# Sustainable Remediation: How to compare the technologies?

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## ABSTRACT

Sustainable development is a widely understood concept that lies at the heart of all environmental activity. It seems obvious that any remediation work must be in line with sustainable development, or it would not make sense at all to remediate.

However, when it comes to define what sustainable remediation means, no practical scoring tool exists and many publication only focus on very limited aspects of sustainable development. Therefore a tool where various remediation plans can be compared with the same criteria has been developed under the form of a methodology. The system is not a hard scoring system as, by definition, sustainable development addresses areas as different as social impacts, human health, economic value of land, etc.

The proposed system scores individually the three aspects of sustainable development (economic, environmental and social) and then multiplies the segment-scores for an overall sustainability score. The system does allow for different weighing of parameters and/or addition of certain parameters which can be determined based on political priorities.

The methodology is to be used only for comparing different remediation options and/or plans in order to classify them on sustainability. This criterion is to be seen as all-inclusive, since it also includes pricing for instance.

## INTRODUCTION

A widely accepted definition of sustainable development is "*a pattern of resource use that aims to meet human needs while preserving the environment so that these needs can be met not only in the present, but also for future generations. The term was used by the Brundtland Commission which coined what has become the most often-quoted definition of sustainable development as development that "meets the needs of the present without compromising the ability of future generations to meet their own needs*." [12]

The field of sustainable development can be conceptually broken into three constituent parts: environmental, economical and social sustainability, as illustrated in Figure 1.

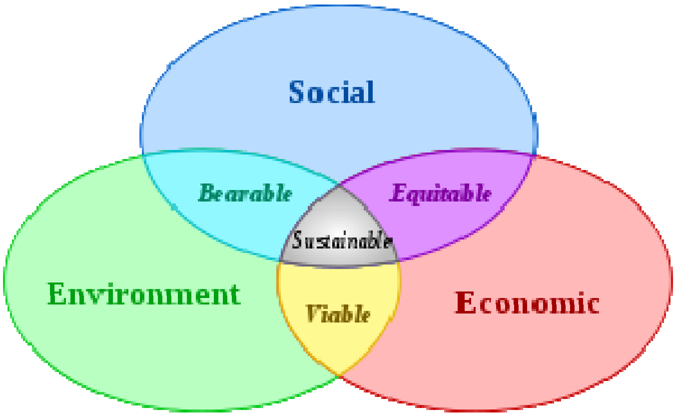


**Figure 1: Three components of sustainable development**

As such, remediation is a good illustration of unsustainable development and bearing today the consequences of such behaviour over the last 100 to 150 years. Today, we face environmental damages due to soil contamination, as well as economical consequences (land is less valuable if worth anything at all due to the contamination it contains), and finally social consequences by having our land usage substantially restricted.

In order to face such a heritage, policy makers have agreed on a Risk Based Land Management (RBLM) approach. That approach is meant to deal with the soil pollution issue in a balanced way between the three aspects of sustainable development. By applying RBLM, one considers that economical efforts for clean-up must be reduced to a level where the environmental critical aspects are taken care of. The minimum clean-up level is defined as '*reducing the risks for humans to an acceptable level*'. One can ask the question whether this approach is really in line with sustainable development and if this policy is not just transferring the problem to the next generation, which will face the same problem we currently face: an unsustainable heritage. An important aspect of sustainability (land usage) is very often skipped in this approach, as well as the potential long-term consequences of leaving residual pollution in the soil/groundwater.

Therefore, a scoring tool integrating all those aspects is presented in order to verify that each application of RBLM for soil remediation matches the sustainability criteria.

## METHOD FOR SCORING SUSTAINABLE REMEDIATION

The need for scoring sustainability is a consequence of the willingness of most people involved in policy-making as well as application of remediation to compare remediation plans with regard to sustainability. It is important for any decision-maker to try to approach, to the best of his knowledge, the best possible score for sustainability, provided sustainable development is considered to be the main marker[3]!

By definition, comparing apples and oranges is impossible from a scientific standpoint. Therefore a scoring system for sustainable development will always be driven by political choices where weighing factors will prevail towards a scientific view[45]. There is no scientific truth for determining how much money a specific living specie is worth, neither is there a correct measure for land use limitation in comparison towards groundwater impact for instance.

The scoring system therefore has to be seen as a methodology leading to an overall score for sustainability, but only to be used in order to compare different options/plans for a same problem, and provided the weighing factors have been kept consistent and in line with the major political guidelines provided. The following proposal is to be seen as a 'default' basis, not a finished work.

As stated before, the methodology is unscientific and therefore subject to all kinds of interpretations. The only purpose of the proposed scoring system is to present a consistent structure that tries to address all aspects of sustainable development and puts our common remediation practices in another light.

## OVERALL SCORE

In line with the definition of sustainable development, the overall score is defined as being the multiplication of the three individual scores (economic, environmental and social), where each of them is a score varying from 1 to 10.

The multiplication has been chosen over the addition of scores in order to favour a balanced solution compared to more extreme solutions. For a remediation plan/option to be sustainable, we have considered that all three aspects must be taken into consideration and that if one of them was to be completely neglected, it would severely affect the overall sustainability score.

## ECONOMICAL SCORE

The economical score is a sum of different elements, all constituting the economic impact. Each of the following parameters is to be expressed in local currency and simply added up to form the total 'economic impact' of the remediation project. The score (1-10) is then resulting of the classification of the various competing options/plans submitted towards each other.:

### Total cost of remediation works

This score relates to the effective costs to be paid for the remediation works/project as described and evaluated.

