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Supplementary Report 2 of the SuRF-UK Framework: Selection of Indicators/Criteria for Use in Sustainability Assessment for Achieving Sustainable Remediation

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CL:AIRE

Supplementary Report 2 of the SuRF-UK Framework: Selection of indicators/criteria for use in sustainability assessment for achieving sustainable remediation

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- Paul Bardos – r3 Environmental Technology Ltd (Joint Chair)
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Disclaimer

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1.1	21 May 2021	Changes to Appendix 1 Indicators Spreadsheet ENV1A – Links have been added to UN Sustainable Development Goal 13 and target 13.1

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1. Introduction

The United Kingdom's Sustainable Remediation Forum (SuRF-UK) was established in 2007 to develop a sustainable remediation framework. The SuRF-UK *Framework for Assessing the Sustainability of Soil and Groundwater Remediation* (CL:AIRE, 2010) helps assessors include sustainable development considerations into land remediation decisions.

Further work has been published by CL:AIRE and is freely available through the SuRF-UK Roadmap: https://www.claire.co.uk/surf-uk. This body of work includes the world's first (and so far only) guidance on identifying indicators for the assessment of sustainable remediation: *Framework for Assessing the Sustainability of Soil and Groundwater Remediation, Annex 1: The SuRF-UK Indicator Set for Sustainable Remediation Assessment* (CL:AIRE, 2011).

What is an indicator/criterion/metric?

An *indicator* is a single characteristic that represents a sustainability effect which can be compared across options to evaluate their relative performance. Hence, indicators need to be measurable or comparable in some way that is sufficient to allow this evaluation, for example amount of recycled soil. An indicator which is measurable might also be called a *metric*, for example, tonnage of recycled soil. (From Network for Industrially Contaminated Land in Europe (NICOLE) 'Road Map for Sustainable Remediation', www.nicole.org).

When an indicator is a basis for comparison to support a decision, then it becomes a *criterion*.

Since their publication these indicators have been used widely, both in the UK and internationally (Bardos *et al*., 2018). Subsequently an ISO Standard 18504:2017 on *Soil Quality - Sustainable Remediation* (ISO, 2017) was published in 2017, which drew heavily on the work of SuRF-UK. With the benefits of nearly ten years' experience implementing the Framework, the SuRF-UK Steering Group considered it was timely to review and refine the "Annex 1" indicator guidance, as well as more clearly describe the process of indicator selection and how it fits into sustainable remediation assessments.

This report is *Supplementary Report 2* of the SuRF-UK Framework. It describes in detail the nature and rationale for 15 SuRF-UK headline indicator categories (see Table 1.1 below), and an approach to indicator selection and use. This is supported by a checklist of possible individual indicators/criteria provided as an appendix. *Supplementary Report 2* replaces the 2011 SuRF-UK Framework Annex 1, which is now withdrawn.

Accompanying this report is *Supplementary Report 1 of the SuRF-UK Framework: A general approach to sustainability assessment for use in achieving sustainable remediation*. It describes a general approach to sustainability assessment that consolidates a range of guidance issued by SuRF-UK since 2011. It provides guidance on how to carry out SuRF-UK sustainability assessments for remediation design and strategy setting and remediation technology selection.

Table 1.1. SuRF-UK headline categories for sustainability indicators.

Environmental	Economic	Social
ENV1: Emissions to air	ECON1: Direct economic costs and benefits	SOC1: Human health and safety
ENV2: Soil and ground conditions	ECON2: Indirect economic costs and benefits	SOC2: Ethics and equity
ENV3: Groundwater and surface water	ECON3: Employment and employment capital	SOC3: Neighbourhoods and locality
ENV4: Ecology	ECON4: Induced economic costs and benefits	SOC4: Communities and community involvement
ENV5: Natural resources and waste	ECON5: Project lifespan and flexibility	SOC5: Uncertainty and evidence

2. Objectives of this document

SuRF-UK defines sustainable remediation as *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* (CL:AIRE, 2010), in line with ISO 18504:2017.

The objective of this report is to explain the nature of the 15 overarching categories of indicators (headlines) that SuRF-UK has set out to support wide ranging and holistic consideration of sustainability, to provide a process for indicator selection and to support comparisons with lines of evidence. It provides a checklist of possible individual sustainability considerations, some direction on lines of evidence for them and a suggested mapping to the UN Sustainable Development Goals (UN, 2015). Its purpose is to facilitate an equitable, transparent and appropriate setting of the scope of sustainability assessments during their framing (definition).

Sustainability assessment broadens out the factors to be considered in remediation decision-making to optimise the functionality and improve the value of the work being carried out. However, sustainability assessment does not replace the underpinning role of risk assessment in contaminated land remediation decisions. This is one of a series of key principles that are the foundation of the 2010 SuRF-UK Sustainable Remediation Framework, which are reproduced in Box 2.1, below. The context for the use of sustainability assessment in remediation decisions is explained in detail in *Supplementary Report 1.*

Sustainability assessment is a part of options appraisal, either when a project that might involve remediation is being planned, and/or for selection of remediation actions. It is a parallel assessment to technical option appraisal. Needless to say sustainability assessment of an option that is not effective, practical nor technically feasible is superfluous.

Box 2.1: Key principles of sustainable remediation (from CL:AIRE, 2010).

Principle 1: Protection of human health and the wider environment. Remediation [site-specific risk management] should remove unacceptable risks to human health and protect the wider environment now and in the future for the agreed land-use, and give due consideration to the costs, benefits, effectiveness, durability and technical feasibility of available options.

Principle 2: Safe working practices. Remediation works should be safe for all workers and for local communities, and should minimise impacts on the environment.

Principle 3: Consistent, clear and reproducible evidence-based decision-making. Sustainable risk-based remediation decisions are made having regard to environmental, social and economic factors, and consider both current and likely future implications. Such sustainable and risk-based remediation solutions maximise the potential benefits achieved. Where benefits and impacts are aggregated or traded in some way this process should be explained and a clear rationale provided.

Principle 4: Record keeping and transparent reporting. Remediation decisions, including the assumptions and supporting data used to reach them, should be documented in a clear and easily understood format in order to demonstrate to interested parties that a sustainable (or otherwise) solution has been adopted.

Principle 5: Good governance and stakeholder involvement. Remediation decisions should be made having regard to the views of stakeholders and following a clear process within which they can participate.

Principle 6: Sound science. Decisions should be made on the basis of sound science, relevant and accurate data, and clearly explained assumptions, uncertainties and professional judgment. This will ensure that decisions are based upon the best available information and are justifiable and reproducible.

3. Functionality of sustainability indicators/criteria

The selection of sustainability indicators is a part of the definition of a sustainability assessment, setting out the range of considerations that are to be considered as a part of "sustainability". Within SuRF-UK's approach to the framing of sustainability assessment this setting of scope is done under Definition Step 2.3 (see *Supplementary Report 1*).

SuRF-UK has developed a checklist of indicators to provide a consistent and transparent basis for this process. Using this guidance has a number of benefits:

- Supporting users in taking a wide view of sustainability.
- Assisting stakeholders in agreeing the sustainability criteria of most interest for a particular context, and ensuring all stakeholders approach this selection from the same starting point.
- Improving the reproducibility of sustainability assessment.

The SuRF-UK indicator checklist is intended to guide users in determining the *scope* of their sustainability assessment, i.e. the range of individual considerations (indicators, criteria) they will apply in the assessment.

SuRF-UK's checklist is divided into 15 headline categories, evenly distributed across the three elements of sustainability, as set out in Table 1.1. The same headline categories have been retained from 2011 to ensure continuity of function and purpose. Each category includes multiple individual possible considerations. Those that are relevant will vary from site to site, project to project.

The primary function of the SuRF-UK sustainability assessment is for the comparison of options, including benchmarking a single option against a "no intervention" strategy. However, there are other potential benefits (see *Supplementary Report 1*):

1. Understanding what wider impacts are occurring to identify possible mitigations to both improve project benefits and reduce possible project risks.
2. Identifying broad opportunities for project gain, potentially occurring for all remediation options, that might be relevant for stakeholders to consider. For example, the potential removal of wider risks from sites such as fire or windblown litter, as well as removal of any antisocial uses of the site (listed under SOC3).

If these are seen as useful additional benefits it may be worth considering indicators that are seen as either signifying project risks, or general project sustainability gains, even if the options being compared are "tied", i.e. similar, for the criterion being compared (see Chapter 5).

The SuRF-UK Framework (CL:AIRE, 2010) describes two points in decision-making at which sustainable remediation considerations may be influential (see Figure 3.1):

- At a project/land use planning stage, when remediation outcomes might be used to influence the pattern of use for a site, for example, siting of building plots and car parks and landscaping, which in turn defines the likely risk management outcomes required ("**Stage A**"); and

- At a treatment specification stage, when remediation objectives have been determined and the decision is based on optimising the remediation route by which these agreed objectives will be delivered ("**Stage B**").

Typically, while it is possible to consider remediation sustainability at Stage A for some sites, there will be a number of projects where remediation objectives are already agreed (and hence not easily changed) so consideration will start at "Stage B".

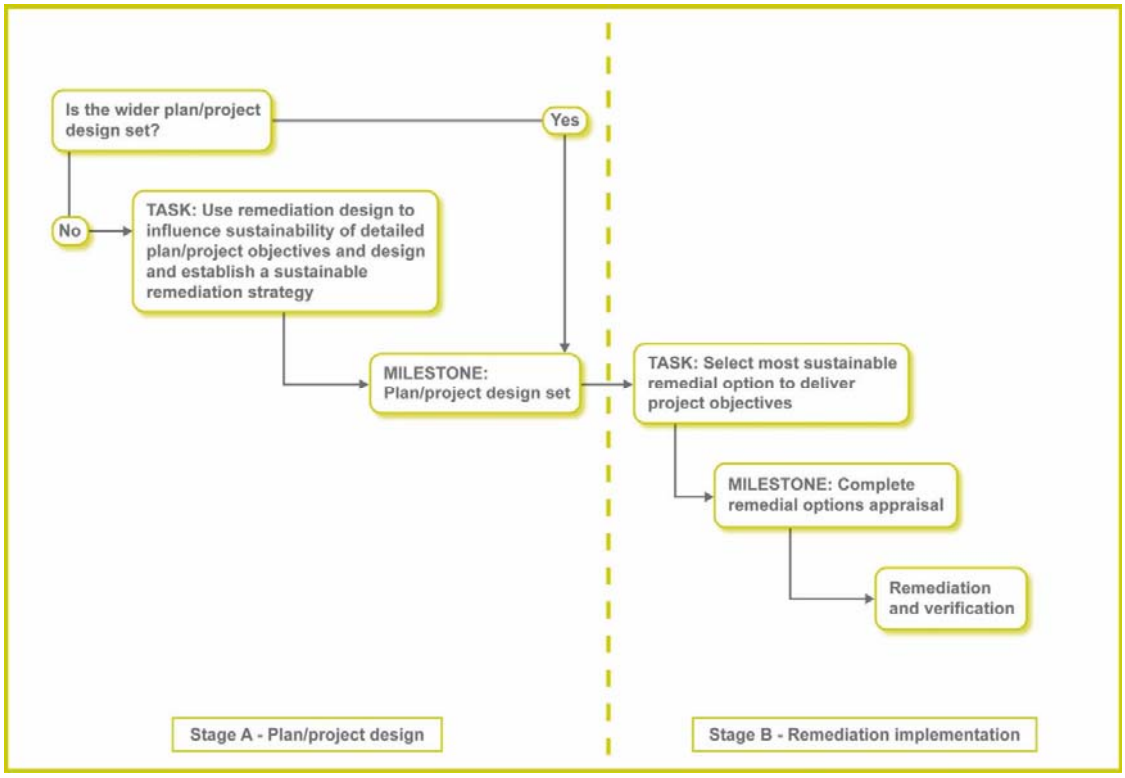

Figure 3.1. Overall schematic of the SuRF-UK Framework (CL:AIRE, 2010).

