INTERNATIONAL STANDARD

ISO 28258

First edition
2013-10-01

Soil quality — Digital exchange of soil-related data

Qualité du sol — Échange numérique de données relatives au sol

Reference number
ISO 28258:2013(E)

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

Published in Switzerland

Contents

Page

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.

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. www.iso.org/directives

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. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received. www.iso.org/patents

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

The committee responsible for this document is ISO/TC Technical Committee ISO/TC 190, *Soil quality*, Subcommittee SC 1, *Evaluation of criteria, terminology and codification*.

Introduction

Concerns about the future of soils are increasing. The quality of soils and the needs for soil protection are an issue of ever-increasing importance, in all countries. Whether it be for matters of land development, recycling of waste, for assessing the consequences of the way of use of soils on the quality of water or, more generally, the maintaining of their ability to guarantee the functions expected of them by society, it is becoming more and more necessary to know soils, to describe them and to analyse them. A large number of standards indicate how to carry out these descriptions and analyses. However, soil-related studies are usually conducted by specialized departments and their results have then to be forwarded to the requesting parties or to the administration. Furthermore, as regards the availability of environmental data for the public, the official services are solicited to put them online, including information related to soils.

Soil data are produced during projects which involve the description of soil and — often, but not necessarily — sampling and analysis. Soil properties are estimated for parts of a soil, which can be genetic horizons or depth classes. This vertical sequence composes a soil profile. The intensity of soil description, sampling and analysis varies greatly among projects. In addition, available metadata, sampling and analytical designs and nomenclatures vary as well.

Due to this wide diversity of data and uses, the hardcopy (paper) form is nowadays rarely suitable, particularly when we consider that soil studies do not generally constitute an end in themselves but are only a part of the data required for the taking of land developmental or environmental-related decisions. Thus, soil data need to be crossed with other environmental, land-use or statistical data sources; the use of geographical information systems (GIS) is therefore essential. The purpose of this International Standard is to provide a general procedure to record all kinds of soil-related data in order to exchange them, while being consistent with relevant International Standards, but without any prerequisite for a given information system.

This International Standard proposes an eXtensible Markup Language (XML)-based format. XML consists of a set of rules for encoding information which is platform- and software-independent. A major advantage of using XML is that it is the standard for data transfer over the Internet. Most existing software tools and programming interfaces are designed to process and query XML files, to transform XML

into other data formats for further processing or display, and to transform XML to/from relational databases, whatever the purpose and the needs of the users. Moreover, a specific form of XML called GML is used for geographic information, promoting its exchange and use in combination with other environmental data.

Consequently, this International Standard contains information on how to encode soil data (metadata, soil description as well as geographic and temporal ones), including specifications and XML codes. In addition, and to make this International Standard "future-proof" between revisions, guidelines are provided for encoding of additional information not yet considered. These basic principles allow also the recipient system/user to read and/or decode information provided in a clear, safe and retrievable manner.

Figure 1 shows the fluxes of soil data, generic to many kinds of applications that can be organized using this International Standard.

