SLOVENSKI STANDARD
oSIST prEN ISO 15175:2017

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Kakovost tal - Karakterizacija onesnaženih tal v zvezi z varstvom podzemne vode (ISO/DIS 15175:2017)

Soil quality - Characterization of contaminated soil related to groundwater protection (ISO/DIS 15175:2017)

Bodenbeschaffenheit - Ermittlung von Kennwerten des Bodens hinsichtlich des Wirkungspfads Boden (ISO/DIS 15175:2017)

Qualité du sol - Caractérisation des sols contaminés en relation avec la nappe phréatique (ISO/DIS 15175:2017)

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Soil quality — Characterization of contaminated soil related to groundwater protection

Qualité du sol — Caractérisation des sols contaminés en relation avec la nappe phréatique

ICS: 13.080.40

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Foreword

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The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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For an explanation on the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT) see the following URL: www.iso.org/iso/foreword.html.

The committee responsible for this document is ISO/TC 190 Soil quality.

ISO 15175 was prepared by Technical Committee ISO/TC 190, *Soil quality*, Subcommittee SC 7, *Soil and site assessment*.

This second edition cancels and replaces the first edition (ISO 15175:2004), which has been technically revised. The main change concerns the focus on contaminated land management. This second edition suggests a tiered approach from simple to complex assessment in order to evaluate the impact of soil contamination of groundwater.

Soil quality — Soil quality — Characterization of contaminated soil related to 4 groundwater protection

1 Scope

This document document provides guidance on the principles behind, and main methods for, the evaluation of sites, soils, and soil materials in relation to their role as a source of contamination of groundwater and their function in transporting, degrading and transforming contaminants. It is focussed on contaminated land management identifying and listing relevant monitoring strategies, methods for sampling, soil processing and analytical methods.

The guidance provided is applicable to the evaluation of the impact of contaminants on groundwater in relation to:

— drinking water quality;

— irrigation water quality;

— watering use;

— industrial use;

— natural base flow.

2 Normative references

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

ISO 5667-11, *Water quality -- Sampling -- Part 11: Guidance on sampling of groundwaters.*

ISO 9001, *Quality management systems — Requirements.*

ISO 11074, *Soil quality — Vocabulary.*

ISO 18400–104, *Soil quality -- Sampling -- Part 104: Strategies.*

ISO 18400–202, *Soil quality - Sampling - Part 202: Preliminary investigations.*

ISO 18400–203, *Soil quality -- Sampling -- Part 203: Investigation of potentially contaminated sites.*

ISO/IEC 17025, *General requirements for the competence of testing and calibration laboratories.*

ISO 25177, *Soil quality – Field soil description*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

3.1
aquifer
geological water-bearing formation (bed or stratum) of permeable rock, or unconsolidated material (e.g. sand and gravels) capable of yielding significant quantities of water

[SOURCE: ISO 5667-11:2009]

3.2
contaminant
substance or agent present in the soil as a result of human activity cf. pollutant (3.4)

NOTE 1 to entry: There is no assumption in this definition that harm results from the presence of the contaminant

[SOURCE: ISO 11074:2015]

3.3
dissolved organic carbon
DOC
concentration of organic carbon remaining in solution after filtration and/or centrifugation under defined conditions

NOTE 1 to entry: It is expressed in mg/l, g/m3

3.4
groundwater
water in the saturated zone and/or unsaturated zone of an underground geological formation or artificial deposit such as made ground, e.g. fill material

[SOURCE: ISO 5667-11:2009]

3.5
groundwater surface
water table
upper boundary surface of the groundwater

[SOURCE: ISO 11074:2015]

3.6
perched water
isolated body of groundwater, which is limited in lateral and vertical extent, located within the unsaturated zone overlying a much more extensive groundwater body and isolated above by a discontinuous poorly permeable surface (discontinuous aquitard)

[SOURCE: ISO 5667-11:2009]

3.7
percolating water
infiltrating water that moves downward in the pore space due to gravity

[SOURCE: ISO 11074:2015]

3.8
point-source input
input of a substance from a stationary discrete source of defined size

NOTE 1 to entry: The sources can be stack emissions, accidental spills, waste dumps, spills on industrial sites, major leaks from sewers and other pipelines.