The relevance of some of the indicators suggested in the checklist may be much stronger at Stage A than Stage B, and vice versa. The key point is that indicators have to be meaningful for the decision being made and the options being compared.

4. The rationale for the 15 SuRF-UK headline categories

Tables 4.1, 4.2 and 4.3 set out the rationale and content of the SuRF-UK headline categories for the environmental, economic and social elements of sustainability. It is worth considering this underpinning information in detail before deciding on whether or not to include a particular consideration or set of considerations into a remediation sustainability assessment. Connections may not always be obvious from the headline category titles, and some considerations may be more important to some stakeholders than others. However, taking an inclusive approach to setting the scope of a sustainability assessment is likely to lead to smoother dialogue, a better supported outcome and ultimately a more robust assessment. The citations and evidence base for these three tables will be published in due course (Bardos *et al*., under review).

Table 4.1. Description of the environmental SuRF-UK indicator headline categories.

Headline Category	Description
ENV1: Emissions to air	This category encompasses: greenhouse gas (GHG) emissions; emissions that contribute to acid rain (e.g. SOx); emissions of ozone depleting substances; ammonia, and emissions that affect ground-level air quality (e.g. NOx, ground level particulates, ozone, volatile organic compounds (VOCs)). • GHG emissions from remediation are now widely considered in remedy selection, and include carbon dioxide, methane, water vapour, nitrous oxide and ozone. Calculations may also take into account emissions embedded in the manufacture and use of materials in remediation as well as the operations, depending on the system boundaries defined for the assessment. Positive impacts are also possible for some remediation options, for example, as a result of carbon sequestration or production of renewables/recyclates. • Where combustion processes take place, including from vehicle engines and generators, the possibility exists for the emission of sulphur and nitrogen oxides as exhaust gases. • Emission of ozone depleting compounds may occur via fugitive emissions of some types of VOCs. • Ammonia may also be a possible emission of concern, for example from biopiles in the vicinity of naturally low nitrogen (oligotrophic) habitats. • Fugitive emissions from processes such as particulates (including bioaerosols), ozone (e.g. from some forms of *in situ* chemical oxidation systems), exhaust gases and VOCs are also legitimate considerations Where remediation ground-level process emissions to air have a particular impact on local communities they should additionally be considered under *SOC3: Neighbourhoods and locality*. In addition where emissions might have an immediate impact on health and safety, such as ground gas generation or emissions of bioaerosols, this may also be considered under *SOC1: Human health and safety*. In many cases mitigation strategies may improve technical performance.
ENV2: Soil and ground conditions	There may be positive and negative secondary impacts on soil and/or geotechnical functionality.

Headline Category	Description
	• Soil functionality will be particularly important for areas which are to be gardens, landscaped or other unsealed areas (agricultural, horticultural, forest, natural areas). However, soil also delivers a range of important ecosystem services, for example, as a carbon sink or water purification, which may still be important even in areas where the soil is partially sealed. • Remediation works can also affect the geotechnical performance of soils, positively for instance via solidification as part of a development platform or potentially negatively for example via the impacts of surfactants. Geotechnical performance will be particularly important where built or infrastructure construction is envisaged, but possibly also important in areas where there is no built construction such as for urban greenspace, for example, in terms of ground stability, and also where waste deposits such as former landfill or mining or processing deposits need to be retained. • It is also important to consider the downstream impact of soil (and similar materials) changes as a result of remediation, for example, on percolating/runoff water which will reach ground or surface water bodies. • Some sites may have specific features of ecological or geological interest related to the soil conditions, which may have a protected status.
ENV3: Groundwater and surface water	Remediation processes affect water, both via deliberate manipulation to affect remediation goals, and indirectly via emissions from site management, for example, from leaching of surface deposits, such as biopiles, undergoing treatment. A range of wider impacts may occur that can affect surface or groundwater quality, and in coastal areas on sea water and the wider marine environment. • Potentially negative secondary impacts include changes in chemistry, such as pH, redox conditions, iron concentrations, contaminants, breaching aquitards, nutrients and emission of unused reagents, and impacts on groundwater resources including consumption of freshwater by discharging pumped groundwater from a 'Pump & Treat' system to waste. • Other secondary impacts include changes in the hydrological regime and changes in aquifer hydrogeological conditions, and also changes in the availability of water as a resource. Changes may be temporary or permanent. • Improvement/protection of water resources may be a primary aim of the remediation. While this is one of the project's risk drivers, it is also a sustainability benefit. For the purposes of sustainability assessments for remediation, consideration should be given to the level of protection / improvement achieved, i.e. the degree of improvement/protection over and above the required functionality of the risk-based remediation. Aspects specifically related to protection of human health should be considered under *SOC1: Human health and safety*, and aspects related to improved amenity, for example, of surface water, could be considered under *ECON2: Indirect economic costs and benefits* and *SOC4: Communities and community involvement*, or if a specific project goal under *ECON1: Direct economic costs and benefits*.
ENV4: Ecology	In some cases the primary driver for the remediation work may be ecological protection, which in the UK would be where remediation has been triggered by an impact on a protected site that is seen as carrying a "significant possibility of significant harm". In this case ecological protection thresholds will likely define primary objectives. However, different options may vary in the degree of protection a remediation option offers over and

Headline Category	Description
	above these primary objectives, and the thresholds themselves may not cover the full range of ecological considerations covered by this headline. Moreover, even where ecological considerations are not a primary driver for the remediation project, the deployment of remediation may have positive and/or negative ecological impacts. This category picks up these wider ecological impacts, not already considered under ENV2 (soil) and ENV3 (water), on fauna, flora and habitats. • A particular focus may be on protected areas, for example (in the UK) areas such as Special Areas of Conservation (SACs), Special Protection Areas (SPAs) or Sites of Special Scientific Interest (SSSI), and also protected species such as bats, rare orchids, Biodiversity Action Plan (BAP) species, and European protected species. • Consideration should also be given to impacts on food chains or migratory behaviours that may be a consequence of land contamination and how it is managed. • There may be operational consequences of works that lead to sources of disturbance (e.g. light, noise and vibration). • It may be appropriate to consider ecosystem services and/or natural capital impacts in a more formal way (EC, 2019; Natural Capital Coalition, 2020), and for some projects positive impacts may be a significant part of the value added for a brownfield/remediation project, for example functionality as green infrastructure. • Alien (non-native invasive) species may be present on many sites, and some types of remediation work may be more prone to causing their spread off site, in particular Japanese Knotweed. Possibly linked to *ECON2: Indirect economic costs and benefits* and *SOC4: Communities and community involvement* if there are consequent amenity benefits.
ENV5: Natural resources and waste	"Natural resources and waste" consider the resource and energy intensity of remedial options, in particular where these are supplied from non-renewable sources or fossil carbon energy. Resource and energy use lead to GHG emissions (ENV1), but ENV5 is concerned with making effective use of resources and energy, which is a separate issue linked to supply and scarcity concerns. Consideration should also be given to legacy impacts for materials which cannot be recycled and become wastes, for example untreated residues from soil washing, taking into account not just excavated materials, but also spent treatment agents and outputs. There are also opportunities within remediation and restoration work to improve the recycling of wastes, for example, making use of composts; to generate recyclates (e.g. re-using excavated materials); or to generate renewable materials such as secondary aggregates. Choices in remediation approach and/or the plan for the re-use of a site (e.g. location of buildings, car parks, gardens etc) can have a major effect on these opportunities to support recycling or create renewables. Choices over the use of locally provided recyclates, repurposing materials on site, or supplying excavated recyclates to off-site redevelopment projects can also have consequential impacts on emissions to air (ENV1) and neighbourhoods (SOC3). Landscape can also be thought of as a resource, particularly for longer term brownfield management/remediation projects. Impacts may be of blight or enhancement, and very much related to the perceptions of local people. Landscape impact may need to be further considered under *ECON1: Direct economic costs and benefits*, *ECON2: Indirect economic*

Headline Category	Description
	costs and benefits and/or *SOC4: Communities and community involvement*, where impacts may be negative (such as impacts in sight lines from existing visitor attractions) or positive (such as perceived landscape improvement which raises development site value or improves local property values in the surroundings). Water is also an important resource, so water usage if not already considered as a part of ENV3, should be considered under ENV5, for instance the relative water demand intensity of different remediation options.

Table 4.2. Description of the economic SuRF-UK indicator headline categories.

Headline Category	Description
ECON1: Direct economic costs and benefits	This category aligns with typical costs benefit assessment for a remediation project, taken from a narrow financial returns perspective, where the costs of the remediation deployment for each option are compared with the value of benefit, such as mitigation of liabilities by the risk management achieved, redevelopment potential released *for the site*, land value enhancement *for the site*. It considers the relative performance of different remedial/management options in terms of their direct costs, increase in the site's value, revenues and capital gains outcomes; and consequences for liability discharge and/or ease of divestment, merger or acquisition. Significant uncertainties exist in the prediction of some of these costs.
ECON2: Indirect economic costs and benefits	This category picks up other tangible costs and benefits. These may be internal to the site owner, such as the impacts of remediation costs on debt financing and its ability to allocate resources to its other interests. Other concerns might relate to reputational or brand value. There may also be more widely shared effects outside the site. Benefits may accrue to the wider area around the site, for example uplift in *surrounding* property values. There are a number of reports that property prices (e.g. for homes) tend to be depressed around contaminated sites/brownfield, although this impact may be quite localised. Remediation of contamination/rehabilitation of brownfield can result in a significant uplift in surrounding property values, or easing of property sales, for instance from the removal of blight or restoration of a brownfield to a "destination". Remediation options may vary in their impact on uplift depending on, for example, how permanent they are perceived to be and what impact they might have on appearance, functionality and landscape. However, property values are affected by a wide range of factors, such as local amenities and distance to urban centres, so a cautious approach to considering uplift is needed. There have also been some reports on improvement in local enterprise as a result of brownfield regeneration and improvement in local tax raising. Costs to a wider area might accrue, for example, from disruption to services, customer footfall or normal patterns of use of the neighbourhood, either during remediation implementation when it may be transient or as a direct consequence of the remediation strategy which may result in a change of end use.

