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Soil quality — Sampling —

Part 5: Guidance on the procedure for the investigation of urban and industrial sites with regard to soil contamination

Qualité du sol — Échantillonnage —

Partie 5: Lignes directrices pour la procédure d'investigation des sols pollués en sites urbains et industriels

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ISO copyright office
Case postale 56 • CH-1211 Geneva 20
Tel. + 41 22 749 01 11
Fax + 41 22 749 09 47
E-mail copyright@iso.org
Web www.iso.org

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

ISO/IEC 10381-5 was prepared by Technical Committee ISO/TC 190, *Soil quality*, Subcommittee SC 2, *Sampling*.

ISO/IEC 10381 consists of the following parts, under the general title *Soil quality — Sampling*:

— *Part 1: Guidance on the design of sampling programmes*,

— *Part 2: Guidance on sampling techniques*,

— *Part 3: Guidance on safety*,

— *Part 4: Guidance on the procedure for investigation of natural, near-natural and cultivated sites*,

— *Part 5: Guidance on the procedure for the investigation of urban and industrial sites with regard to soil contamination*,

— *Part 6: Guidance on the collection, handling and storage of soil for the assessment of aerobic microbial processes in the laboratory*,

— *Part 7: Guidance on sampling of soil gas*,

— *Part 8: Guidance on sampling of stockpiles.*

Introduction

This part of ISO 10381 is one of a group of standards dealing with various aspects of site investigation and sampling. It should be used in conjunction with the other parts of ISO 10381 (see Foreword).

Whilst serious cases of soil contamination mostly occur at urban and industrial sites, serious contamination of agricultural land can also occur (for example, due to pesticides usage, long-term irrigation and application of organic wastes). In such cases, a combination of the methodologies of ISO 10381-4 and ISO 10381-5 may be appropriate. When the objective of an investigation is related to plant growth, reference should be made to ISO 10381-4.

The general terminology used is in accordance with that established in ISO/TC 190 “Soil quality” and more particularly with the terminology given in ISO 11074.

The investigation of ground water, soil gas and surface water falls outside the scope of (this part of) ISO 10381. For more information on ground water and surface water sampling, see ISO 5667. Information on the sampling of soil gas is provided in ISO 10381-7.

Soil quality — Sampling —

Part 5: Guidance on the procedure for the investigation of urban and industrial sites with regard to soil contamination

1 Scope

This part of ISO 10381 gives guidance on the procedure for the investigation of urban and industrial sites, where either it is known that soil contamination is present, or the presence of soil contamination is suspected. It is also applicable where there is a need to establish the contamination status of the site, or there is a need to establish the environmental quality of the site for other purposes.

This part of ISO 10381 includes guidance on the collection of information that is necessary for risk assessment and/or the development of remedial action plans (e.g. whether remediation is required and suggestions as to how this might be best achieved). However, it only provides guidance on the information required in general. It is emphasized that specific remediation methods may need additional information.

This part of ISO 10381 is also applicable to sites where no soil contamination is expected, but the soil quality is to be determined (e.g. to make sure that there is no contamination present).

Although the sites considered in this document have been defined as urban and industrial sites, the guidance contained in this part of ISO 10381 is equally applicable to any site where the degree and extent of contamination needs to be established.

NOTE 1 Contamination is defined as a result of human influences; however, the methods described for investigation are also applicable where there are naturally high concentrations of potentially harmful substances.

NOTE 2 A number of different objectives for soil sampling are listed in Annex A, along with references to the relevant parts of ISO 10381.

NOTE 3 Although the general part of the information for the risk assessment and/or the development of remedial action plans is gathered by applying this part of ISO 10381, this document does not give guidance on the decisions and actions that follow from a site investigation, for example, risk assessment and decisions about the requirements for remediation (if any).