### Total costs of monitoring works (incl. internal costs)

In addition to the short-term remediation cost, additional monitoring costs must be taken into account at least for the monitoring period. Those costs should also include internal costs, or at least an estimate of those costs.

### Estimate cost of future remediation work (in case of residual pollution) weighed by the probability of occurrence

When residual contamination is left in place (and consequently part of the problem transferred to the next generation), future remediation costs should be estimated and weighed against the probability of occurrence of such remediation in the future. The higher the residual pollution, the higher the probability of occurrence. A reasonable discount rate (in combination wih a suitable inflation rate) should also be applied to those costs.

### Variation on land value

After remediation works, the real estate involved should have an increased value. That increase in value is a positive economic aspect and should be taken into account to mitigate remediation costs (current and future).

**ENVIRONMENTAL SCORE**

The environmental score relates to the variation brought by the remediation project to our environment. As such, it is different than the environmental impact, which constitutes, senso strictu, a social impact and is dealt in that section.

Environmental impacts can be diverse but should include the following aspects:

<u>Reduction of the impact on human health</u>

This is typically measured through the range of risk assessment models used to determine if there is a risk (or an unacceptable risk) related to that specific site. The models can indicate a risk level (albeit acceptable) and compare the risk level before and after the remediation. The higher the difference between both risk levels, the higher the score.

<u>Reduction of the impact on the ecosystem</u>

The same logic applies when determining the impact of the remediation on the ecosystem, albeit that there aren't as many models available to quantify the situation (pre- and post remediation). Focus should be on consistency when using a model.

<u>Net CO2 impact</u>

The net CO2 impact of the remediation project includes all the works done on site, off site and the transportation impact of soil (eventually). Total net CO2 impact can be measured using various models. It is important to keep consistency by using the same model for evaluation the different projects/approaches.

<u>Net impact on the use of primary resources</u>

Primary resources, such as clean water, sand, gravel, or other non-renewable resources should be accounted for. The net impact on each of those resources then needs to be compared for the different projects, leading to a classification (itself leading to a score)

<u>Recycling level – Ladder of Lansink</u>

When treating soil and/or groundwater, one should take into account the recycling level achieved according to the ladder of Lansink. The higher the reuse/recycling, the higher the score. Soil that can be reused without limitations as soil will score higher than soil that is recycled in concrete for example.

**SOCIAL SCORE**

The social aspects of soil contamination relate in part to the land usage and in part to the nuisances involved by the remediation works.

The first part relates to the limitations of use of the land before and after the remediation project/option. This aspect should reflect how much more possibilities can society in general have for usage of that particular piece of land. As a general indication, the maximum score should be given to a multi-functional use (any use possible going from industry to agriculture, park, etc.) and the lowest to a strict limitation in use (no access to the site for any societal activity for example).

The second social aspect is related to the total impact of the remediation works on society. This impact is traditionally measured through an Environmental Impact Assessment. However, the exercise, when applied, is mostly used to verify 'compliance'. In other words, it determines whether or not the project is acceptable but does not favour or hamper projects which generate more or less nuisances. It is either acceptable or not, without real nuances. Aspects to be taken into account are:

- Surface water
- Air emissions
- Noise
- Traffic
- Vibrations
- Visual impact
- Other disturbances (economic and social life for instance)

For this purpose, the total impact of each project (after mitigation measures as proposed in the remediation project) should be classified from that standpoint and point given in function of the total impact on society of the remediation works.

In our model, the second aspect weighs half as much as the first one. This is justified by the short term impact of the remediation works compared to the long-term impact of increased land usage.

**SUMMARY**

| **TOTAL SCORE** | | **ECO x ENV x SOC** | | **1 - 1000** |
|---|---|---|---|---|
| ***Economical Score*** | | ***Default weighing*** | ***ECO*** | ***1-10*** |
| | Total cost of remediation works | 10 | 1-10 | |
| | Total Cost of monitoring measures (incl. internal costs) | 10 | 1-10 | |
| | Future remediation costs (weighed by probability of occurrence) | 10 | 1-10 | |
| | Increase in value of real estate | 10 | 1-10 | |
| ***Environmental Score*** | | | ***ENV*** | ***1-10*** |
| | Impact on human health | 10 | 1-10 | |
| | Impact on Ecosystem | 10 | 1-10 | |
| | Total Net CO2 impact | 10 | 1-10 | |
| | Total impact primary resources | 10 | 1-10 | |

| | | | | |
|---|---|---|---|---|
| | Recycling level (ladder Lansink) | 10 | 1-10 | |
| ***Social Score*** | | | ***SOC*** | ***1-10*** |
| | Land usage limitation | 10 | 1-10 | |
| | Impact of remediation works (EIA) | 5 | 1-5 | |

## CONCLUSIONS

Sustainable development is a widely overused concept that is currently applied to nearly anything and possibly in any sense. Soil remediation is no exception to that. While almost everybody agrees that soil remediation must be sustainable, it appears that no scoring tools exist in relation with a practical definition of this very broad concept and its application to soil remediation plans/options.

The proposed methodology offers a way to compare different remediation plans by taking into account various aspects of sustainable development and scoring them in a consistent manner. Policy makers can use the tool to adjust their own priorities in the weighing of every parameter, so that all projects are consistently compared over the same methodology.

## REFERENCES

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