Headline Category	Description
ECON3: Employment and employment capital	Remediation, and particularly where it facilitates brownfield regeneration, can have a marked (typically beneficial) impact on local employment and employment capital. SuRF-UK uses "employment capital" to describe the skills and employability of individuals and the workforce as a whole, as well as opportunities for training. Job creation can be a major driver for many brownfield projects, and may also be associated with significant gains in employment capital as a result of upskilling and providing a wider range of employment opportunities. Different approaches to brownfield restoration may have differing benefits and this may impact option appraisal at "Stage A" (see Figure 3.1). Brownfield re-use strategies may also deliberately target creating sheltered employment to support vulnerable or disadvantaged groups. Restored brownfield sites can also be important opportunities for the development of skills and wider public education. Job creation and skills development can be a particular benefit in emerging economies.
ECON4: Induced economic costs and benefits	Remediation of a site may trigger specific wider investments or developments in an area which were not part of the original project, and not foreseen in the original remediation investment. These may include the treatment of other contaminated land or water in the area. The attraction of new investment and new businesses to an area may be a deliberate strategy for a brownfield restoration initiative, to create new economic clusters. At Stage A different remedial approaches may support different opportunities for the overall functionality of a brownfield undergoing restoration, and hence its economic value. There may also be wider economic gains related to the choice of remediation technology made. In some cases, projects may be the first implementation of a particular remedial approach, or an early adopter, and so bring forward significant innovation, skill and know-how benefits. For both Stage A and Stage B remediation options may differ in the likely project benefit in terms of development of track record, know-how and support for market penetration (by being an early adoption example), which may benefit service providers. These may be significant economic benefits for service providers, and conceivably for Society as a whole if technologies are promoted whose wider replication would offer significant potential benefits in performance, cost and sustainability.
ECON5: Project lifespan and flexibility	The project lifespan describes the period of time over which risk management is likely to be effective, for example, containment solutions will inevitably need to be effective and durable over a long duration, perhaps in the order of decades, whereas solutions that destroy contaminants are essentially immediate. Remedial options will also differ in their requirement for ongoing institutional controls for the site or a water source, for example in terms of the monitoring needed for their verification and the time over which this needs to take place; but also in restrictions on use, for example limitations on the use of groundwater as potable water. In some jurisdictions it may be necessary to consider the long-term effectiveness of institutional controls if these are required by particular remedial options. Related to lifespan is understanding the duration of the remediation works before the site is returned to beneficial use. Some *in situ* treatments may have fairly long operating periods before remediation targets are reached. However, sites can be returned to use with remediation ongoing, for example *in situ* groundwater treatment, as well as longer term management options such as phytoremediation. Hence, while the time to completion of

Headline Category	Description
	remediation may vary between options, the impact of this may also be mitigated depending on the overall project design. Flexibility and resilience describe the ability of a remedial option to cope with changing conditions, and are particularly important for longer term solutions based on containment or institutional control. These are increasingly important considerations, especially given the potential long-term impacts of climate change on remediation measures, such as containment or natural attenuation as water regimes change. However, flexibility may also be a highly pragmatic strategy for sites where information on the location and nature of contamination is limited because of constraints on the site investigation. Flexibility and resilience also describe the ability of a remedial option to cope with changing economic conditions and circumstances (e.g. if the site owner decides to close and divest the site or changes in the economic conditions of a site operator). Passive systems, and systems with low-maintenance requirements (and operational and maintenance cost), are likely preferable for long-term remediation operations. Similarly remediation that permanently destroys contamination may be preferable (be more durable and have lower long-term risk management requirements) than other strategies.

Table 4.3. Description of the social SuRF-UK indicator headline categories.

Headline Category	Description
SOC1: Human health and safety	Human beings are Society, and hence a pre-eminent concern in the social element of sustainable remediation is human health and safety. Remediation is triggered because there is an unacceptable risk to a receptor, which is frequently harm to human health. All remediation options being considered should mitigate these risks of harm to human health; if they do not they are not *effective* remediation options. Remediation and other brownfield management works may have the potential for negative impacts on/risks to human health and safety for people working on or visiting a site, or located in its vicinity, via: • Disturbance of contaminated materials causing possibilities for exposure. • Movement of large-scale machinery, excavations. • Movement of vehicles on roads. • Smaller scale machinery, for example generators, pumps, and blowers generate heat and vibration that can be a hazard to workers. • Health effects of air emissions from dust and particulates including bioaerosols. • Hazardous chemicals used in remediation processes. • Movement and off-site transport of remediation wastes which may be hazardous. • It may also be relevant to consider impacts on well-being of different remediation options, for example fears from very dramatic interventions or dread contaminants (such as asbestos) or disruption (see below) that persists for extended periods. The mental health impacts of stress for local residents may be substantial, depending on the scale of perceived impact. In most countries the risk driver for any remediation work takes account of the current or future use of the site. However, some remediation options

Headline Category	Description
	may support a wider range of possible future uses of the site (and so facilitate future land use change). Moreover, remediation options may vary in additional wider health *benefits*. Of increasing interest are public health and well-being benefits that might accrue from exercise and well-being as people are more encouraged to be outside in restored/improved environments. It is noteworthy that there is a potential overlap with *SOC3: Neighbourhoods and locality*, and the assessor can choose how to deal with this to ensure there is no duplication of consideration. For example, SOC1 could be reserved for credible human health and safety impacts, and SOC3 for impacts that are likely to be a disruption but not necessarily a health and safety concern.
SOC2: Ethics and equity	Sustainable remediation should consider intergenerational equity and whether the nature or duration of remedial works results in the transfer of contamination impacts and/or their mitigation to future generations. Broader considerations of ethics and equity may seem something of a distant category for many remediation and brownfield practitioners. Indeed, in practice, it may be hard to draw meaningful comparisons across remediation options for many ethics and equity issues at Stage B decisions (see Figure 3.1). However, ethics and equity issues may be highlighted for sites where there is significant public interest: • Wider concerns may include differences between options in probity in procurement and supply chain behaviour; due care and diligence over potential and perceived impacts on local communities, and potential ethical concerns of stakeholders such as sensitivities to particular technological approaches, for example, relating to public concern over the use of genetically modified organisms in a remediation process. SOC2 outcomes may vary more across options at Stage A, especially for longer term projects where the remediation and future land-use might be combined, for example in a phytoremediation over decades or where remediation may lead to a fundamental shift in land-use that varies depending on choices being made. Remediation work may affect different community groups in different ways, or to a different extent. Where remediation takes place in one community to regenerate a deprived area, it can adversely impact the local residents. If that local community has a greater proportion of a particular ethnic, vulnerable, disadvantaged (etc.) group, then the remediation itself might be seen to adversely affect those groups. • A contentious example of this is the possible process of so-called “green gentrification” where potential improvement of an area might be thought to exclude lower income inhabitants as property costs increase. Increasing property values might be seen simultaneously as a dis-benefit under SOC2, while a benefit under *ECON1: Direct economic costs and benefits/ECON2: Indirect economic costs and benefits*, depending on the views of the stakeholders taking part in the sustainability assessment. • There may be disproportional benefits for some parties (e.g. to site owners) versus negative impacts for non-beneficiaries (such as local communities), which may be particularly significant in emerging economies.
SOC3: Neighbourhoods and locality	In common with other types of development work, remediation processes may directly and negatively impact neighbourhoods through disruption associated with noise, vibration, light, dust, odour and/or impacts on local

Headline Category	Description
	road traffic/local travel. Neighbour concerns can particularly focus on operational periods, especially if those extend into antisocial hours (e.g. night-time, or during shift-workers off-time). While specific thresholds may well be set by the environmental permitting required by the remediation works, options are likely to vary in how easily they can meet these thresholds, or indeed if they can exceed them. Where the scale of impact of disruption is such that it may result in a risk to health or well-being then it would be considered under SOC1, otherwise it is considered under SOC3. Additional consideration can apply for sites with historical and/or landscape significance, or where there may be issues of heritage culture or their appreciation associated with their past, and potential ongoing use. The potential presence of important built environment features or buried archaeological features/artefacts should be considered. Obviously, options will vary in their hazard for buried features depending on their degree of disturbance of the subsurface. There may also be benefits for a locality from remediation work, depending on the approach taken, which improve the "liveability" of a local area which will be most evident when works are completed. These benefits may include: removal of invasive weeds, clearance of vermin, mitigation of odour, or reduction in the informal or antisocial use of the site. Also worthy of consideration is the potential removal of wider risks from sites such as fire or windblown litter.
SOC4: Communities and community involvement	Whereas SOC3 is related to how areas are affected (e.g. by secondary emissions from a site), SOC4 focuses on how people use an area and its functionality. This category covers a range of interactions including how remediation might affect local services, community functions and amenity such as improvement of the local landscape and other renovations (e.g. the consequential development of infrastructure such as pathways or roads, public open space etc). Indeed for some sites future public use may be a part of the remediation concept. This may be particularly significant for remedial approaches, such as phytoremediation for biomass, which could also form part of the new functionality of the site. Where the remediation is linked with the broader regeneration/redevelopment of an area, then it is often the wider issues beyond remediation that are of greatest concern and public interests. More generally, communities may be concerned by the stigma a contaminated site creates in its locality, both in the sense of anticipated impact on property values, and in the wider sense of attractiveness and sense of place. There may also be temporary impacts from remediation work, which can vary from option to option, such as: restrictions on access or opening new points of access to a site, restrictions on ability to roam, closure of paths and roads. The impacts of these changes may be more pronounced for the elderly or people with restricted movement. Some sites may play an important role in urban vitality and culture, such as sites used for recreational activities (e.g. parks, urban gardens or urban farms). Potential restrictions on use will be more impactful for these sites. This category is also intended to record any differences between options in how well they support compliance with local policies/spatial planning objectives; and the transparency of decisions to local communities and their degree of engagement with them.

Headline Category	Description
	As mentioned above the SuRF-UK indicator guidance is both an overarching checklist and a palette of choices that has already been drawn up. It may not necessarily reflect all the concerns a local community might have, which may be a highly pertinent consideration for some sites, for example sites which are being regenerated as part of a community action or project. A range of "bottom up" engagement processes exist (e.g. Burford *et al.,* 2013). Wider issues may affect community perspective about remediation end points than compliance with published thresholds guidance or achieving particular economic valuations. For example, clear preferences for particular forms of remedial response may be expressed, such as contaminant removal-based options. Community perceptions of risks and their mitigation may differ markedly from technical expert opinions. The various community values will need to be reconciled with technical opinions and also the legitimate concerns of other stakeholders (such as the site owner, the regulator etc), which may be challenging. Anecdotal information gathered from a survey of CL:AIRE members suggests that these wider concerns may be related to the built development that is facilitated by the remediation, and can be a major obstacle to relationship building, even though the impact of concern is not directly related to the implementation of the remediation *per se*, but rather what it facilitates.
SOC5: Uncertainty and evidence	Different remedial options may have different levels of uncertainty and evidence regarding their feasibility and performance. Additional concerns might relate to regulatory acceptability, ease of verification and the expertise of the technology provider. Considerations within this category include: • The relative level of quality of the evidence available in support of particular remediation options and any uncertainties associated with it, related to their primary and secondary impacts and effectiveness in a general sense. • The quality of site/project specific investigations that are available to support a particular remedial option (see below). • The verification/validation requirements that would have to be met by their implementation and the lines of evidence needed to support this. Consideration of uncertainty and quality of evidence should also encompass consideration of uncertainties in site investigation work, which may impact different remediation options differently. Attention should be paid to consistency and appropriateness in sample collection, preparation and analytical approach, especially as this may have been carried out by multiple parties, taking into account compliance with analytical good practice and independence. It is also reasonable to consider whether there has been a conscious or unconscious bias in the presentation of data and results which may overstate remediation performance. This category may also consider the risk management decision-making for a site taking place at Stage A, as choices may vary depending for example on the use of generic criteria versus robust site-specific risk-based remedial criteria and the quality of conceptual site models used. *The SuRF-UK framing approach directly addresses uncertainty in the sustainability assessment itself, and suggests the use of sensitivity analyses to explore the impacts of any such uncertainties, as set out in Supplementary Report 1. This is outside the scope of this category.*

5. How to use the checklist during framing

Specific suggestions for indicators/criteria to be used in sustainability assessment have been drawn out from Tables 4.1, 4.2 and 4.3 and set out in Appendix 1 of this report. This checklist can be used at *Step 2.3 of the Definition Stage* of the framing process (see *Supplementary Report 1*) to support the definition of the scope of a sustainability assessment.