NOTE 4 This part of ISO 10381 deals only with the investigation of the ground. It is important to recognize that on old urban and industrial sites, there may be derelict buildings and/or industrial plants awaiting demolition, dismantling or refurbishment. Failure to investigate these buildings before demolition may put the safety of workers at risk or lead to the spread of contamination on and around the site. The investigation of derelict buildings or remnant foundations falls outside the scope of this part of ISO 10381.

NOTE 5 In many situations there is a close relation between the contamination of the soil, ground water, soil gas and — to a lesser extent — surface water.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 11074, *Soil quality — Vocabulary*

3 Terms and definitions

For the purpose of this part of ISO 10381, the terms and definitions of ISO 11074 apply.

4 Objectives

4.1 General

This guidance provides a framework for the various stages and phases that can be taken in the investigation of land. The resulting determination of the contamination status can then lead to risk assessment and where necessary facilitate the selection and application of appropriate remedial actions. Guidance on data and information requirements for particular purposes is provided in a number of International Standards including ISO 15175, ISO 15176, ISO 15799, and ISO 15800.

4.2 Definitions of objectives

The reasons for an investigation and hence the objectives can vary widely but are generally:

— to identify and assess the risks to those using the site, and in the event of redevelopment, to subsequent users and occupiers of the site;

— to identify and assess the risks presented to the environment including adjacent land, surface and groundwater, ecosystems and public health;

— to identify and assess the risks which may be presented to workers who may be involved in investigation, remediation, redevelopment or maintenance of the site;

— to identify and assess the potential for adverse effects on building materials;

so that decisions can be made about the importance of the risks and whether it is necessary to take any form of action to deal with them.

From the principal objectives of the investigation, a number of subsidiary objectives can be derived. These may include the following:

a) determine if any immediate action is required to protect exposed receptors;

b) identify compounds that are, or may be, present that may represent a risk to one or more actual or potential receptors;

c) identify receptors (e.g. human, ecosystems, groundwater) that are or may in the future be at risk;

d) identify pathways by which particular receptors may be exposed to the contaminants;

e) provide the data and other information to use in a risk assessment;

f) provide information to aid the design of protective or remedial measures;

g) enable characterization of contaminated materials to ensure safe and suitable handling and disposal;

h) provide reference data against which the achievement of remediation performance can be judged;

i) enable judgements to be made about the likely impact of continued use of the site on soil quality;

j) provide information to assess the risk of (legal) environmental liabilities and the effect on the value of the property.

These generalized objectives will be formulated into specific requirements depending upon the purpose of the investigation.

EXAMPLE A site investigation prior to the purchase of a site for the construction of domestic dwellings could have one or more of the following objectives:

— establish the history of the site and the potential for the presence of contamination;

— establish the nature, extent and distribution of (expected) contamination within the site boundaries;

— identify the potential for migration of contamination beyond the site boundaries including surface and ground water (this may indicate there are potential legal environmental liabilities);

— identify any immediate dangers to public health, safety, and the environment;

— identify constraints in relation to a proposed development (human and environmental risks) and any remedial works necessary and provide data from which to develop cost estimates;

— provide information to facilitate the formulation of a full interpretative report with conclusions, recommendations and budget costing for remedial actions.

5 General strategy of site investigation

5.1 General

Determination of the extent of a contaminated area and particularly the assessment of human and environmental risks caused by contamination can be complex. Because of this complexity, the process of identifying, quantifying and evaluating the risks associated with contaminated land should be an iterative process with several stages of investigation (each with specific objectives to be achieved), in order to obtain sufficient relevant data to characterize the potential risks, pathways and receptors of concern. The objectives should be reconsidered at each stage, and the requirements for further investigation reviewed as the investigatory and assessment processes are developed.

The principal phases are

— preliminary investigation (see 5.2),

— exploratory investigation (see 5.3, 7 and 8), and

— main site investigation (see 5.4, 7 and 9).

The relationship between these phases is illustrated in Figure 1.

