



Evaluating Remediation Options Using a Feasibility Study

This document provides guidance to qualified professionals on how to complete a feasibility study for a contaminated site. A feasibility study can assist qualified professionals to evaluate and select the best remediation alternative for a site and may be part of a remediation plan.

This guidance may be used at any site; however, a feasibility study is typically needed for large, complex sites.

Introduction

A feasibility study is a methodology for remedial decision making, where a range of remediation alternatives are possible, and where administrative, environmental, financial, and social factors are involved in the decision-making process.

A conceptual site model should be developed, and remediation goals established before a feasibility study is conducted.

A feasibility study provides evidence to regulatory agencies and affected parties that a range of remediation alternatives were considered based on specific factors, and the selected method is protective of human health and the environment for current and future conditions.

In general, there are three steps to completing a feasibility study:

- Step 1: Identifying alternatives
- Step 2: Measuring performance
- Step 3: Selecting the best option

Step 1: Identifying alternatives

The remediation alternatives evaluated must be achievable and meet all applicable provincial laws including the *Environmental Management Act* (EMA), its regulations, and associated protocols.

A range of remediation alternatives should be considered, including both in-situ and ex-situ technologies as well as long term risk management of remaining contamination. Examples

include removal with offsite disposal, *in-situ* treatment, containment, prevention of exposure through engineering or institutional controls, and monitored natural attenuation. At least three remediation alternatives should be evaluated.

Step 2: Measuring performance

Remediation alternatives should be evaluated against the performance criteria described below.

A scoring system should be developed by the project team to screen applicable remediation alternatives considering remediation goals and site-specific conditions like contaminants, development status, cost and cleanup time. The scoring system should be clear and well supported and can be based on either a numerical or weight of evidence approach.

Performance Criteria

Protection of human health and the environment

Protection of human health and the environment is the performance criteria of greatest importance.

The protection level for each of the remediation alternatives should be scored as one of the following:

- **Low Protection:** Remediation alternatives that, on their own, do not effectively address the entire extent of contamination and result in unacceptable risk to some human and/or ecological receptors. If a remediation alternative is scored “low” you do not need to evaluate other performance criteria for that alternative, and it should be withdrawn from further consideration.
- **Moderate Protection:** Remediation alternatives where contamination is left on the site and permits, advisories, or health and safety plans for workers are required to manage contamination to ensure human health or environmental protection.
- **High Protection:** Remediation alternatives that remove or close possible exposure pathways. Examples include the removal of all contamination (in-situ or ex-situ methods) or placement of a permanent soil cap or hard surfacing to prevent exposure, resulting in no unacceptable risks to human or ecological receptors.

A risk assessment may be needed to score certain remediation alternatives.

Effectiveness and permanence

As per Section 56 of the EMA, preference must be given to remediation alternatives that provide permanent solutions - by reducing the volume, toxicity, and/or mobility of contaminants, for example. This is evaluated through short-term effectiveness and long-term effectiveness and permanence, as described below:

a. Short-term effectiveness

These criteria address the effects of each remediation alternative during the implementation phase of the remedial action.

Short term effectiveness should be evaluated with regards to:

- Risks to workers and the community that might result from implementation of the proposed remediation alternative. For example, generation of dust, transportation of hazardous waste, or inhalation of hazardous vapours.
- Environmental impacts that might arise from the construction or implementation of the proposed remediation alternative. For example, impact to groundwater conditions, damage to habitat that would not otherwise occur as part of redevelopment, risks to animals and plants, or erosion.
- Estimated time required to achieve remediation objectives.

b. Long-term effectiveness and permanence:

These criteria address how each remediation alternative minimizes future risk, ensuring the remediation will remain effective over time with minimal ongoing intervention. These criteria also consider the potential risks that might remain at the site after the remedial objectives have been met and whether controls are needed to manage risks long term.

Long term effectiveness and permanence should be evaluated to the extent practicable with regards to:

- A risk assessment, taking into consideration the volume of remaining contaminants and their toxicity, mobility, and propensity to bioaccumulate.
- Risk controls needed to manage remaining risks, including ongoing monitoring and the potential need for replacement or upgrades to these controls. Consideration should also be given to consequences of a potential risk control failure.
- Vulnerability of the remediation alternative to current and future climate hazards. See [guidance for considering climate change in remediation](#) for more information.

Technical feasibility

Confirm the necessary scientific knowledge, technology, tools, and skilled people are available to successfully complete the remediation alternative under the conditions at the site.

Technical feasibility may also refer to the ability of a remediation alternative to meet the remediation goals based on site specific conditions. For example, it may not be technically feasible or safe to remediate a site due to:

- Congested underground utilities.

- Active transportation corridors that cannot be shut down.
- Geotechnical reasons such as maintaining structural stability of infrastructure.
- Complex topography such as steep slopes and deep groundwater, or mature forests
- Physical removal or disturbance that may result in more ecological harm than benefit (e.g., loss of important habitat).

Timeframe

The estimated time to complete remediation includes all remediation actions required to meet the Contaminated Sites Regulation numerical and/or risk-based standards.

This criterion should be ranked based on time to achieve remediation in the context of potential risk. For example, it may be acceptable for a site with low or unlikely risks to human health or the environment to undergo remediation over an extended time frame, whereas such an approach would not be acceptable where elevated risks to human health or the environment may be ongoing or imminent.

Costs

Total cost data for the remediation alternatives should be analysed in reference to capital costs (consisting of direct and indirect costs), and annual operation and maintenance costs.

Capital costs include those expenditures initially incurred to develop, design, and implement the remediation alternative.

Public acceptance

Public consultation or review of proposed remediation alternatives should be considered when a community is affected by contamination. The different remediation alternatives should be explained to ensure the affected community is informed and is given a reasonable opportunity to discuss their concerns and provide input to the remedial option selection process.

Engagement or consultation with First Nations potentially affected by the contaminated site may be necessary and is determined on a case-by-case basis. See [proponent resources for engagement and consultation](#) for more information.

Additional environment or social benefits

Beyond the performance criteria described above, other criteria may be considered that provide additional environmental or social benefits. Environmental benefits could include:

- Green and sustainable remediation: for example, using low-energy technologies, or natural processes to minimize overall environmental impact when cleaning up contamination.
- Re-establishment of a resource for food.
- Expansion of green or recreational space.

Social benefits could include job creation or supporting local businesses.

Step 3: Selecting the best option

The remediation alternative selected for implementation is expected to comply with the numerical standards or risk-based standards prescribed in the [Contaminated Sites Regulation](#).

Selection of the best remediation alternative should be based on the scoring of the criteria described in Step 2. The highest ranked remediation alternative would normally be selected for implementation. However, a lower ranked alternative may be selected if there is sufficient rationale, for example, if public or First Nations consultation identified a preference for a lower ranked alternative, or if a lower ranked alternative is more sustainable.

Offsets

Environmental offsets are a way to compensate for environmental impact from contamination that is not technically feasible or safe to remediate at one location by improving the environment at another location.

Following the evaluation process, if no remediation alternatives remain or a less-than-ideal remediation alternative is the only option, offsets may be considered. For example, if the highest-ranked remediation alternative would damage sensitive habitat, by paving over or permanently removing areas used by species at risk, offsets may be an option. Contact remediationFAQs@gov.bc.ca for further advice.

Reporting

Feasibility studies are typically completed and submitted as part of a remediation plan and should include:

- A description or tabulated results showing how the alternatives were scored and ranked.
- Rationale for the remediation alternative selected.
- Records of communication with affected parties and First Nations, where applicable.