Appendix 1 separates out individual indicators/criteria within each headline category. It provides some preliminary guidance about the lines of evidence that might be used to support a comparison for each indicator, primarily at a Tier 1 (qualitative) comparison. The lines of evidence suggestions provided deliberately avoid detailed examples to favour assessors and project teams making their own site and project specific conclusions. Appendix 1 also maps indicators against specific UN Sustainable Development Goals (UN, 2015), as these may be a factor in decisions about the relevance of different indicators/criteria (see Box 5.1).

Box 5.1: Linkage of SuRF-UK indicators to UN SDGs.

In 2015, subsequent to the original publication of the SuRF-UK indicator guidance (CL:AIRE, 2011), the United Nations published a series of 17 Sustainable Development Goals (SDGs)[1]. These encompass 169 individual sustainability targets (UN, 2015) and are based on an intergovernmental consensus. There are direct linkages to 13 of the SDGs (Bardos *et al.*, 2018) and indirect linkages to the remaining four, but most importantly each SuRF-UK indicator can be mapped to at least one SDG, as is demonstrated in Appendix 1. The mapping is based on the 2015 listing of SDGs. Minor modifications were made in 2020 (Sachs *et al.,* 2020), but do not have a substantive effect on the mapping[2].

There are three key activities in using the checklist in developing a scope for the range of issues to be covered by a sustainability assessment: *consider*, *document* and *finalise*, shown in Figure 5.1. Apply these to each of the indicators/criteria in the checklist.

[1] The Sustainable Development Goals, otherwise known as the Global Goals, are a universal call to action to end poverty, protect the planet and ensure that all people enjoy peace and prosperity.

[2] The most relevant changes were an alteration in the wording related to embodied water in imports, and addition of indicators related to biodiversity threats embodied in imports. The other changes related to data sources used in SDG monitoring process.

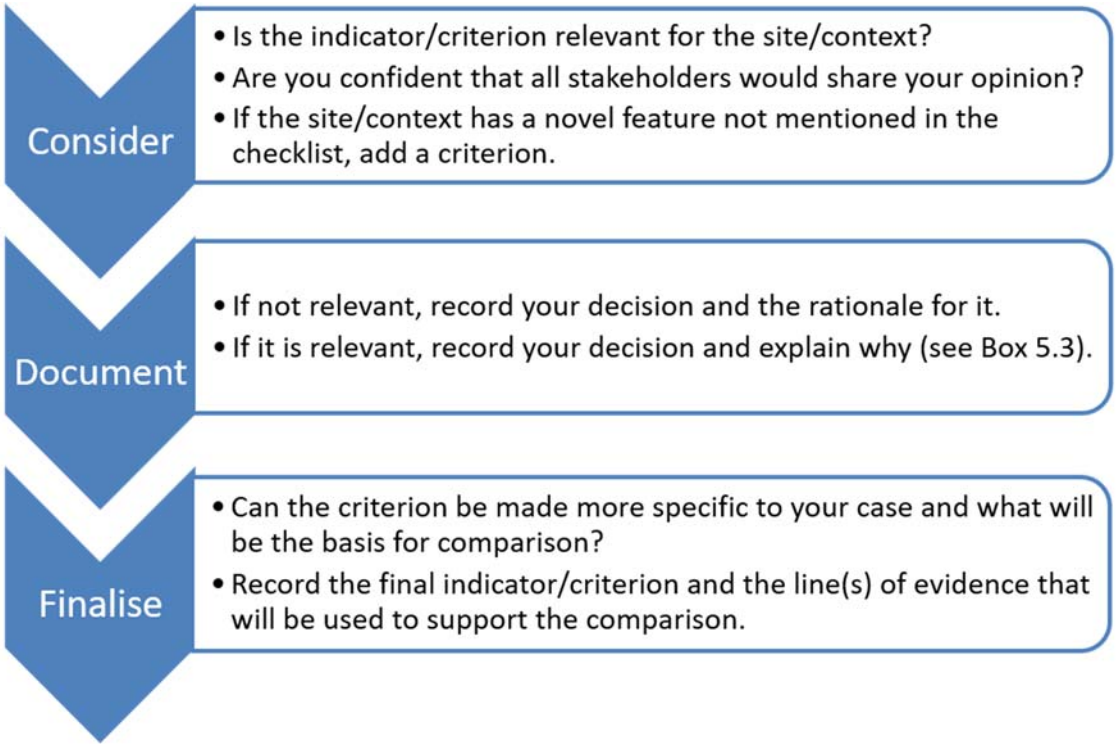

Figure 5.1. Selecting suggested indicators/criteria.

The checklist criteria are all comparable (i.e. can be ranked) in qualitative terms, and Appendix 1 suggests how *lines of evidence* can be used for making these rankings. The checklist does not propose individual metrics (measurable qualities), what it provides are considerations for which indicators might need to be agreed for a particular site/project.

The individual indicator/criteria suggestions are presented as features, for example, "soil functionality" or "requirements for validation/verification". For qualitative and semi-quantitative tiers of sustainability assessment, these suggestions can likely be used directly in ranking or scoring based comparisons, based on technical opinion and supporting lines of evidence. Lines of evidence may include measurements. However, for quantitative (Tier 3) assessments a measurement based approach may be preferred. Not all of the SuRF-UK indicator/criteria suggestions are directly measurable. Some may need to be estimated via a surrogate or based on a more formal survey of stakeholder opinions. *Supplementary Report 2* does not give comprehensive definitions of what measurement approach is valid for each of its indicator/criteria suggestions, as there is a large number of possibilities. Assessors need to make their own proposals for measurements, where measurement is seen as necessary. These measurements need to be seen as valid and representative by the various stakeholders engaged in the sustainability assessment process, or who will be informed by it.

Not all indicators/criteria suggested in the checklist are quantifiable or readily quantifiable, even where they are clearly important. Some of these may be supported by measurements, but will still be opinion based. It is therefore important to engage widely with interested parties during the sustainability assessment process to get a robust basis for opinion-based comparisons. Difficulty in quantification should not rule an indicator or criterion out of consideration as it may represent issues of considerable importance, at least to some stakeholders. They can be compared (ranked) in a qualitative (Tier 1) sustainability assessment and may potentially be capable of being scored at Tier 2, based on the lines of evidence suggested.

5.1 Avoiding duplication of indicators in defining scope

A general difficulty with sustainability assessments is duplication of effects, or double counting, which should be removed as far as possible. However:

- Some impacts or benefits may be split over several indicators, hence any necessary cross-referencing should be clearly reported.
- Different stakeholders may disagree about what is being duplicated depending on what is important to them. In this situation, sensitivity analyses can be used to compare the effect on overall outcome of inclusion/exclusion of a particular criterion.
- Where an indicator/criterion has been excluded as it is thought to be a duplication, the reason for its exclusion should be clearly explained.
- In some cases an apparent duplication may not be double counting, but a legitimate synergy: for example, the production of renewable energy on brownfield may be seen as beneficial across indicators in several categories at once (such as ENV1, ECON1 and ECON 2). In this situation adding some cross-referencing and explanation will make the sustainability assessment a lot clearer.

Ensure careful recording of all deliberations and decisions and the rationale and evidence used to set the sustainability assessment scope (i.e. which considerations are excluded vs. included), for example using a template (see *Supplementary Report 1*). Be ready to review these choices in the light of wider stakeholder engagement as the sustainability assessment is iterated. The use of a conceptual model with sustainability linkages (driver, mechanism, receptor) can assist transparency, as well facilitating the avoidance of "double counting" (see *Supplementary Report 1*).

5.2 Managing positive and negative effects

While making the selection of indicators, it is useful to be already considering how the sustainability assessment comparison will be structured and aggregated across the different indicators/criteria selected, for example using rankings at the level of individual criteria, or overarching rankings for each category. Bear in mind that impacts may be negative or positive and decide how this will be reflected in rankings or categorisations to ensure a consistent approach for benefits vs dis-benefits. Also take into account that, at least at a headline category level, there may be a mixture of positive and negative effects that need to be considered for each category (see Box 5.2).

Box 5.2: Dealing with positive and negative effects within a single category.

It may not be obvious how to combine individual indicators within a category where comparisons may have a positive effect for some and a negative effect for others. For example, at Stage A, SOC1 might include an indicator about public health and well-being benefits from access to parkland on a remediated brownfield in one option, while the parkland is absent in another option and this would be a comparison of relative benefit. Another legitimate criterion might be to compare health and safety *risks* across remediation options and this would be a comparison of relative dis-benefit. The resolution is straightforward: *the ranking must always be consistent, for example, 1 is best, 2 is not as good etc*. "Best" means most benefit and least dis-benefit.

A subsidiary question is how to combine individual rankings within a single headline category. The most obvious way to do this is to take an average, as this means the rankings for each headline category will be normalised to the same range.

5.3 Considering indicators where all options are likely to perform similarly

Careful consideration also needs to be given to the pros and cons of including criteria which are likely to be tied across the options under assessment to determine whether these criteria should be included or not (see Box 5.3).

Box 5.3: Likely tied criteria and indicator selection.

During indicator selection it may already be apparent that all of the options under consideration would be tied or very close for a particular criterion. In some cases the criterion may be considered relatively insignificant, for example, no options will lead to noticeable emissions of ozone depletion compounds. In this situation it may be sensible to discard this criterion to save wasting effort, and document your reasons for doing so. In other cases, the criterion may be one that is considered quite important, for example, all options are similar in terms of GHG emissions. In this situation it may be sensible to leave this criterion in the assessment. It is not necessarily appropriate to choose an option on the basis of relatively few criteria where differences are very evident but their weighting is low, when one or more options are otherwise tied. This may give a false impression, and there are two better ways forward: (1) if the tied options are all broadly acceptable the choice might be made simply to take the cheaper approach; or (2) if there is still contention between stakeholders, this might suggest a higher Tier sustainability assessment is necessary. There may be benefits in retaining tied rankings also to show broadly occurring sustainability gains, or potential broad project risks (See Chapter 3).

5.4 Considering indicators that are local or temporary

The various indicators selected may vary how they occur over time. Some may be issues that only exist prior to remediation and which are subsequently mitigated during the works taking place, some may be essentially temporary in nature such as disruption, and some may be long term or permanent such as the generation of GHGs or benefits from long-term changes in site amenity. Some effects may be more or less proximal to the site and its neighbourhood, whereas others are independent of proximity. The overarching sustainability assessment should consider ***all impacts***. However, individual considerations can be flagged as to whether or not they are proximal, temporary etc based on the boundaries agreed in *Definition Step 2.2* of the framing process (see *Supplementary Report 1*). This flagging would allow for *sub-analyses*, for example focusing on the longer term, or pulling out temporary proximal effects. These sub-analyses may be useful in determining, for example, messaging to local communities, needs for mitigation measures, or long-term (clearly intergenerational) effects.