Supplementary investigations may be required subsequent to the main site investigation in order to provide information relevant to the selection of remedial methods, or design remediation of construction works.

Following completion of any of these investigations, a report giving its results should be prepared.

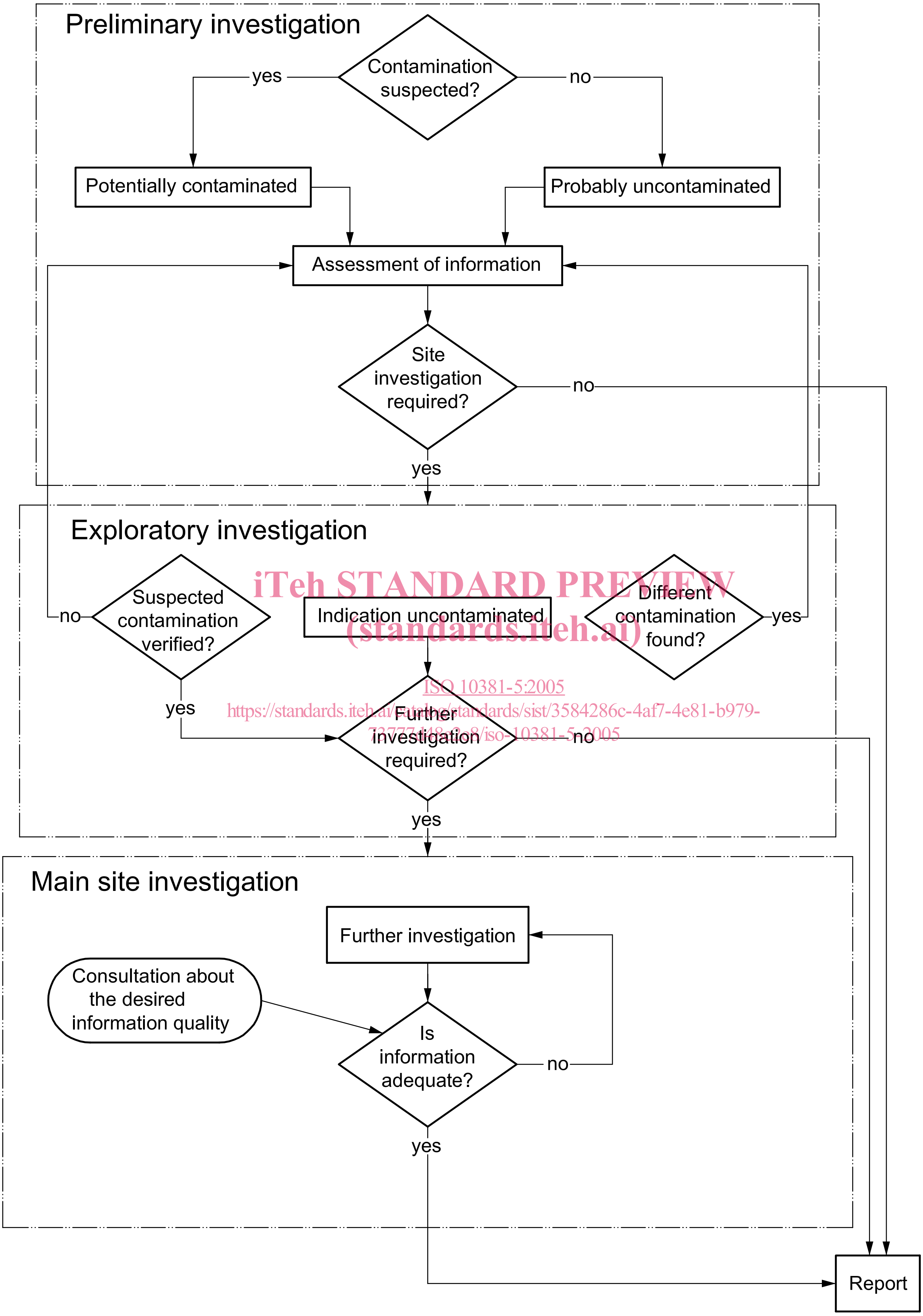

Figure 1 — Flow-chart of phases of site investigation

The strategy for the investigation (whether preliminary, exploratory or main site) will be determined by the objectives. For example, the different requirements of site investigations for the purpose of selling, determining whether contamination is present as suspected, or redevelopment will influence the spacing of sample locations and the number of samples analysed, and hence the cost of the investigation.