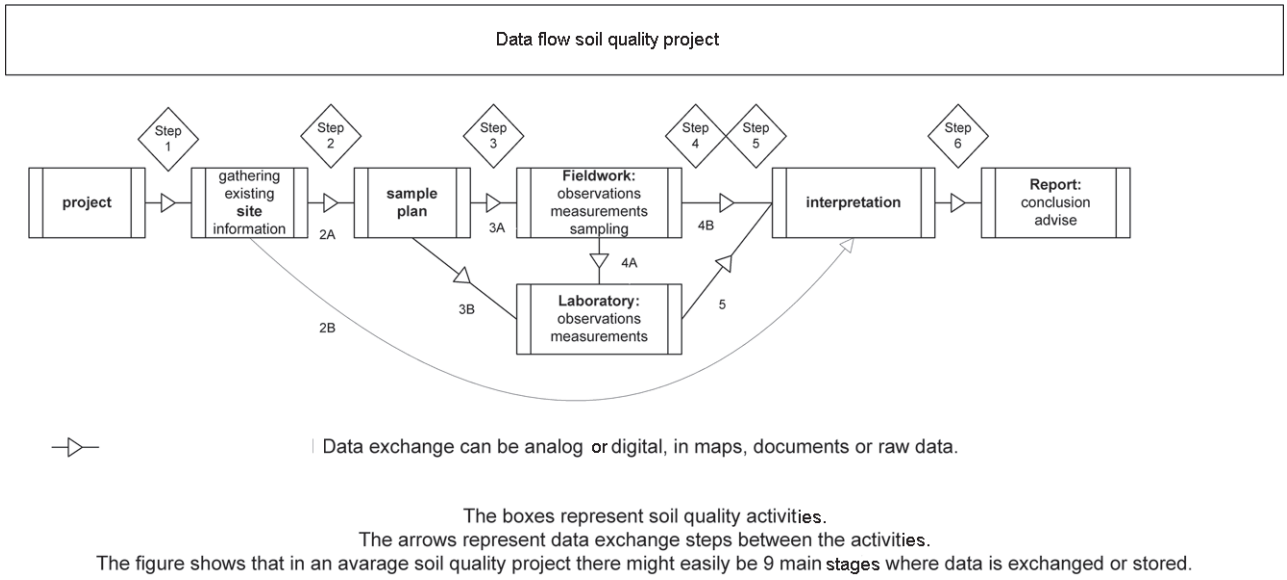

Figure 1 — Common data exchanges in soil quality

Soil quality — Digital exchange of soil-related data

1 Scope

This International Standard describes how to digitally exchange soil-related data. It aims to facilitate the exchange of valid, clearly described and specified soil-related data between individuals and organizations via digital systems, and enables any soil data producer, holder or user to find and transfer data in an unambiguous way.

This International Standard contains definitions of features, several parameter specifications and encoding rules that allow consistent and retrievable data exchange. It also allows the explicit geo-referencing of soil data by building on other International Standards, thus facilitating the use of soil data within geographical information systems (GIS). Because soil data are of various origins and are obtained according to a huge variety of description and classification systems, this International Standard provides no attribute catalogue, but a flexible approach to the unified encoding of soil data by implementing the provisions of ISO 19156 observations and measurements (OM) for use in soil science.

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 11074, *Soil quality — Vocabulary*

ISO 15903, *Soil quality — Format for recording soil and site information*

ISO 19106:2004, *Geographic information — Profiles*

ISO 19109, *Geographic information — Rules for application schema*

ISO 19118, *Geographic information — Encoding*

ISO 19136, *Geographic information — Geography Markup Language (GML)*

ISO 19156:2011, *Geographic information — Observations and measurements*

ISO 25177:2008, *Soil quality — Field soil description*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 11074 and in ISO 19109, and the following, apply.

3.1
analysis
process by which a sample is tested for composition or state according to a described procedure

Note 1 to entry: Most analyses are carried out on dislocated samples, but analyses can also be carried out on material *in situ*.

3.2
analytical result
qualitative or quantitative characteristic of a material obtained by an analysis

3.3
application schema
conceptual schema for data required by one or more applications

[SOURCE: ISO 19101.]

3.4
attribute
characteristic of a feature

Note 1 to entry: Objects and entities (see ISO 11179) are features in the context of this International Standard.

3.5
borehole
boring
bore
penetration into the subsurface with removal of soil/rock material by using, e.g. a hollow tube-shaped tool

Note 1 to entry: Generally, it is a vertical penetration.

[SOURCE: ISO 11074.]

3.6
class
description of a set of objects that share the same attributes, operations, methods, relationships, and semantics

[SOURCE: ISO/IEC 19501.]

3.7
code
member of a code list

3.8
code list
defined set of valid values of an attribute parameter

3.9
data model
description of the organization of data in a manner that reflects an information structure

3.10
extensible mark-up language
XML
subset of SGML (standard generalized markup language) which uses semantic tags in a structured format

Note 1 to entry: SML offers a flexible way to create information formats and to share both data and metadata with other applications and users.

Note 2 to entry: See ISO 13374-2.

3.11
feature
abstraction of a real world phenomenon

[SOURCE: ISO 19101.]

Note 1 to entry: A feature has identity and properties (it can be described with attributes).

Note 2 to entry: Any feature is an instantiation of a feature type, e.g. several described real-world soil profiles are all features of the feature type SoilProfile.

3.12
feature catalogue
catalogue(s) containing definitions and descriptions of feature types

3.13
feature type
class of features having common characteristics

[SOURCE: ISO 19156.]

Note 1 to entry: For this International Standard, it is considered that both geographic and soil quality related real-world and abstract objects can be features.