6. Summary of key points

This report explains the nature of the 15 overarching categories of indicators (headlines) that SuRF-UK has set out to support wide ranging and holistic consideration of sustainability. It provides a process for indicator selection and for supporting comparisons with lines of evidence. It contains a checklist of possible individual sustainability considerations, some direction on lines of evidence for them and a suggested mapping to the UN Sustainable Development Goals . Its purpose is to facilitate an equitable, transparent and appropriate setting of the scope of sustainability assessments during their framing (definition).

The headline categories themselves and the supporting detail behind them *are intended as being advisory and not prescriptive*. They are meant to allow decision-makers to consider a wide scope of sustainability issues. Although the guidance presented here has a wide-ranging scope, it cannot be exhaustive, and it is quite possible that stakeholders may wish to include additional considerations that they feel would otherwise not be represented. The structure is also only advisory. SuRF-UK's intent was to create an equal number of categories under the three elements of sustainability (i.e. environmental, economic, social) to exemplify and underpin a balanced approach to consideration of each of them. However, for a particular site/project stakeholders may wish to alter this structure. For example, past suggestions have been to separate out ECON5, lifespan and flexibility as two distinct headline categories; or to separate out climate change impacts from ENV1 as a specific headline distinct from other air emissions considerations. SuRF-UK does not seek to prevent changes that are seen as useful for a particular site or project. However, SuRF-UK does recommend that these decisions are taken *before* the assessment as part of the framing process, and they need to be agreeable to *all* of the stakeholders who might have an interest in the sustainability assessment being produced, within the 15 headline category structure.

7. References

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Appendix 1: Indicator checklist, lines of evidence, mapping to UN SDGs

Supplied as a separate spreadsheet (in pdf and Excel formats).

Headline Category		Possible individual indicators / criteria	Lines of evidence that could be used to support qualitative comparison	Cross references to other indicators	UN SDG Link	The linked UN SDG wordings
	Environmental					
ENV 1	Emissions to air	A. Climate change - greenhouse gases (e.g. CO_2, CH_4, N_2O, etc.)	There are formal quantitative tools for carbon footprint, carbon balance which typically consider other gases as carbon equivalents. Be cautious about generic claims for technologies; their provenance may be unclear and they may lack impartial validation. Moreover greenhouse gas impacts are likely to also be site specific, requiring a parallel assessment across all options being considered for a specific site. At a qualitative level, consideration of how options compare in terms of relative energy intensity, potential for carbon sequestration, and potential avoidance of current / future greenhouse gas emissions may be used as an initial line of evidence.		Goals: 11.6, 12.4, 13, 13.1	11.6 By 2030, reduce the adverse per capita environmental impact of cities, including by paying special attention to air quality and municipal and other waste management 12.4 By 2020, achieve the environmentally sound management of chemicals and all wastes throughout their life cycle, in accordance with agreed international frameworks, and significantly reduce their release to air, water and soil in order to minimize their adverse impacts on human health and the environment Goal 13 Take urgent action to combat climate change and its impacts 13.1 Strengthen resilience and adaptive capacity to climate related hazards and natural disasters in all countries
		B. Acid rain - emissions of NO_x, SO_x	Emissions of NOx, SOx could be modelled and quantified. At a qualitative level, consideration of how options compare in terms of likely exhaust gas emissions (e.g. from machinery, combustion), and hence release of SOx and NOx, may be used as an initial line of evidence.	SOC1 or SOC3 for local ground level impacts, e.g. of SOx and NOx	Goals: 11.6, 12.4	
		C. Ground air quality - Particulates (especially PM5 and PM10), ground level ozone; volatile contaminants / reagents, ammonia (from biopiles) etc.	Emissions of particulates and ozone could be modelled and quantified. At a qualitative level, consideration of how options compare in terms of likely exhaust gas emissions (e.g. from machinery, combustion), and hence release of ozone and particulates, may be used as an initial line of evidence. This headline considers atmospheric impacts in a general sense, rather than local impacts.	SOC1 or SOC3 for local ground level impacts	Goals: 11.6, 12.4	
		D. Ozone depleting substances	Emissions of ozone depleting substances could be modelled and quantified for process plant, if relevant. At a qualitative level, consideration of how options compare in terms of likely fugitive emissions, in particular not forgetting initial excavation and grading operations may be used as an initial line of evidence.	SOC1 or SOC3 for local ground level impacts	Goals: 11.6, 12.4	
ENV 2	Soil and ground conditions	A. Changes in soil functionality (particularly topsoil) for flora and fauna	Soil functionality describes the combination of biological, chemical and physical circumstances which deliver its ecosystem services and meet its ecosystem needs. These include, for example: fertility (biological turnover of nutrients in the soil), structure (porosity and ability to support root growth) and other aspects of soil condition (e.g. pH, nutrient and pH buffering). These properties can be measured, but this would be an intensive task, and the effects of treatment options would be hard to model in a fully quantitative sense, if indeed this was possible. At a qualitative level, an initial line of evidence could be consideration of how options compare in terms of likely impacts, for example a thermal treatment will remove organic matter which underpins soil functionality, or addition of a biochar might improve buffering.	ENV4 for wider ecological and ecosystem service impacts	Goals: 2.4, 12.4, 15.1	2.4 By 2030, ensure sustainable food production systems and implement resilient agricultural practices that increase productivity and production, that help maintain ecosystems, that strengthen capacity for adaptation to climate change, extreme weather, drought, flooding and other disasters and that progressively improve land and soil quality 9.1 Develop quality, reliable, sustainable and resilient infrastructure, including regional and transborder infrastructure, to support economic development and human well-being, with a focus on affordable and equitable access for all 11.4 Strengthen efforts to protect and safeguard the world's cultural and natural heritage 12.4 By 2020, achieve the environmentally sound management of chemicals and all wastes throughout their life cycle, in accordance with agreed international frameworks, and significantly reduce their release to air, water and soil in order to minimize their adverse impacts on human health and the environment 15.1 By 2020, ensure the conservation, restoration and sustainable use of terrestrial and inland freshwater ecosystems and their services, in particular forests, wetlands, mountains and drylands, in line with obligations under international agreements
		B. Changes in water filtration, drainage and purification processes in the subsurface	Potentially quantifiable, but likely to be complex, difficult and time consuming, and assumptions needed to model the effects of different options could be highly subjective. At a qualitative level, an initial line of evidence could be consideration of how options compare in terms of likely impacts, for example whether any amendments, or the process used, might disrupt biological, chemical and/or physical functions affecting water quality in the subsurface, including the effect of residual treatment agents.	Take care to avoid double counting with ENV3	Goals: 2.4, 12.4	
		C. Changes in soil erosion, particularly affecting surface water / sediments	Potentially quantifiable, but outcomes might be contentious and the process is likely to be complex, difficult and time consuming, and assumptions needed to model the effects of different options could be highly subjective. At a qualitative level, an initial line of evidence could be consideration of how options compare in terms of likely impacts, for example an approach involving revegetation may reduce erosion risks.	Take care to avoid double counting with ENV3	Goals: 2.4, 12.4	
		D. Changes in soil / subsurface structure affecting drainage, including soil sealing	Potentially quantifiable, but outcomes might be contentious and the process is likely to be complex, difficult and time consuming, and assumptions needed to model the effects of different options could be highly subjective. At a qualitative level, an initial line of evidence could be consideration of how options compare in terms of likely impacts, for example the impact of geomembranes or stabilisation.	Take care to avoid double counting with ENV3	Goals: 2.4, 12.4	
		E. Structures in the subsurface (impact of wells, impact on buried services)	While options might be compared, a quantitative comparison seems hard to realise. At a qualitative level an initial line of evidence could be consideration of how options compare in terms of likely impacts, for example how well drilling might affect the subsurface, or a thermal method might affect fibre-optic or other cabling.	Take care to avoid double counting with ENV3. SOC1 if there are potential impacts on health and safety.	Goals: 9.1?	
		F. Changes in geotechnical properties (incl. compaction)	Potentially quantifiable, but outcomes might be contentious and the process is likely to be complex, difficult and time consuming. At a qualitative level, an initial line of evidence could be consideration of how options compare in terms of likely impacts, for example the use of solidification or active compaction. Geotechnical changes may be desirable or undesirable depending on the context of the site and its current / planned use.	SOC1 if there are potential impacts on health and safety. Possibly also linked to ECON2 and SOC4 is there are amenity benefits, ECON1 if improvement is a specific project goal (cross reference not a duplication).	Goals: 9.1?	
		G. Impact/benefits to sites of special geological interest e.g. SSSIs and geoparks	Possibly quantifiable depending on the impacts of concern, but outcomes might be contentious and the process is likely to be complex, difficult and time consuming, and assumptions needed to model the effects of different options could be highly subjective. At a qualitative level, an initial line of evidence could be consideration of how options compare in terms of likely impacts, for example in terms of the amount of site disturbance.		Goals: 11.4, 12.4	