Before embarking on any phase or stage of investigation, it is important to set data quality objectives in terms of the type, quantity and quality (e.g. analytical quality) of the data and other information that is to be collected. These data quality objectives will depend in part on the nature of the decisions to be made on the basis of the investigation, and the confidence required in those decisions. Failure to set data quality objectives at the outset can lead to considerable waste of money, if, for example, the data collected are not suitable or sufficient for a reliable risk assessment, or leave too many uncertainties about the “conceptual model” developed for the site (see 6.5 for the definition of the conceptual model).

When deciding on the strategy, consideration should be given to the applicability and use of onsite analysis and/or in-situ measurement techniques. This part of ISO 10381 does not provide any specific guidance on these topics.

5.2 Scope of preliminary investigation

The preliminary investigation comprises a desk study and site reconnaissance (walk-over survey, site inspection). It is carried out using historical records and other sources to obtain information on the past and present usage of the site together with information about local soil properties, geology, pedology, hydrogeology and environmental setting.

From this preliminary investigation, the possibility of contamination can be deduced, and hypotheses can be formulated on the nature, location and distribution of the contamination.

These hypotheses form part of the overall conceptual model of the site that should be developed, encompassing not only the contamination aspects but also the geology, pedology, hydrogeology, geotechnical properties and the environmental setting. The current and planned site uses are also important aspects of the conceptual model.

The preliminary investigation should provide sufficient information

— for initial conclusions about potential risks to actual or potential human and other receptors, and

— to determine whether there is a need for further action.

The amount and type of information required will depend on the objectives of the investigation. The amount of work required will vary with the age of the site, the complexity of its historic usage, and the complexity of the underlying geology, etc.

It should be remembered that the contamination on a site may be more complex than initially indicated (for example, by current usage) and adequate information on the history of the site should always be obtained in the preliminary investigation.

5.3 Scope of exploratory investigation

The exploratory investigation involves an onsite investigation, including collecting samples of soil or fill, surface water, groundwater, and soil gas, where appropriate, and the subsequent analysis or testing of the collected samples. The data and information produced are then assessed to determine if the hypotheses from the preliminary investigation are correct, and, where appropriate, to test other aspects of the conceptual model. It is therefore mainly a qualitative investigation rather than quantitative, typically only a few samples will be analysed.

In some cases where the hypotheses are indicated as being correct, no further investigation may need to be carried out.

However, it may become apparent as a result of the exploratory site investigation, for example, that the contamination pattern is more complex, or concentrations of contamination are higher than anticipated, and may have already caused or in the future may cause a hazard. In this situation, the information obtained may be inadequate to make decisions with a satisfactory degree of confidence, and it will be necessary to carry out a main site investigation to produce sufficient information to enable a full risk assessment to be carried out, the need for protective or remedial measures to be determined, and in due course and possibly following further stages of investigation, to select, design and apply protective or remedial measures.

5.4 Scope of main site investigation

The main site investigation serves for the quantitative determination of the amount and spatial distribution of contaminants, their mobile and mobilisable fractions and possibilities of spreading in the environment. This includes possible future development of the contamination situation.