NOTE 2 to entry Point-source input can cause both locally contaminated sites and relatively uniformly contaminated sites.

[SOURCE: ISO 11074:2015]

3.9
pollutant
substance or agent present in the soil (or groundwater) which due to its properties, amount or concentration causes adverse impacts on soil functions or soil use

[SOURCE: ISO 11074:2015]

3.10
pore water
water that fills the pores or cavities within a body of rock or soil

[SOURCE: ISO 5667-11:2009]

3.11
risk assessment
process of risk analysis and evaluation of the damaging effects on man and the environment, with respect to the nature, extent, and probability of occurrence of these effects

[SOURCE: ISO 11074:2015]

3.12
soil
upper layer of the Earth's crust composed of mineral particles, organic matter, water, air and organisms

[SOURCE: ISO 11074:2015]

3.13
soil characterization
determination of relevant physical, chemical, and biological properties of the soil

[SOURCE: ISO 11074:2015]

3.14
soil function
description of the significance of soils to man and the environment

EXAMPLE Control of substance and energy cycles as compartment of ecosystems, basis for the life of plants, animals, and man, basis for the stability of buildings and roads, basis for the yield of agriculture, horticulture, and forestry, carrier of genetic reservoir, document of natural history, archaeological and paleoecological document.description of the significance of soils to man and the environment

[SOURCE: ISO 11074:2015]

3.15
soil gas
gas and vapour in the pore spaces of soils
[SOURCE: ISO 11074:2015]

3.16
soil material
excavated soil, dredged materials and soil treated to remove or destroy or reduce the environmental availability of contaminants

[SOURCE: ISO 11074:2015]

3.17
soil pores
part of the soil volume, between the solid particles of the soil
[SOURCE: ISO 11074:2015]

3.18
soil water
all water of the unsaturated and saturated zone

[SOURCE: ISO 11074:2015]

3.19
total organic carbon, TOC
all carbon present in organic matter

[SOURCE: ISO 11074:2015]

3.20
unsaturated zone
part of an aquifer in which the pore spaces of the formation are not totally filled with water

[ISO 6107-2:2006]

4 General

Soils are of central importance within the water cycle because their storage and filter functions have a lasting influence on the water balance and groundwater quality. In this context, particular attention shall be paid to the following functions:

— mechanical filter functions (retention of suspended sludge and contaminant particles);

— chemical filter functions (sorption and mobilization of substances);

— transformation functions (degradation or transformation of substances).

Soil is understood as a porous medium consisting of three phases: the solid phase, the liquid phase and the gaseous phase. The ratio of these phases and their respective compositions vary widely in time and space.

The assessment of contamination affecting groundwater quality requires a profound understanding of the governing processes and reactions of potentially toxic compounds in soils. Contaminants are translocated in all three phases of soils as a function of the properties of the chemicals and the soil. Hence strategies for assessing risks to groundwater due to soil contamination should vary with the contaminants considered, and should take into account those soil properties which mainly govern the soil's filter, retention, release and transformation functions.

Vaporous contaminants, essentially volatile organic compounds (VOCs) are likely to migrate in the unsaturated zone in gaseous form. Knowledge of the soil gas quality in the unsaturated zone allows detection of contamination before it reaches the saturated zone as well as in the saturated zone.

In addition to considering the properties of the chemicals and the soil governing the behaviour of contaminants in soils, different ways for contaminants to enter soils should also be evaluated when designing suitable risk assessment strategies, with respect to contamination of groundwater. Soil and groundwater contamination can be caused by different sources on different spatial scales, as indicated in Figure 1.