Headline Category		Possible individual indicators / criteria	Lines of evidence that could be used to support qualitative comparison	Cross references to other indicators	UN SDG Link	The linked UN SDG wordings
ENV 3	Groundwater & Surface Water	A. Effects on suitability of water for potable or other uses (based on long-term protection of available water resources) including pH, taint as well as contamination	Mitigation of risks to water quality may well be an inherent part of the risk management goals for a site. Some options may achieve a higher level of "protection" than others for example in terms of the level of contaminant reduction, the stability of the effect and the chances of any rebound. Treatments may have wider impacts on water quality, for example taint, levels of dissolved/suspended substances, redox & pH and colour. In most cases a quantitative assessment of these outcomes for each option is feasible, but subjectivity may be hard to determine, and outcomes may not be directly comparable, especially if the specific site context is not properly considered. At a qualitative level, an initial line of evidence could be consideration of how options compare in terms of likely impacts, for example, whether they use additives or processes that affect quality by changing pH, redox or may spread beyond the treatment zone perimeter (for example a dissolved substance such as surfactant or redox agent).	Possibly also linked to ECON2 and SOC4 if there are amenity benefits, ECON1 if water improvement is a specific project goal (cross reference not a duplication). ECON5 in terms of considerations of the robustness of the solution.	Goals: 3.9, 6.1, 6.3-6.5, 12.4	3.9 By 2030, substantially reduce the number of deaths and illnesses from hazardous chemicals and air, water and soil pollution and contamination 6.1 By 2030, achieve universal and equitable access to safe and affordable drinking water for all 6.3 By 2030, improve water quality by reducing pollution, eliminating dumping and minimizing release of hazardous chemicals and materials, halving the proportion of untreated wastewater and substantially increasing recycling and safe reuse globally 6.4 By 2030, substantially increase water-use efficiency across all sectors and ensure sustainable withdrawals and supply of freshwater to address water scarcity and substantially reduce the number of people suffering from water scarcity 6.5 By 2030, implement integrated water resources management at all levels, including through transboundary cooperation as appropriate 6.6 By 2020, protect and restore water-related ecosystems, including mountains, forests, wetlands, rivers, aquifers and lakes 12.2 By 2030, achieve the sustainable management and efficient use of natural resources 12.4 By 2020, achieve the environmentally sound management of chemicals and all wastes throughout their life cycle, in accordance with agreed international frameworks, and significantly reduce their release to air, water and soil in order to minimize their adverse impacts on human health and the environment 14.1 By 2025, prevent and significantly reduce marine pollution of all kinds, in particular from land-based activities, including marine debris and nutrient pollution 14.2 By 2020, sustainably manage and protect marine and coastal ecosystems to avoid significant adverse impacts, including by strengthening their resilience, and take action for their restoration in order to achieve healthy and productive oceans 15.1 By 2020, ensure the conservation, restoration and sustainable use of terrestrial and inland freshwater ecosystems and their services, in particular forests, wetlands, mountains and drylands, in line with obligations under international agreements
		B. Effects on legally binding environmental objectives e.g. Water Framework Directive	The Water Framework Directive sets goals for surface water quality and remediation of a site may either contribute to these goals or potentially hamper them. Effects may arise from mitigation of contaminants targeted by the remediation, but wider effects (as described above) may also take place. This indicator is specific to achieving compliance with wider environmental quality policy for water. In most cases a quantitative assessment of these outcomes for each option is feasible, but subjectivity may be hard to determine, and outcomes may not be directly comparable, especially if the specific site context is not properly considered. At a qualitative level an initial line of evidence could be consideration of how options compare in terms of likely impacts, for example , whether they use additives or processes that affect quality by changing pH, redox or may spread beyond the treatment zone perimeter (for example a dissolved substance such as surfactant or redox agent).	Possibly also linked to ECON2 and ECON1 if water improvement is a specific project goal. Potentially use this indicator / criteria rather than ENV3A or 3C if these compliance regimes are a dominant consideration for the site stakeholders.	Goals: 3.9, 6.1, 6.3-6.5, 12.4, 15.1	
		C. Effects on biological function (aquatic ecosystems) and chemical function	Functionality properties can be measured, but this would be an intensive task, and the effects of treatment options would be hard to model in a fully quantitative sense, if indeed this was possible. At a qualitative level an initial line of evidence could be consideration of how options compare in terms of likely impacts, for example whether a chemical oxidation treatment might degrade functionality.		Goals: 6.6, 12.4, 15.1	
		D. Effects on mobilisation of dissolved substances	This indicator considers the mobilisation of substances already present in the subsurface, including contaminants but also potentially "normal" aquifer constituents. At a qualitative level an initial line of evidence could be consideration of how options compare in terms of likely impacts, for example what wider impacts might arise from the use of a surfactant.	ENV3A	Goals: 3.9, 6.1, 6.3-6.5, 12.4	
		E. Effects on marine, brackish/transitional waters	The particular circumstances of coastal brownfield / contaminated sites and marine or transitional waters are considered within this indicator. In most cases a quantitative assessment of these outcomes for each option is feasible, but subjectivity may be hard to determine, and outcomes may not be directly comparable, especially if the specific site context is not properly considered. At a qualitative level an initial line of evidence could be consideration of how options compare in terms of likely impacts, for example , whether they use additives or processes that affect quality by changing pH, redox or may spread beyond the treatment zone perimeter.		Goals: 6.5, 6.6, 12.4, 14.1, 14.2	
		F. Effects/benefits of water abstraction resulting from the remediation process or its outcome, e.g. changing river levels or water tables	Likely quantified and modelled for remediation options to be compared. A qualitative line of evidence could be consideration of how options compare in terms of likely impacts and benefits to water resources, based on their design.		Goals: 3.9, 6.1	
		G Effects on the movement of surface or groundwater and possible impacts (ponding, flooding risks, changes in flow regime)	Some aspects are likely quantified and modelled for the remediation options to be compared. A qualitative line of evidence could be forecasting based on expert opinions of how options compare in terms of likely impacts and benefits, based on their design.	Possibly also linked to ECON2, SOC1, and SOC4 if there are amenity benefits, ECON1 if improvement is a specific project goal (cross reference not a duplication).	Goals: 12.2	
		H. Synergies with surface water management, including sediments, banks, flood management regimes	While options might be compared, a fully quantitative comparison seems hard to realise. A qualitative line of evidence could be forecasting based on expert opinions of how options compare in terms of likely impacts and benefits, based on their design.	Possibly also linked to ECON2 and SOC4 if there are amenity benefits, ECON1 if improvement is a specific project goal.	Goals: 12.2	
		I. Effects on coastline management including benefits for / issues from the management of sediments, dredgings	While options might be compared, a fully quantitative comparison seems hard to realise. A qualitative line of evidence could be consideration of how options compare in terms of likely impacts and benefits, based on their design.	Possibly also linked to ECON2 and SOC4 if there are amenity benefits, ECON1 if improvement is a specific project goal.	Goals: 12.2, 14.1, 14.2	

Headline Category		Possible individual indicators / criteria	Lines of evidence that could be used to support qualitative comparison	Cross references to other indicators	UN SDG Link	The linked UN SDG wordings
ENV 4	Ecology	A. Effects on flora, fauna and food chains (esp. protected species, biodiversity, protected sites, consideration of alien species)	Mitigation of risks to ecological targets may well be an inherent part of the risk management goals for a site. Some options may achieve a higher level of "protection" than others, for example, in terms of the level of contaminant reduction, the stability of the effect and the chances of any rebound. Treatments may have wider impacts on ecology, for example, via their impact on water or soil functionality or because habitat is removed or impacted, e.g. the degree of site clearance needed and disturbance different options cause on a site. Beneficial changes may also occur, depending on site design. In many cases a quantitative assessment of these outcomes for each option is feasible, but its subjectivity may be hard to determine, and outcomes may not be directly comparable, especially if the specific site context is not properly considered. At a qualitative level, an initial line of evidence could be consideration of how options compare in terms of likely impacts. Phytoremediation is an interesting example option as it may have positive or negative effects on ecology depending on the approach and which aspects of ecology are of most importance to stakeholders.	Possibly also linked to ECON2 and SOC4 if there are amenity benefits (cross reference not a duplication).	Goals: 12.2, 12.4, 15.3, 15.A	12.2 By 2030, achieve the sustainable management and efficient use of natural resources 12.4 By 2020, achieve the environmentally sound management of chemicals and all wastes throughout their life cycle, in accordance with agreed international frameworks, and significantly reduce their release to air, water and soil in order to minimize their adverse impacts on human health and the environment. 15.1 By 2020, ensure the conservation, restoration and sustainable use of terrestrial and inland freshwater ecosystems and their services, in particular forests, wetlands, mountains and drylands, in line with obligations under international agreements 15.3 By 2030, combat desertification, restore degraded land and soil, including land affected by desertification, drought and floods, and strive to achieve a land degradation-neutral world. 15.5 Take urgent and significant action to reduce the degradation of natural habitats, halt the loss of biodiversity and, by 2020, protect and prevent the extinction of threatened species 15.A Mobilize and significantly increase financial resources from all sources to conserve and sustainably use biodiversity and ecosystems
		B. Significant changes in ecological community structure or function and consequent impacts on ecosystem services	Potentially could be forecast in a quantitative way and modelled for remediation options to be compared. A qualitative line of evidence could be forecasting based on expert opinions of how options compare in terms of likely impacts and benefits, based on their design.	This indicator is closely linked to ENV4A but emphasises the delivery of ecosystem services as opposed to diversity of species. Possibly also linked to ECON2 and SOC4 if there are amenity benefits (cross reference not a duplication).	Goals: 12.2, 12.4, 15.3, 15.A	
		C. Effects of disturbance (e.g. light, noise and vibration) on ecology	While options might be compared, a fully quantitative comparison seems hard to realise. A qualitative line of evidence could be forecasting based on expert opinions of how options compare in terms of likely impacts and benefits, based on their design.	This indicator is closely linked to ENV4A, emphasising in particular disturbance to off site wildlife.	Goals: 15.5	
		D. Use of equipment that affects/protects fauna (e.g. bird/bat flight, or animal migration)	While options might be compared, a fully quantitative comparison seems hard to realise, although perhaps a local opinion survey might be a possibility. A qualitative line of evidence could be forecasting based on expert opinions of how options compare in terms of likely impacts and benefits, based on their design.	This indicator is closely linked to ENV4A, emphasising in particular disturbance to visiting wildlife.	Goals: 15.5	
ENV 5	Natural resources and waste	A. Impacts/benefits for land re-use such as landscape changes, multifunctionality	While options might be compared, a fully quantitative comparison seems hard to realise. A qualitative line of evidence could be forecasting based on expert opinions of how options compare in terms of likely impacts and benefits, based on their design.	Landscape impacts may also affect ECON1, ECON2 and SOC4 (cross reference not a duplication).	Goals: 8.4?, 12.2, 15.3	6.1 By 2030, achieve universal and equitable access to safe and affordable drinking water for all 7.2 By 2030, increase substantially the share of renewable energy in the global energy mix 7.3 By 2030, double the global rate of improvement in energy efficiency 8.4 Improve progressively, through 2030, global resource efficiency in consumption and production and endeavour to decouple economic growth from environmental degradation, in accordance with the 10-Year Framework of Programmes on Sustainable Consumption and Production, with developed countries taking the lead 11.6 By 2030, reduce the adverse per capita environmental impact of cities, including by paying special attention to air quality and municipal and other waste management. 12.2 By 2030, achieve the sustainable management and efficient use of natural resources 12.5 By 2030, substantially reduce waste generation through prevention, reduction, recycling and reuse 15.3 By 2030, combat desertification, restore degraded land and soil, including land affected by desertification, drought and floods, and strive to achieve a land degradation-neutral world
		B. Use of energy/fuels taking into account their type/origin and the possibility of generating renewable energy by the project	Options should be comparable on the basis of quantified assessments at least in part. A qualitative line of evidence could be consideration of how options compare in terms of likely impacts and benefits, based on their design, for example taking into account how renewable energy is factored into delivery, or can be an outcome for the site.	ECON1 if production of renewables is a specific project goal (cross reference not a duplication).	Goals: 7.2, 7.3, 8.4, 12.2	
		C. Use of primary resources and substitution of primary material resources within the project or external to it, rates of recycling, rates of legacy waste generation, use of other recyclates.	Options should be comparable on the basis of quantified assessments at least in part. A qualitative line of evidence could be forecasting based on expert opinions of how options compare in terms of likely impacts and benefits, based on their design.	ECON1 if cost savings accrue (cross reference not a duplication).	Goals: 8.4, 11.6, 12.2, 12.5	
		D. Use / re-use of water, impacts/benefits for water abstraction, use and disposal	Options should be comparable on the basis of quantified assessments at least in part. A qualitative line of evidence could be forecasting based on expert opinions of how options compare in terms of likely impacts and benefits, based on their design.	Additional to effects already considered under ENV3	Goals: 6.1, 8.4, 12.2	

