



Ministry of
Environment and
Climate Change Strategy

PROTOCOL 19 ***FOR CONTAMINATED SITES***

Site Investigation and Reporting

Version 1

Prepared pursuant to Section 64 of the
Environmental Management Act

Approved:

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Protocol Implementation

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1.0 Definitions

Terms defined in the Environmental Management Act (EMA) and the Contaminated Sites Regulation (CSR) apply to this protocol, in addition to the following:

“**acid rock drainage**” means low pH surface or ground water that results from the oxidation of sulfide minerals, elemental sulfur, or the dissolution of acid generating minerals found in rocks.

“**non-waste soil**” means soil with substance concentrations less than CSR soil and vapour standards applicable at a receiving site.

2.0 Introduction

This protocol is made under the authority of EMA section 64 1(c), 1(d), 2(a), 2(b), 2(c), 2(f), 2(g) and builds on requirements for site investigations and reporting set out in the CSR 49(2)(b), 58 and 59.

Consistent with EMA and the CSR, this protocol specifies requirements for investigation, analysis and interpretation, and assessment for soil relocation activities.

The requirements described in this protocol must be met when relocating soil suspected to be non-waste from a source site to a receiving site.

This protocol should be used in conjunction with other ministry’s policies, protocols, and guidance.

3.0 Qualified professionals

All aspects of this protocol must be completed by or under the supervision of qualified professionals. It is the responsibility of the site owner or operator to retain qualified professionals with demonstratable experience, to ensure that the soil quality at the source site is properly characterized prior to relocation while adhering to applicable BC legislation, regulations, standards, protocols, procedures, and guidance.

4.0 Sample collection and analysis

Sampling methodologies and quality control/quality assurance procedures must follow the B.C. Field Sampling Manual or any applicable methods and/or procedures prescribed in protocols.

1. Subject to paragraph 2, substances must be analysed by a “qualified laboratory”, as defined in the Environmental Data Quality Assurance Regulation using methods specified in:
 - a. the B.C. Environmental Laboratory Manual; or
 - b. if no methods are specified for the required analysis in the B.C. Environmental Laboratory Manual, a method approved in writing by the director on a case-by-case basis.
2. If a director is satisfied that either a method specified in the B.C. Environmental Laboratory Manual is not appropriate in the circumstances or that another method will provide more accurate results, the director may require an alternative method under this paragraph in writing and on a case-by-case basis.

5.0 Sampling and analysis plans for relocation of non-waste soil

This section describes requirements for the investigation and characterization of soil suspected to be non-waste that is to be relocated from a source site to a receiving site. The sampling requirements in this section are not considered appropriate for the classification of soil suspected to be waste quality soils.

5.1 Identifying potential contaminants of concern for non-waste soil

To identify potential contaminants of concern (PCOCs) for non-waste soil, the following actions must be completed:

1. Review site historical use and records, including a search of the site registry, to determine current and past activities or uses, accidents and spills, and practices and management relating to potential contamination at the site and neighbouring sites.
2. One or more site reconnaissance visits with visual inspection of buildings, property, equipment, land, surface water and biota for indicators or presence of contamination.
3. Interviews with current or former owners, occupants, neighbours, directors, employees and government officials who can, with reasonable attempts, be contacted respecting information on activities that may have caused contamination.

PCOCs must be selected based on the historical and current specified industrial and commercial uses identified at the source site.

5.2 Soil and soil vapour sampling and analysis plans

A qualified professional must prepare a sampling and analysis plan that applies to the soil to be relocated from the source site. The sampling and analysis plan must:

1. Identify each location where soil is to be excavated for relocation.

2. Include a site plan with site buildings, areas of potential environmental concern (APECs), PCOCs identified from historical reviews, and areas where soil is to be removed.
3. Ensure an appropriate level of sampling and analysis is carried out to determine the concentration of PCOCs in the excavated soil and identify the soil from the source site that meets the quality for relocation to the receiving site.
4. Determine the location, concentration, and distribution of substances in the soil to be excavated by sampling soil and vapour using sampling methods described in section 5.3.