3.14
geography markup language
GML
XML encoding in compliance with ISO 19118 and, more specifically, ISO 19136 for the transport and storage of geographic information modelled according to the conceptual modelling framework used in the ISO 19100 family of International Standards and including both the spatial and non-spatial properties of geographic features

3.15
horizon
domain of a soil with a certain vertical extension, which is more or less parallel to the surface and is homogeneous for most morphological and analytical characteristics, developed in a parent material through pedogenic processes or made up of *in situ* sedimented organic residues of up-growing plants (peat)

3.16
layer
domain of a soil with a certain vertical extension developed through non-pedogenic processes, displaying an unconformity to possibly over- or underlying adjacent domains

Note 1 to entry: In the framework of soils deeply modified by human activity, artificial layers may be due to different kinds of deposits (concrete, bricks, etc.).

Note 2 to entry: Layers may be part of a horizon.

3.17
metadata
data that defines and describes other data

[SOURCE: ISO/IEC 11179-1:2004]

Note 1 to entry: Metadata are data, and data become metadata when they are used as defined. This happens under particular circumstances, for particular purposes, and with certain perspectives. The set of circumstances, purposes or perspectives for which some data are used as metadata is called the *context* (see ISO/IEC 11179-1).

Note 2 to entry: In turn, some metadata may provide the context for the interpretation of the data they are related to, e.g. units of measurement give an idea how to interpret the measurement value.

Note 3 to entry: This definition is similar to that of “data about data”, as defined in ISO 19115, among other International Standards.

3.18
non-destructive investigation
application of a set of procedures or techniques to obtain observations on a material without lastingly changing its physical structure and chemical characteristics

3.19
observation
act of observing a property, with the goal of producing an estimate of the value of the property

Note 1 to entry: This definition is conformant with the definition of *observation* in ISO 19156.

3.20
plot
elementary area where individual observations are made and/or samples are taken

Note 1 to entry: All types of plots only provide locality, but not soil information itself. For example, a borehole is the location where you gather the information to abstract a profile information from.

3.21
profile element
general term for both horizons and layers

3.22
project
unique process, consisting of a set of coordinated and controlled activities with start and finish dates, undertaken to achieve an objective conforming to specific requirements, including the constraints of time, cost and resources

Note 1 to entry: An individual project may form part of a larger project structure.

Note 2 to entry: In some projects, the objective(s) is (are) refined and the product characteristics defined progressively as the project proceeds (see IEC 62198).

Note 3 to entry: The data can be existing or new.

Note 4 to entry: For the purposes of this International Standard, the objective is the collection or interpretation of soil data (see also 3.23).

[SOURCE: ISO 9000:2000, definition 3.4.3 — modified. Notes 2 to 4 are particular to this International Standard.]

3.23
project
<digital exchange of soil-related data>activity that leads to the collection of soil data

3.24
sample
solid, liquid, gaseous or living material extracted from the soil, soil solution, sewage water, interflow water or soil air to be described or analysed

3.25
sampling
process by which a sample is obtained

3.26
site
defined area which is subject to a soil quality investigation

Note 1 to entry: A site provides the area around a plot.

3.27
soil feature types
specific set of feature types specified in this International Standard

3.28
soil body
artificial but recognizable tridimensional entity in a soil continuum

3.29
soil map
two- or three-dimensional representation of soil or its properties for a geographic extent

3.30
soil mapping unit
aggregate of all soil delineations which are identified by a unique symbol, colour, name or other representation on a map

3.31
soil profile
describable representation of the soil that is characterized by a vertical succession of horizons or at least one or several parent material layers

Note 1 to entry: The soil profile is abstracted from observations in a trial pit or a boring.

3.32
subclass
class that inherits attributes, operations, methods, relationships and semantics from another class, with some restrictions or extensions

Note 1 to entry: An instance of subclass can be always considered as an instance of the parent class

3.33
trial pit
test pit
trench
excavation prepared to carry out profile descriptions, sampling, and/or field tests

[SOURCE: ISO 11074.]

3.34
URL
Uniform resource locator
mechanism for identifying resources on the Internet (such as Web pages) by specifying the address of the resource and the access protocol used

[SOURCE: ISO 9241-151:2008.]

3.35
URN
universal resource name
code identifying a service or a resource on the Internet

[SOURCE: ISO 5127:2001.]

3.36
UML
unified modelling language
type of modelling element that extends the semantics of the metamodel

[SOURCE: ISO/IEC 19501.]

3.37
XSD
XML schema definition
extensible schema definition
set of rules to which an XML document shall conform in order to be considered “valid” according to that schema

Note 1 to entry: Where XML is the language, XSD is a specific definition using the XML language.