Headline Category		Possible individual indicators / criteria	Lines of evidence that could be used to support qualitative comparison	Cross references to other indicators	UN SDG Link	The linked UN SDG wordings
	Economic					8.1 Sustain per capita economic growth in accordance with national circumstances and, in particular, at least 7 per cent gross domestic product growth per annum in the least developed countries 8.4 Improve progressively, through 2030, global resource efficiency in consumption and production and endeavour to decouple economic growth from environmental degradation, in accordance with the 10-Year Framework of Programmes on Sustainable Consumption and Production, with developed countries taking the lead. 9.4 By 2030, upgrade infrastructure and retrofit industries to make them sustainable, with increased resource-use efficiency and greater adoption of clean and environmentally sound technologies and industrial processes, with all countries taking action in accordance with their respective capabilities
ECON 1	Direct economic costs and benefits	A. Direct financial costs and benefits of remediation / management for organisation	Options should be comparable on the basis of quantified assessments at least in part. A qualitative line of evidence could also be based on the financial models for remediation costs.		Goals: 8.1, 8.4, 9.4	
		B. Other costs associated with the work (incl. operation and any ongoing monitoring, regulator costs, planning, permits/licences, and debt financing if relevant)	Options should be comparable on the basis of quantified assessments at least in part. A qualitative line of evidence could also be based on the financial models for the site.		Goals: 8.1, 8.4, 9.4	
		C. Uplift in site value to facilitate future development or investment	Options should be comparable on the basis of quantified assessments at least in part. A qualitative line of evidence could also be based on the financial models for site appreciation.		Goals: 8.1, 8.4, 9.4	
		D. Consequences of capital and operation costs on liability discharge, ease of divestment etc	Options should be comparable on the basis of quantified assessments at least in part. A qualitative line of evidence could also be based on the financial models for liabilities and how these might be affected by different remediation scenarios.		Goals: 8.1, 8.4, 9.4	
ECON 2	Indirect economic costs and benefits	A. Allocation of financial resources internally	Potentially quantifiable, if relevant.		Goals: 8.1, 8.4	8.1 Sustain per capita economic growth in accordance with national circumstances and, in particular, at least 7 per cent gross domestic product growth per annum in the least developed countries 8.3 Promote development-oriented policies that support productive activities, decent job creation, entrepreneurship, creativity and innovation, and encourage the formalization and growth of micro-, small- and medium-sized enterprises, including through access to financial services 8.4 Improve progressively, through 2030, global resource efficiency in consumption and production and endeavour to decouple economic growth from environmental degradation, in accordance with the 10-Year Framework of Programmes on Sustainable Consumption and Production, with developed countries taking the lead 9.1 Develop quality, reliable, sustainable and resilient infrastructure, including regional and transborder infrastructure, to support economic development and human well-being, with a focus on affordable and equitable access for all 11.1 By 2030, ensure access for all to adequate, safe and affordable housing and basic services and upgrade slums 12.6 Encourage companies, especially large and transnational companies, to adopt sustainable practices and to integrate sustainability information into their reporting cycle
		B. Changes in surrounding land/property values	Potentially quantifiable, but may be complex to achieve. A qualitative line of evidence could also be based on the reports in the technical literature and the expert opinions of property developers / estate agents / surveyors involved in the project.		Goals: 8.1, 8.4, 11.1	
		C. Risks of damages (e.g. to surrounding property, or from improper disposal of wastes)	Likely not quantifiable. A qualitative line of evidence might be forecasting based on expert opinion and the likelihood of creating illegal deposit, damage from remediation process effects, or spreading Japanese Knotweed.		Goals : 8.1, 8.4, 9.1	
		D. Impact on corporate reputation	Potentially quantifiable, but may be complex to achieve. At a qualitative level, an initial line of evidence could be consideration of how options compare based on the opinions of different stakeholders, in particular the site owner and consultant.		Goals: 12.6	
		E. Consequences for the locality's economic performance	Potentially quantifiable. At a qualitative level, an initial line of evidence could be consideration of how options compare based on the opinions of different stakeholders, for example, the local authority and local business networks.		Goals: 8.3, 8.4, 9.1	
		F. Tax implications (e.g. from local property taxation)	Potentially quantifiable. At a qualitative level, an initial line of evidence could be consideration of how options compare based on the opinions of different stakeholders, for example, the local authority and local business networks.		Goals: 8.1, 8.4	
ECON 3	Employment and employment capital	A. Job creation	Potentially quantifiable, but may be complex to achieve. At a qualitative level, an initial line of evidence could be consideration of how options compare in terms of their design in discussion between stakeholders.		Goals: 8.1	4.4 By 2030, substantially increase the number of youth and adults who have relevant skills, including technical and vocational skills, for employment, decent jobs and entrepreneurship 4.7 By 2030, ensure that all learners acquire the knowledge and skills needed to promote sustainable development, including, among others, through education for sustainable development and sustainable lifestyles, human rights, gender equality, promotion of a culture of peace and non-violence, global citizenship and appreciation of cultural diversity and of culture's contribution to sustainable development 8.1 Sustain per capita economic growth in accordance with national circumstances and, in particular, at least 7 per cent gross domestic product growth per annum in the least developed countries
		B. Employment levels (short and long term)	Potentially quantifiable, but may be complex to achieve. At a qualitative level, an initial line of evidence could be consideration of how options compare in terms of their design in discussion between stakeholders.		Goals: 4.4, 4.7	
		C. Skill levels before and after (for people)	Potentially quantifiable, but may be complex to achieve. At a qualitative level, an initial line of evidence could be consideration of how options compare in terms of their design in discussion between stakeholders.		Goals: 4.4, 4.7	
		D. Opportunities for education and training	Potentially quantifiable, but may be complex to achieve. A qualitative line of evidence would be consideration of the option design and likely delivery to assess impacts in discussion between stakeholders.		Goals: 4.4, 4.7	

Headline Category		Possible individual indicators / criteria	Lines of evidence that could be used to support qualitative comparison	Cross references to other indicators	UN SDG Link	The linked UN SDG wordings
ECON 4	Induced economic costs and benefits	A. Creating opportunities for inward investment into the area, for example, facilitating a follow-on remediation project	Potentially quantifiable, but may be complex to achieve. At a qualitative level, an initial line of evidence could be consideration of how options compare in terms of their design in discussion between stakeholders, for example considering other local sites and the potential for their facilitation, and how this might differ across options. A specific consideration might be the potential for linkage of projects under the CL:AIRE Development Industry Definition of Waste Code of Practice initiative.		Goals: 8.2	8.2 Achieve higher levels of economic productivity through diversification, technological upgrading and innovation, including through a focus on high-value added and labour-intensive sectors 9.2 Promote inclusive and sustainable industrialization and, by 2030, significantly raise industry's share of employment and gross domestic product, in line with national circumstances, and double its share in least developed countries 9.5 Enhance scientific research, upgrade the technological capabilities of industrial sectors in all countries, in particular developing countries, including, by 2030, encouraging innovation and substantially increasing the number of research and development workers per 1 million people and public and private R&D spending
		B. Benefits to the technology provider (e.g. in facilitating technology replication/demonstration)	Likely quantifiable, but remediation operation providers may not want to reveal the data. At a qualitative level, an initial line of evidence could be forecasting of how options compare in terms of their outcomes in discussion between stakeholders.		Goals: 8.2, 9.2, 9.5	
		C. Innovation and new skills (for organisations)	Potentially quantifiable, but may be complex to achieve. At a qualitative level, an initial line of evidence could be forecasting of how options compare in terms of their outcomes in discussion between stakeholders.		Goals: 8.2, 9.2, 9.5	
ECON 5	Project lifespan and flexibility	A. Duration of the risk management (remediation) benefit, e.g. fixed in time for a containment system / length of time taken for beneficial effects to become apparent	Potentially quantifiable, but may be complex to achieve. At a qualitative level, an initial line of evidence could be forecasting based on how options compare in terms of their outcomes over time, for example containment would have a fixed design life time whereas destruction of the contamination is permanent. This needs to be a well evidenced discussion, for example to avoid an over-optimistic scenario for pump and treat based options.		Goals: 9.1	9.1 Develop quality, reliable, sustainable and resilient infrastructure, including regional and transborder infrastructure, to support economic development and human well-being, with a focus on affordable and equitable access for all 13.1 Strengthen resilience and adaptive capacity to climate-related hazards and natural disasters in all countries
		B. Factors affecting chances of success of the remediation / management works and issues that may affect works, incl. community, contractual, environmental, procurement and technological risks	Likely not quantifiable. A qualitative line of evidence would be consideration of the assumptions and choices underpinning each option, relating these to the specific context of the site in discussion with a range of site stakeholders. Additional information may need to be requested from the various remediation option providers. If the sustainability assessor is also one of these remediation providers, a potential conflict of interest exists and some means of external peer review would be beneficial to validate.		Goals: 9.1	
		C. Ability of project to respond to changing circumstances, including discovery of additional contamination, different soil materials, or timescales	Likely not quantifiable. A qualitative line of evidence would be consideration of the assumptions and choices underpinning each option, relating these to the specific context of the site in discussion with a range of site stakeholders. Additional information may need to be requested from the various remediation option providers. If the sustainability assessor is also one of these remediation providers, a potential conflict of interest exists and some means of external peer review would be beneficial to validate.		Goals: 9.1	
		D. Ability to respond to changing regulation or its implementation	Likely not quantifiable. A qualitative line of evidence would be consideration of the option choices and the specific context of the site and the various remediation option providers, in open discussion with them. If the sustainability assessor is also one of these providers some means of external review would be beneficial to validate.		Goals: 9.1	
		E. Robustness of solution to climate change effects	Likely not quantifiable. A qualitative line of evidence would be consideration of the option choices and the specific context of the site and the various remediation option providers, in open discussion with them. If the sustainability assessor is also one of these providers some means of external review would be beneficial to validate.		Goals: 9.1, 13.1	
		F. Robustness of solution to altering economic circumstances	Likely not quantifiable. A qualitative line of evidence would be consideration of the option choices and the specific context of the site and the various remediation option providers, in open discussion with them. If the sustainability assessor is also one of these providers some means of external review would be beneficial to validate.		Goals: 9.1	
		G. Requirements for ongoing institutional controls	Likely not quantifiable. A qualitative line of evidence would be consideration of the option choices and the specific context of the site and the opinions of the regulator, planning authority are likely to be crucial to coming to a ranking.		Goals: 9.1	

