaries within which the assessment is to be carried out)
- Scope (identify specific factors, e.g. indicators, criteria for inclusion/exclusion and level of detail of the assessment)
- Methodology (agree, with participants, the method used to compare options and how the assessment will be presented)
- Reviewing uncertainties (agree approach for addressing uncertainty and assessing their potential effect on outcomes).

See Section 5.2 of "NanoRem Case Study Sustainability Assessment Background and Workbook"

How will the sustainability assessment be implemented?

The sustainability assessment will be implemented following the approach that has been defined and agreed by the participants. The key steps in this are:

- Carrying out comparisons across options for each individual sustainability criterion
- Aggregating these individual assessments into an overall assessment of sustainability
- Interpreting the aggregated assessment
- Appraisal of any uncertainties
- Concluding the findings of the sustainability assessment.

It is based on simple tables using qualitative categories, such as "good" or "neutral" or "better", or simple rankings, such as the example in Figure 2.

See Section 5.3 of "NanoRem Case Study Sustainability Assessment Background and Workbook"

Figures

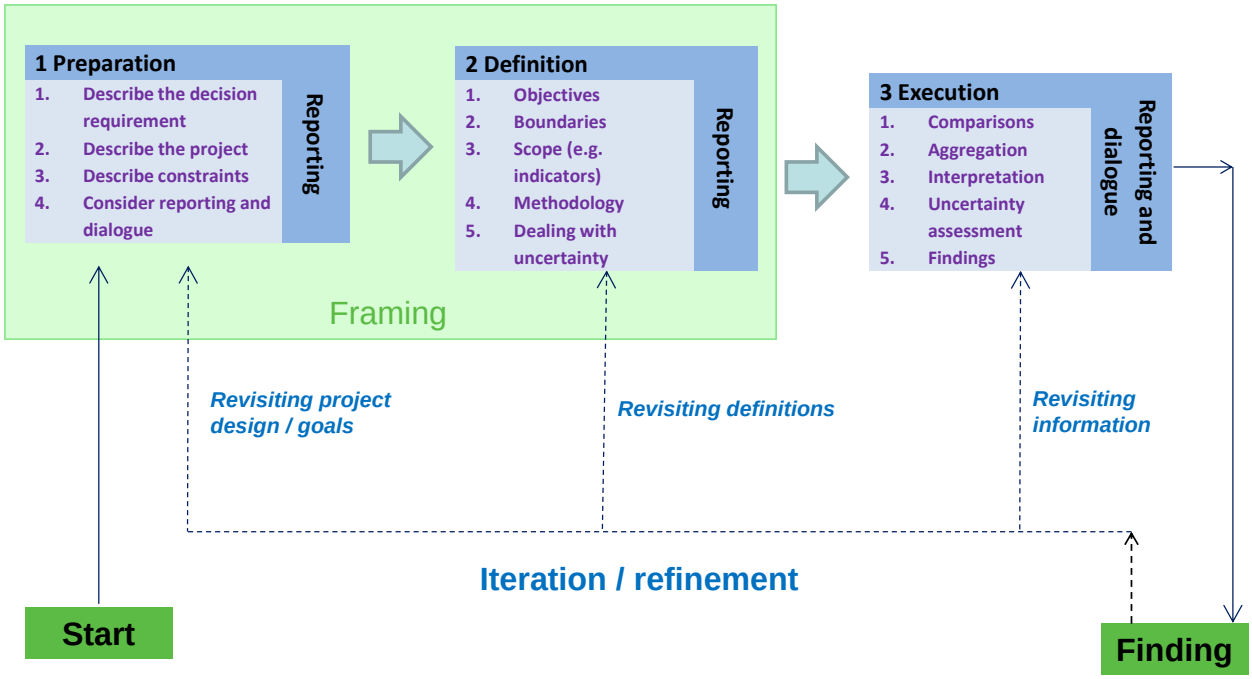

Figure 1 NanoRem Approach to Sustainability Assessment (from SuRF-UK)

Environment	Option 1	Option 2
Emissions to Air	Good	Fair
Soil and ground conditions	Very good	Fair
Groundwater & surface water	Very good	Good
Ecology	Good	Poor
Natural resources & waste	Fair	Excellent

Figure 2 Example qualitative sustainability assessment reporting table for a simple comparison (from SuRF-UK)