



Ministry of  
Environment and  
Climate Change Strategy

# ***PROTOCOL 14***

## ***FOR CONTAMINATED SITES***

### Requirements for Determining Barite Sites

Version 3.0

Prepared pursuant to Section 64 of the  
*Environmental Management Act*

Approved:

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Kevin Butterworth  
Director of Waste Management

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Date

**Effective Date: March 1, 2023**

## 1.0 Definitions

**“anthropogenic barium”** means any form of barium present, stored, used, or disposed of at a site by humans.

**“barite”** means the chemical compound, barium sulphate ( $\text{BaSO}_4$ : CAS No. 7727-43-7, 13462-56-7).

**“barite site”** means a site at which it can be demonstrated to the satisfaction of the Director that anthropogenic barium at the site is exclusively in the form of barite.

## 2.0 Introduction

The toxicity of barium is attributed to the barium ion ( $\text{Ba}^{+2}$ ) and therefore the toxicity of a particular barium compound is related to that compound's solubility. Although in general the solubility of barium compounds increases with decreasing pH, barite (barium sulphate) is virtually insoluble in alcohol, alkalis and weak or dilute acids. Consequently barite is unique among barium compounds in being virtually insoluble and non-toxic under most environmental conditions.

The [BC Environmental Laboratory Manual](#) provides two analytical methods for the analysis of barium in soil:

- Strong Acid Leachable Metals (SALM) in Soil, and
- Soluble Barium by Calcium Chloride Extraction (“calcium chloride method”).

At sites where barium has only been used in the form of barite for commercial or industrial purposes, the SALM analytical method can result in considerable overestimation of soluble barium concentrations in soil when compared to more environmentally relevant extraction methods. To address this issue of extractive bias related to barite, the calcium chloride method may be used at barite sites.

The calcium chloride method is based on calcium chloride cation exchange-associated extraction of barium from soil rather than the traditional strong acid extraction used in SALM. Compared to SALM, the calcium chloride method is much less “aggressive” in its ability to extract barium from barite in soil. However, this method will efficiently extract barium from other more soluble, and therefore more toxic, barium compounds which may be present in soil.

At any site, including barite sites, barium concentrations in soil may be determined using the SALM method. The calcium chloride method, however, has been designed and validated strictly for use at barite sites.

The purpose of this protocol is to provide a procedure by which a site may be determined to be a barite site, and to specify associated rules of application related to the use of the calcium chloride method at such sites.

### **3.0 Determination if a site is a barite site**

For the purposes of this Protocol, a site may be determined to be a barite site based on evidence that demonstrates to the satisfaction of the Director that the sole anthropogenic source of barium at the site can be attributed to barite. Examples of acceptable documentary evidence include, but are not necessarily limited to:

- invoices, bills of sale, bills of lading, receipts, and other financial records;
- well drilling (Tour) reports<sup>1</sup>;
- daily well drilling records and well logs;
- contractor service invoices and receipts;
- BC Oil and Gas Commission<sup>2</sup> drilling Waste Disposal Summary forms or other waste disposal information on record<sup>3</sup>;
- well installation, maintenance and decommissioning records (well files);
- records provided, reviewed or assessed in environmental consultant site reports; and
- records provided, reviewed or assessed in other pertinent company or government (Federal, Provincial or local) reports.

The provision of complete, documentary evidence related to the determination of a site as a barite site is the responsibility of the person undertaking investigation and/or remediation of the site.

### **4.0 Rules of application related to the use of the calcium chloride method**

The use of the calcium chloride method to characterize barium concentrations in soil under the Contaminated Sites Regulation is authorized only at a site determined to be a barite site.

Use of the SALM method to characterize barium concentrations in soil is authorized at all sites, including sites determined to be barite sites for which a person decides not to characterize barium concentrations in soil by using the calcium chloride method.

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<sup>1</sup> Tour reports, notification forms and daily drilling records may be obtained from IHS RapiData™, at <https://my.ihs.com/energy>

<sup>2</sup> Note that in 2022 amendments were made to the *Oil and Gas Commission Act* which renamed the Act as the *Energy Resource Activities Act* and the Oil and Gas Commission as the British Columbia Energy Regulator. Those amendments were not yet in force on the date this protocol was established.

<sup>3</sup> The BC Oil and Gas Commission may also be able to provide Tour reports, notification forms and daily drilling records. In addition, the BC Oil and Gas Commission maintains a drilling waste tracking system that may be accessed at <https://www.bccgc.ca/energy-professionals/online-systems/esubmission/>

A person who decides to use the calcium chloride method to characterize soil barium concentrations must also determine representative soil background barium concentrations<sup>4</sup>.

## Reporting

### 5.1 Reporting requirements

Documentary evidence related to the determination of the site as a barite site must be provided in the preliminary site investigation report prepared for the site and submitted in support of applications for contaminated site certification documents under the Regulation.

### 5.2 Reporting requirements related to barium in background soil

A preliminary site investigation report prepared for a barite site must include representative soil background barium concentration data. The sampling requirements for background barium soil data are as follows:

- select three different background locations within the immediate locale of the barite site,
- at each background location collect a minimum of four soil samples consisting of:
  - one surface soil sample, obtained from 0 m to 0.1 m from the surface of the background location;
  - one shallow subsurface soil sample obtained from 0.5 m to 0.6 m from the surface of the background location;
  - one intermediate subsurface soil sample obtained from 0.9 m to 1.0 m from the surface of the background location; and
  - one deep subsurface soil sample obtained from 1.5 m to 2.0 m from the surface of the background location<sup>5</sup>,
- split each collected sample into equal parts, and
- analyze one part using the SALM in soil method and the other part using the calcium chloride method.

The background soil barium concentrations obtained for the 24 samples form a component of the preliminary site investigation report for the barite site.

### Revision history

Approved Date	Effective Date	Document Version	Notes
December 10, 2008	January 1, 2009	2.0	
March 20, 2023	March 1, 2023	3.0-	Updated to reflect CSR Stage 14 amendments

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<sup>4</sup> Currently, the ministry lacks regional or local background soil barium estimates determined by the new CaCl<sub>2</sub> methodology.

<sup>5</sup> Where geological conditions would allow doing so.