Headline Category		Possible individual indicators / criteria	Lines of evidence that could be used to support qualitative comparison	Cross references to other indicators	UN SDG Link	The linked UN SDG wordings
	Social					
SOC 1	Human health and safety	A. Risk management performance of the project (long term) in terms of delivery of mitigation of unacceptable human health risks (chronic and acute)	Mitigation of risks to human health will be a part of the risk management goals for a site. Some options may achieve a higher level of "protection" than others for example in terms of the level of contaminant reduction, the stability of the effect and the chances of any rebound. In most cases a quantitative assessment of any "extra" protection for each option is feasible, but subjectivity may be hard to determine, and outcomes may not be directly comparable, especially if the specific site context is not properly considered. At a qualitative level, an initial line of evidence could be consideration of how options compare in terms of likely impacts, for example, in terms of their likely removal of risks to human health receptors and the extent of their reliance on additional institutional controls (such as restrictions on use).	Potentially use SOC1 for considerations where there is a likely direct health impact, and SOC3 where the impact is more towards "nuisance"	Goals: 3.9	3.6 By 2020, halve the number of global deaths and injuries from road traffic accidents 3.8 Achieve universal health coverage, including financial risk protection, access to quality essential health-care services and access to safe, effective, quality and affordable essential medicines and vaccines for all 3.9 By 2030, substantially reduce the number of deaths and illnesses from hazardous chemicals and air, water and soil pollution and contamination 8.8 Protect labour rights and promote safe and secure working environments for all workers, including migrant workers, in particular women migrants, and those in precarious employment 11.7 By 2030, provide universal access to safe, inclusive and accessible, green and public spaces, in particular for women and children, older persons and persons with disabilities
		B. Risks to site workers, site neighbours and the public during restoration / management works (excavation, machinery and traffic, as well as smaller machinery, use of hazardous reagents or processes (e.g. heat) and potential transport of hazardous wastes	Some form of quantitative or semi-quantitative risk assessments may already be available, but subjectivity may be hard to determine, and outcomes may not be directly comparable. At a qualitative level, an initial line of evidence could be consideration of how options compare in terms of likely impacts, for example, in terms of their use of machinery and transportation.		Goals: 3.6, 8.8	
		C. Risk management performance on remediation works and ancillary operations (incl. process emissions such as bioaerosols, allergens, PM10)	Some form of quantitative or semi-quantitative risk assessments may already be available, but subjectivity may be hard to determine, and outcomes may not be directly comparable At a qualitative level, an initial line of evidence could be consideration of how options compare in terms of likely impacts, for example, in terms of their use of different reagents or the types of process emissions likely and what control processes might be in place.	Potentially use SOC1 for considerations where there is a likely direct health impact, and SOC3 where the impact is more towards "nuisance"	Goals: 3.9	
		D. General impacts on human health and well being: positive impacts might be from the provision of amenity; negative impacts might relate to fears, for example over the release of dread contaminants	Potentially quantifiable, but may be complex to achieve. At a qualitative level, an initial line of evidence could be consideration of how options compare in terms of the outcomes of their design in discussion between stakeholders, in particular local authorities and residents.		Goals: 3.8?, 11.7	
SOC 2	Ethics and equity	A. How well the spirit of the 'polluter pays principle' is upheld with regard to distribution of impacts/benefits	Likely not quantifiable. A qualitative line of evidence would be consideration of the option choices and the specific context of the site and the various remediation option providers, in open discussion with them. If the sustainability assessor is also one of these providers some means of external review would be beneficial to validate.		Goals: 1.4	1.4 By 2030, ensure that all men and women, in particular the poor and the vulnerable, have equal rights to economic resources, as well as access to basic services, ownership and control over land and other forms of property, inheritance, natural resources, appropriate new technology and financial services, including microfinance 5.5 Ensure women's full and effective participation and equal opportunities for leadership at all levels of decision-making in political, economic and public life 10.2 By 2030, empower and promote the social, economic and political inclusion of all, irrespective of age, sex, disability, race, ethnicity, origin, religion or economic or other status 10.3 Ensure equal opportunity and reduce inequalities of outcome, including by eliminating discriminatory laws, policies and practices and promoting appropriate legislation, policies and action in this regard 11.7 By 2030, provide universal access to safe, inclusive and accessible, green and public spaces, in particular for women and children, older persons and persons with disabilities 12.7 Promote public procurement practices that are sustainable, in accordance with national policies and priorities 16.3 Promote the rule of law at the national and international levels and ensure equal access to justice for all 16.6 Develop effective, accountable and transparent institutions at all levels
		B. Whether impacts/benefits of works are unreasonably disproportionate to particular groups, including gender concerns and consideration of "green gentrification" concerns	Likely not quantifiable. A qualitative line of evidence would be consideration of the option choices and the specific context of the site and the various remediation option providers, in open discussion with them. If the sustainability assessor is also one of these providers some means of external review would be beneficial to validate.		Goals: 1.4, 5.5, 10.2, 10.3, 11.7, 16.3	
		C. What is the duration of remedial works and are there issues of intergenerational equity (e.g. avoidable transfer of contamination impacts to future generations)?	Likely not quantifiable. A qualitative line of evidence would be consideration of the option choices and the specific context of the site and the various remediation option providers, in open discussion with them. If the sustainability assessor is also one of these providers some means of external review would be beneficial to validate.		Goals: 1.4	
		D. How options compare in the business ethics of their providers (e.g. sustainability of supply chains for inputs to remediation work, transparency, working practices, in procurement processes)	Likely not quantifiable. A qualitative line of evidence would be consideration of the option choices and the specific context of the site and the various remediation option providers, in open discussion with them. If the sustainability assessor is also one of these providers some means of external review would be beneficial to validate.		Goals: 12.7, 16.6	
		E. Whether treatment approaches raise any ethical concerns for (some) stakeholders, e.g. use of genetically modified organisms, corporate practices	Likely not quantifiable. A qualitative line of evidence would be consideration of the option choices and the specific context of the site and the various remediation option providers, in open discussion with them. If the sustainability assessor is also one of these providers some means of external review would be beneficial to validate.		Goals: 12.7, 16.6	

Headline Category		Possible individual indicators / criteria	Lines of evidence that could be used to support qualitative comparison	Cross references to other indicators	UN SDG Link	The linked UN SDG wordings
SOC 3	Neighbourhoods and locality	A. Effects from dust, light, noise, odour and vibrations during works and associated with traffic, including both working-day and night-time/weekend operations	Some form of quantitative or semi-quantitative risk assessments may already be available, but subjectivity may be hard to determine, and outcomes may not be directly comparable. At a qualitative level, an initial line of evidence could be consideration of how options compare in terms of likely impacts, for example, in terms of their use of machinery and transportation, or the operation of equipment such as fans, and considering the working hours for different options.		Goals: 9.1?	9.1 Develop quality, reliable, sustainable and resilient infrastructure, including regional and transborder infrastructure, to support economic development and human well-being, with a focus on affordable and equitable access for all 11.1 By 2030, ensure access for all to adequate, safe and affordable housing and basic services and upgrade slums 11.2 By 2030, provide access to safe, affordable, accessible and sustainable transport systems for all, improving road safety, notably by expanding public transport, with special attention to the needs of those in vulnerable situations, women, children, persons with disabilities and older persons 11.4 Strengthen efforts to protect and safeguard the world's cultural and natural heritage
		B. Wider effects of changes in site usage by local communities (e.g. reduction in antisocial activities on a derelict site)	Potentially quantifiable, but may be complex to achieve. At a qualitative level, an initial line of evidence could be face to face discussions of how options compare in terms of the outcomes between different stakeholders.		Goals: 11.4	
		C. Changes in the built environment, architectural conservation, conservation of archaeological resources	Likely not quantifiable. At a qualitative level, an initial line of evidence could be face to face discussions of how options compare in terms of the outcomes between different stakeholders.		Goals: 11.1, 11.4	
		D. Improvement in facilities / services	Potentially quantifiable, but may be complex to achieve. At a qualitative level, an initial line of evidence could be consideration of how options compare in terms of the outcomes of their design in discussion between stakeholders, for example, considering development of Sustainable Transport Opportunities.		Goals: 9.1, 11.2, 11.4	
SOC 4	Communities and community involvement	A. Changes in the way the community functions and the services they can access (all sectors – commercial, residential, educational, leisure, amenity)	Potentially quantifiable, but may be complex to achieve. At a qualitative level, an initial line of evidence could be face to face discussions of how options compare in terms of the outcomes between different stakeholders.		Goals 9.1	1.4 By 2030, ensure that all men and women, in particular the poor and the vulnerable, have equal rights to economic resources, as well as access to basic services, ownership and control over land and other forms of property, inheritance, natural resources, appropriate new technology and financial services, including microfinance. 5.5 Ensure women's full and effective participation and equal opportunities for leadership at all levels of decision-making in political, economic and public life 9.1 Develop quality, reliable, sustainable and resilient infrastructure, including regional and transborder infrastructure, to support economic development and human well-being, with a focus on affordable and equitable access for all 11.A Support positive economic, social and environmental links between urban, peri-urban and rural areas by strengthening national and regional development planning 11.3 By 2030, enhance inclusive and sustainable urbanization and capacity for participatory, integrated and sustainable human settlement planning and management in all countries 12.8 By 2030, ensure that people everywhere have the relevant information and awareness for sustainable development and lifestyles in harmony with nature 16.7 Ensure responsive, inclusive, participatory and representative decision making at all levels 16.10 Ensure public access to information and protect fundamental freedoms, in accordance with national legislation and international agreements 17.14 Enhance policy coherence for sustainable development
		B. Quality of communications and community engagement (where this differs between options being considered)	Potentially quantifiable, but may be complex to achieve. At a qualitative level, an initial line of evidence could be consideration of how options compare in terms of the outcomes of their design in discussion between stakeholders. A range of dialogue and engagement tools may support development of more concrete indicators of community values.		Goals: 1.4, 5.5, 12.8, 16.7	
		C. Effect of the project on local culture and vitality	Likely not quantifiable. At a qualitative level, an initial line of evidence could be face to face discussions of how options compare in terms of the outcomes between different stakeholders.		Goals: 1.4	
		D. Compliance with local policies/spatial planning objectives, as well as national and international good practice	Potentially quantifiable. At a qualitative level, an initial line of evidence could be consideration of how options compare in terms of the outcomes of their design in discussion between stakeholders		Goals: 9.1, 11.A, 11.3, 16.10, 17.14	

Headline Category		Possible individual indicators / criteria	Lines of evidence that could be used to support qualitative comparison	Cross references to other indicators	UN SDG Link	The linked UN SDG wordings
SOCS	Uncertainty and evidence	A. Robustness and rigour of the information provided for each option considered	Likely not quantifiable, however independent peer review may offer a route to some form of scoring across options. At a qualitative level, an initial line of evidence could be consideration of how options compare in terms of the outcomes of their design in discussion between stakeholders. Considerations might include track record, availability of published / validated performance information and track record of the technology and its operator.		Goals: 9.1, 9.5	9.1 Develop quality, reliable, sustainable and resilient infrastructure, including regional and transborder infrastructure, to support economic development and human well-being, with a focus on affordable and equitable access for all 9.5 Enhance scientific research, upgrade the technological capabilities of industrial sectors in all countries, in particular developing countries, including, by 2030, encouraging innovation and substantially increasing the number of research and development workers per 1 million people and public and private R&D spending
		B. How options differ in their intrinsic levels of uncertainty	Potentially quantifiable, but may be complex to achieve. At a qualitative level, an initial line of evidence could be consideration of how options compare in terms of certainty in meeting remedial objectives, as well as any uncertainties over wider impacts. Discussions need to be wide ranging, for example including fugitive emissions from processes of excavation and screening if these are required pretreatment for remediation options, as well as the reliability and comparability of monitoring and verification data made available.		Goals: 9.1, 9.5	
		C. Requirements for validation/verification	Likely not quantifiable. At a qualitative level, an initial line of evidence could be consideration of how options compare in terms of the outcomes of their design in discussion between stakeholders, in particular regulators.		Goals: 9.1	
		D. Degree to which robust site-specific risk-based remedial criteria have been established (e.g. justified & realistic conceptual site model versus unnecessarily conservative and/or precautionary assumptions/data)	Likely not quantifiable. At a qualitative level, an initial line of evidence could be consideration of how options compare in terms of the outcomes of their design in discussion between stakeholders, in particular regulators.		Goals: 9.1	