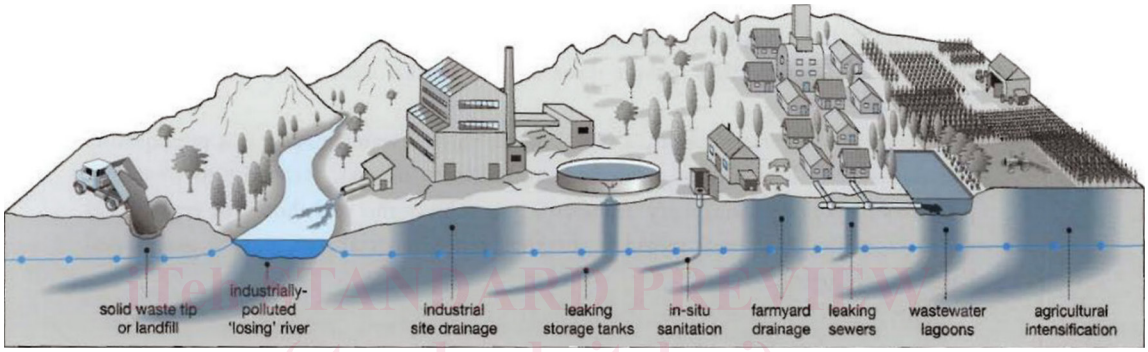

Figure 1 — Common sources of groundwater contamination (focus on contaminated land management) [33]

On regional and larger scales, soil contamination is caused, for example, by wet and dry atmospheric deposition and has predominantly diffuse character on a moderate level of contamination. On a local scale, a variety of point sources can cause all kinds and magnitudes of soil and groundwater contamination. In the case of immiscible contaminants (for example hydrocarbons), most of the contamination forms a separate fluid phase from water. A fraction is soluble and capable of migrating to groundwater. In the unsaturated zone, another fraction could be in vapour phase. Depending on the relative density in water, the behaviour of the contaminant is very different. The Light Non Aqueous Phase Liquids (LNAPL) have a lower density and the Dense Non Aqueous Phase Liquids have a higher density than that of water. Most point sources of contamination can also be regarded as off-site diffuse sources of groundwater contamination. It is evident that different contamination scenarios as a function of contamination sources and scale demand different investigation strategies with respect to groundwater impact. Furthermore, groundwater impact assessment depends on the aquifer system: unconfined or confined (figures A.1) and the type of porosity: porous media, fractured media or karst environment (figures A.2). At present there are no uniform principles for the investigation and evaluation of contaminated soils and contaminated sites in relation to the protection of water resources.

Investigation strategies may be simple to complex. Simple or qualitative approaches mostly refer to assessment of, for example, the potential leaching risk of chemicals through the soil towards groundwater. In contrast to complex or quantitative approaches, the level of actual soil contamination is not taken into account. Approaches of this type can also be used, e.g. to classify larger areas with respect to their capability of protecting groundwater resources against contamination, or as an introductory step in an assessment of an actual contaminated site.

To assess the on-site impact on groundwater resulting from specific soil contamination, quantitative approaches based on site-specific investigation procedures including laboratory and/or field measurements have to be carried out. Laboratory measurements can include physical, chemical and biological analysis, and leaching tests. Assessments of this kind should also take into account natural background concentrations of a substance and other natural conditions affecting the impact on the groundwater. Assessments of impact on groundwater often include a temporal aspect, since the actual impact might not be measurable at the time of the investigation, but could happen sometime in the future.

Assessments also depend on the purposes of investigations, for example:

— conservation of soil functions in order to prevent groundwater contamination;

— soil and groundwater monitoring;

— risk assessment;

— controlling remediation measures.

A listing of suitable methods is covered in the main part of this document (see Clause 5).

Since the impact on groundwater can lead to impact on surface waters, this aspect can in some cases be relevant in an overall impact assessment. This issue is not addressed explicitly in this document.

5 Impact assessment

5.1 General

A prerequisite for the evaluation of the soil-to-groundwater pathway is the determination of the relevant physical, chemical and biological characteristics of soils and the hydrological characteristics of the site. It is therefore necessary to collect data for the assessment of the contamination source with respect to the type and degree of contamination and extent of source(s).

It is also necessary to describe the soil compartment that is impacted by the source, and the factors in this compartment affecting the impact on the groundwater, e.g. the geometry, hydraulic conditions and natural chemical and biologic processes. Many processes occurring in this soil compartment (physical, chemical and biological processes) may influence the groundwater impact. Input to the soil compartment includes the infiltration of water and specific contaminants. Output is the contaminant flux out of the compartment of the groundwater zone investigated (e.g. mass/volume/unit of time).

The processes involved are illustrated schematically in Figure 2 and a description of the relevant parameters is given in Table 1.