5.3 Collection of soil and soil vapour samples

When collecting soil and soil vapour samples from non-waste soil to be relocated from the source site:

1. Determine the location, concentration, and distribution of PCOCs in the soil to be excavated by sampling undisturbed soil (in-situ sampling).
2. Identify areas to be sampled for PCOCs, using a coarse grid with 25 to 50 m spacing between sampling locations. Grid spacing must be decreased in areas with greater potential for contamination, including areas within 50 m of site APECs or within 10 m from lateral and vertical extents of known contamination.
3. Conduct targeted sampling at select depths with the potential for maximum concentrations of PCOCs.
 - a. In-situ soil sample depth selection must include:
 - i. Surface soil samples collected from a maximum depth of 0.5 m below the site surface.
 - ii. Samples collected at a depth immediately above fine-grained soil units.
 - iii. Samples from the water table elevation, if applicable.
 - iv. For homogeneous soil units, soil samples collected at vertical intervals of 1 to 2 m spacing.
 - b. In-situ soil vapour sampling must target locations nearest the source zone and must be collected at a depth of 1 m or greater below the site surface. While in-situ soil vapour sampling is preferred, for sites with shallow groundwater, an alternate soil vapour sampling method may be required such as soil vapour sampling of ex-situ stockpiles.

If an in-situ sampling approach is not practical or feasible, samples must be collected from stockpiles where soil is temporarily stored.

In preparing and implementing the sampling and analysis plan, the qualified professional must ensure that the following requirements are satisfied:

1. The number of samples collected and analyzed must be sufficient to give a high degree of confidence to characterize PCOCs in all soil to be relocated.

2. Where there is information regarding the location of PCOCs within an APEC that is within the excavation area, sample locations must be identified with the objective of locating the maximum concentration. Soil and vapour samples must be collected from representative depths and locations to characterize substances in the soil that is to be relocated.
3. Soil vapour samples must be collected at source sites where the soil to be relocated contains prescribed volatile chlorinated substances above detectable limits or contains a volatile substance concentration in soil greater than the generic numerical soil standard for low density residential land use (RL_{LD}) or the lowest value of the matrix numerical soil standards for RL_{LD}.
4. Field logs must be recorded and finalized for all sampling locations to document the soil and soil vapour conditions within the project area.
5. At a minimum, every soil sample, required to be collected, must be analyzed for the following parameters:
 - a. Polycyclic aromatic hydrocarbons (PAH).
 - b. metals (aluminum, antimony, arsenic, barium, beryllium, boron, cadmium, chromium, cobalt, copper, lead, lithium, manganese, molybdenum, nickel, selenium, silver, strontium, tin, uranium, vanadium, and zinc).
 - c. any PCOC relevant to current and historical site use as identified during the historical review.
6. The following additional requirements apply to soil samples collected using an in-situ sampling approach (in relation to the area identified where sampling is required):
 - a. For non-volatile parameters, discrete samples from the same formation may be collected from several locations, mixed together, and submitted as a composite sample as described in CSR Technical Guidance 1, "Site Characterization and Confirmation Testing (TG1). The use of composite samples does not change the minimum number of samples specified for analysis.
 - b. A minimum of three soil samples must be analyzed if less than 600 cubic metres of soil will be relocated.
 - c. If more than 600 cubic meters of soil will be relocated, at least three samples must be analyzed for the first 600 cubic meters, with one additional sample analyzed for each 200 cubic metres of soil up to 10,000 cubic metres of soil to be relocated.
 - d. At least one additional soil sample must be analyzed for each 450 cubic metres after the first 10,000 cubic metres of soil to be relocated up to 40,000 cubic metres.
 - e. At least one additional soil sample must be analyzed for each additional 2,000 cubic metres after the first 40,000 cubic metres of soil to be relocated.
7. The following additional requirements apply to soil samples collected using a stockpile sampling approach:

- a. Samples must be collected at different depths within a stockpile to characterize the depth profile and the spatial variation, laterally and vertically, of the PCOCs within the stockpile.
 - b. Soil samples must be collected from a depth of greater than 0.3 m below the stockpile surface.
 - c. For non-volatile parameters, discrete samples can be collected from stockpiles and combined to provide composite samples for characterization, as described in TG1. The use of composite samples does not change the minimum number of samples specified for analysis.
 - d. A minimum of three soil samples must be analyzed if less than 130 cubic metres of soil will be relocated.
 - e. If more than 130 cubic metres of soil will be relocated, at least three samples must be analyzed for the first 130 cubic meters, with one soil sample analyzed for each additional 130 cubic metres of soil up to 2,600 cubic metres of soil to be relocated.
 - f. At least one additional soil sample must be analyzed for each 200 cubic metres after the first 2,600 cubic metres of soil to be relocated.
8. The following additional requirements apply to soil vapour samples collected using an in-situ sampling approach (in relation to the area identified where sampling is required):
- a. A minimum of two soil vapour samples must be analyzed if less than 600 cubic metres of soil will be relocated.
 - b. If more than 600 cubic meters of soil will be relocated, at least two soil vapour samples must be analyzed for the first 600 cubic meters, with one additional sample analyzed for each additional 2,500 cubic metres of soil.
9. The following additional requirements apply to soil vapour samples collected from a stockpile:
- a. Samples must be collected, within a stockpile to characterize the PCOCs within the stockpile.
 - b. The minimum depth for a soil gas probe is 1.0 m below the stockpile surface. Place a surface seal such as a plastic sheet over the portion of stockpile being sampled to minimise ambient air leakage.
 - c. The vapour sample must be collected after equilibration of vapour within the stockpile. Use a photoionization detector to confirm equilibration. The minimum equilibration time is one week after placement of the stockpile.
 - d. Complete leak testing at each sample probe location.
 - e. A minimum of three soil vapour samples must be analyzed if less than 250 cubic metres of soil will be relocated.
 - f. If more than 250 cubic metres of soil will be relocated, at least three soil vapour samples must be analyzed for the first 250 cubic meters, with one soil vapour sample

analyzed for each additional 250 cubic metres of soil up to 2,500 cubic metres of soil to be relocated.

- g. At least one additional soil vapour sample must be analyzed for each 500 cubic metres after the first 2,500 cubic metres of soil to be relocated.
10. A sufficient number of soil samples must be collected and analyzed to determine the representative pH of soil at the receiving site to evaluate matrix numerical soil standards for soil to be relocated.
11. The soil analytical data must be compared to site specific factors applicable to the receiving site for matrix numerical soil standards

5.4 Quarried material sampling and analysis plans

For quarried material derived from the mining and crushing of bedrock, the original deposits are to be evaluated for potential metal leaching and acid rock drainage (ML/ARD). These procedures for evaluating the potential for ML/ARD are based upon static tests, site specific factors and the interpretation of these parameters by a qualified professional. ML/ARD evaluation must be performed in advance of materials being mined where volumes to be relocated exceed 1000 m³, or greater than 100 m³ where the mined rock is to be relocated adjacent to sensitive habitat.

Samples are to be collected of representative, unweathered, in-situ rock samples for testing. Composite sampling is not acceptable. The samples must be collected using professionally acceptable sample collection methods and must be taken by or under the supervision of a qualified professional.

At a minimum, a sample must be collected at a frequency of 1 sample per 2,000 m³ and every sample analyzed for all of the following parameters:

- From Acid-Base Accounting (ABA) test: Neutralization Potential Ratio (NPR) –Neutralization Potential (NP)/Acid Potential (AP)
- Sulfide sulfur
- Four Acid Digestion Total Metals Analysis (Four Acid metals) – anomalous metal concentrations in comparison to CSR standards
- Shake Flask Extraction Test (SFE) – indication of leachable oxidation products for current condition of material: acidity, metals.

Based upon the sample results, the following applies to the potential relocation of the quarried material.

1. If the rock sample has an NPR less than 1, this result indicates that the sample has a high potential to produce ARD and is unsuitable for relocation to a receiving site. An NPR value of less than 1 suggests that the rock should not be further disturbed or exposed.

2. If the rock sample has an NPR between 1 and 2, this result indicates a level of uncertainty with the sample to produce ARD. Site-specific factors must be considered and results of the sulphide, Four Acid metals, and SFE analysis methods must be used to evaluate the potential for ARD to occur from this source prior to determining the final use of the material.
3. If the rock sample has an NPR value greater than 2, this result indicates that the sample has a low potential to produce ARD, however, it could still contribute to near-neutral pH metals drainage. The site-specific factors must be considered and results of the sulphide, Four Acid metals, and SFE analysis methods must be used to evaluate the potential for ARD to occur from this source prior to determining the final use of the material.

Revision history

Approved Date	Effective Date	Document Version	Notes
January 24, 2023	March 1, 2023	1	New protocol – includes requirements necessary for implementation of CSR Stage 14 soil relocation amendments.