It requires the collection and analysis of soil or fill, surface water, ground water, and soil gas samples in order to obtain the information necessary to enable a full assessment of the risks presented by the contamination to humans and other potential receptors, and also to enable appropriate containment or remediation actions to be identified (sometimes), together with an initial estimate of costs. The analysis of samples can be supported by model calculations and investigation techniques without sampling. Detailed design of protective or remedial works may require further stages of investigation.

The amount and nature of the information required from the main site investigation (or any particular stage of it) will vary depending on the nature of the site, and the objectives of the investigation. The implications of the decisions on what actions should be implemented on a site will vary from site to site. Additionally, the amount and quality of the information required will also vary according to the requirements of the decision making processes (e.g. the risk assessment, decisions regarding the need for and type of remedial actions). All parties involved in the decision making process should be kept fully informed as information is produced to ensure that the information is sufficient for the purpose intended.

After completion of the interpretation of the information generated, including any risk assessment, it should be possible to determine whether protective or remedial measures are required and to make generalizations about the type of measures that might be appropriate.

6 Preliminary investigation

6.1 Introduction

The preliminary investigation serves for gaining knowledge of relevant information, its accuracy and plausibility, and to consider uncertainties and knowledge gaps and their relevance regarding the aim of investigation.

The preliminary investigation consists of:

— a desk study in which information on the history and other relevant aspects of the site is collected and critically reviewed;

— a site reconnaissance (site inspection, walk-over survey);

— development of a conceptual model of the site, in particular

  1) formulation of hypotheses on the possible type(s) and amount of contamination,

  2) migration pathways (on- and off-site), and spatial and temporal distribution; together with

  3) hypotheses regarding other aspects of the site, such as the hydrogeology;

— drawing conclusions with regard to the need for and scope of further investigations;

— identification of any need for immediate actions to protect humans or the environment (e.g. fencing, removal of superficial deposits).

The objectives of the preliminary investigation should be set out formally before the investigation is started to ensure that the scope (e.g. sources of information searched) is appropriate.

In most cases, it should be possible to make a preliminary assessment of (potential) risks to humans and other receptors.

The information gathered should also enable

a) the design of subsequent stages or phases of intrusive investigation so as to minimize the risks of further spread of contamination or creation of new migration pathways (e.g. boreholes and trial pits), and

b) the adoption of appropriately safe methods of working during intrusive investigation (see ISO 10381-3).

The minimum information that should be collected in the preliminary investigation is set out in 6.2 and 6.3 and the procedures on how the information may be obtained are provided in 6.4. Guidance on reporting the results of the preliminary investigation is provided in 6.6.

6.2 Information on past and present use

The rapid growth of urban areas has resulted both in the absorption of areas which were formerly rural and in the change of use of existing urban land. Contamination within urban areas is therefore frequently the result of some historic industrial process that has occurred on the site, or nearby, and information to be collected for both urban and industrial sites is very similar.

Data gathered on historic and contemporaneous use of a site should, so far as is possible, provide information on the following (subject to any agreed limitations within the objectives):

— any development, building or other activity that has taken place on the site and its immediate surroundings;

— any specific actions that were taken in the past, and (description of the chemical composition of) any materials that were used, in connection with industrial, building or other activities on the site;

— industrial or other activities which have been (or are currently) potential causes of soil contamination (production processes, storage facilities, materials transport facilities (also underground transport), with an indication (as precise as possible) of the location(s);

— details with regard to cables, conduits, areas of soft landscape and areas of hard landscape, areas of made ground and areas of tipped material, effluent treatment, sludge disposal, surface drainage, chemical storage, underground tanks, waste materials, building rubble, etc.;

— information on adjacent land use (present and intended) which could affect the site under investigation.

Information with regard to similar sites elsewhere may be used for comparison.

6.3 Information on geology, pedology, hydrology and hydrogeology

Information should be collected on the geology and pedology of the area and the hydrological and hydrogeological situation as far as available. The scale at which this information should be collected, and the degree of detail that is required, can only be determined in a subjective manner, but should be in line with the defined objectives of the investigation.