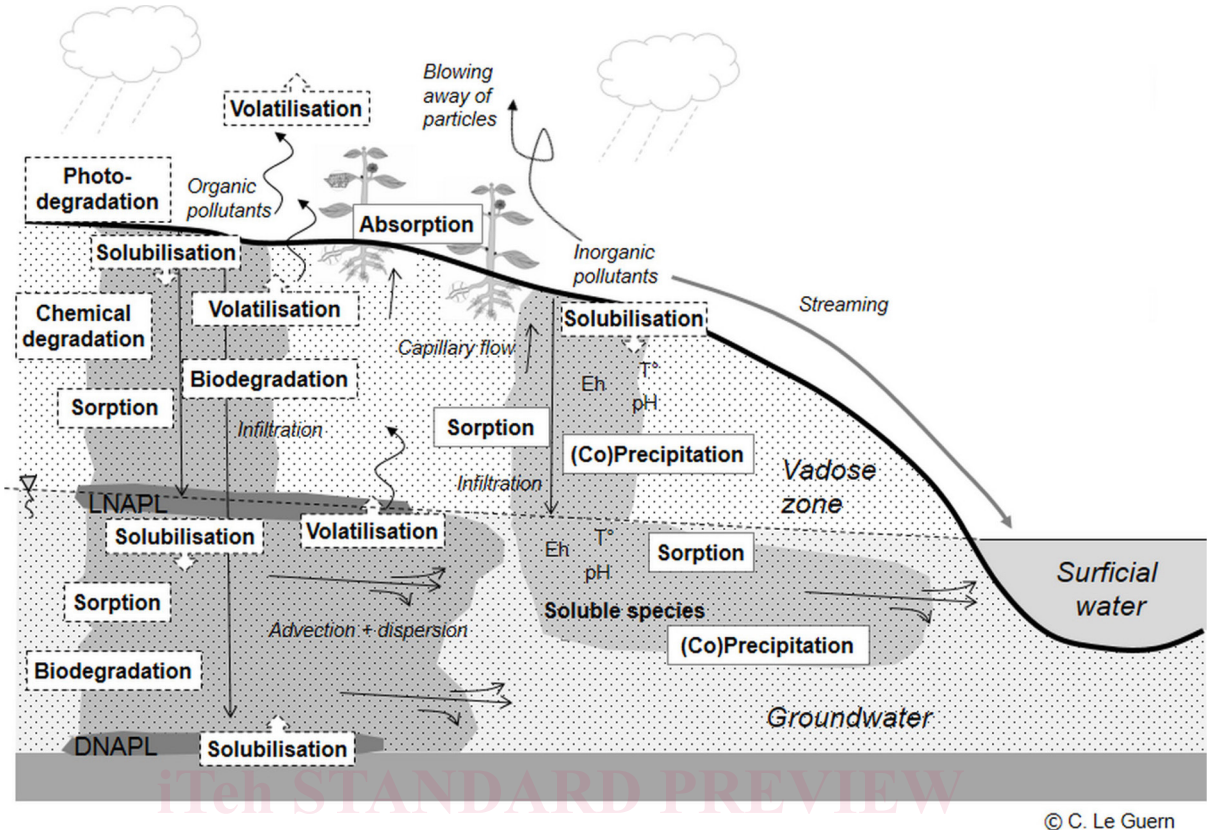

Figure 2 — Schematic diagram illustrating the soil compartment covered by the assessment procedure and processes affecting the impact of contamination on groundwater [24]

The types of information needed to describe the relevant soil compartment include pedology (e.g. soil unit), lithology of parent material, hydrogeology (e.g. permeability), physico-chemical conditions (e.g. pH) and biological conditions (e.g. substrate availability). The study area of the impact assessment depends on many factors, such as the following:

— The origin of the contamination: diffuse versus hot spot;

— The type and characteristics of contaminants (e.g solubility, persistance);

— The type and characteristics of the aquifer (e.g dispersivity, velocity);

— The use of the aquifer (e.g drinking water supply, industrial supply).

5.2 Relevant soil processes

Contaminant transport in the unsaturated zone is governed not only by the transport of percolating water but also by a number of biological, physical and chemical processes. Which of these processes are to be considered important within a given context depends on the type of contaminants and the actual soil conditions. An overview of soil and contaminant parameters related to contaminant transport is given in Table 1.

Contamination ageing influences different processes in soil: decrease of degradation and mobility, increase of sorption and viscosity. This parameter should be taken into account for the impact assessment.