Note 2 to entry: XSD is sometimes called: “XML schema”.

4 Rationale

4.1 General

This International Standard is specifically made for the exchange of soil quality data. It does not deal with the nevertheless very common use and exchange data from other disciplines, like geotechnics, geo-information, or groundwater investigation and management.

Sometimes, soil data exchange is successful or not determined by the interpretation of the incoming data by the receiving system. Basically, the receiving system can only successfully interpret incoming data when the feature types described by the data and the parameters themselves are known prior to the data exchange.

To get a handle on the problem that a huge number of systems exist for the description of soils with different parameters, parameter names, and parameter value code lists, this International Standard defines a set of features with which soils are described and that is complete, i.e. cannot be extended within the framework of this International Standard.

If soil quality data defined according to this International Standard are combined with other kinds of data, the soil quality part shall be performed, using the XML namespace “ISO 28258”.

Additionally, very few, inherent properties of these features are defined as well. This feature catalogue enables the data receiving system to allocate any data to a known feature class.

The flexibility needed to consider soil-related data of various origins is maintained by not defining any other part of the soil description, i.e. the attributes for any of these features and — if needed — the list of their valid values (code lists). Instead, a structure is provided how to define them and how to relate to these definitions from data exchange files.

When exchanging data, the sender and receiver shall both refer to the same attribute parameters and code lists and interpret them in the same way. When pieces of data are exchanged, a reference should be made to its definition in a definition file; when a coded value is exchanged, a reference shall be made to the relevant code list using URN. For data exchange, a code list can be included completely or not at all. If included, the code list shall be provided as a separate file.

It is recommended that attributes parameters and code lists according to Clause 5 are made publicly available by the producer or publisher of the soil-related data in digital form.

In order to make use of advantages of data modelling with a wider, more generic scope, this International Standard is based on the rules and requirements of ISO 19156 and ISO 19136.

To provide a good reference for soil quality data, all soil quality items of ISO 25177 are worked out as an example soil quality data list in Annex A.

The codes of the soil attributes examples in Annex A are given in Annex B.

Clause 5 provides the information model for soil quality data exchange used in this International Standard. All soil quality information shall (eventually) refer to a specific place (point, location, mapping unit) in or under the surface of the earth. For all geographical information, the ISO 19100 family of International Standards is used.

All analytical results shall refer to an appropriate standard, if available.

4.2 Requirements worked out

This International Standard requires that soil quality data exchange is based on an information model itself based on ISO 19156. Thus, this International Standard provides a basis for soil quality data exchange, while maintaining flexibility (“extend the model according to your own needs”).

Another way of maintaining flexibility is using parameters that can be added and filled in according to particular needs.

Qualitative values for attributes are usually standardized in lists ("code lists", "domain tables"). For example, the values for attribute "land use" might be from the list:

— "agriculture";

— "forest";

— "snow or ice cover";

— ....

ISO 25177 provides several such lists. Again, in different types of investigation different code lists may be used. For example, the code list for soil types may differ among countries. This International Standard does not prescribe which code lists are to be used. However, when qualitative soil data are exchanged, it should be done with reference to a data source where the qualitative value is defined. For example, two parties agree to exchange data on land use using the codes provided in ISO 25177:2008, 4.2. The data exchange should contain at least the value itself (e.g. "18; Snow or ice cover") and a reference, for example, to "ISO 25177:2008, 4.2 land use". Preferably, such a reference is given using an URL so that the reference can be found easily by either man or machine.

4.3 Introduction main soil quality data set

ISO 25177 and ISO 15903 provide standards for the description of attributes of soil data. When exchanging soil quality data in a particular context, additional attributes shall be considered that do not occur in ISO 25177 and ISO 15903. Additional attributes may differ in a particular context — for example, a country or a project. In order to make it possible to exchange all types of relevant soil data attributes, this International Standard prescribes only general rules for soil data exchange with a suggestion on how to exchange the most common soil data attributes as listed in ISO 25177 and ISO 15903.

Clause 5 provides the information model for soil quality data exchange used in this International Standard. The model may be extended or modified in specific situations, according to rules provided in this International Standard.

5 Soil features information model

5.1 Principles from observations and measurements

This International Standard inherits principles from ISO 19156, but specializes in features of interest and the description of observations and measurements for soil domain artefacts.

Figure 2 describes the relationship between this International Standard and other International Standards.

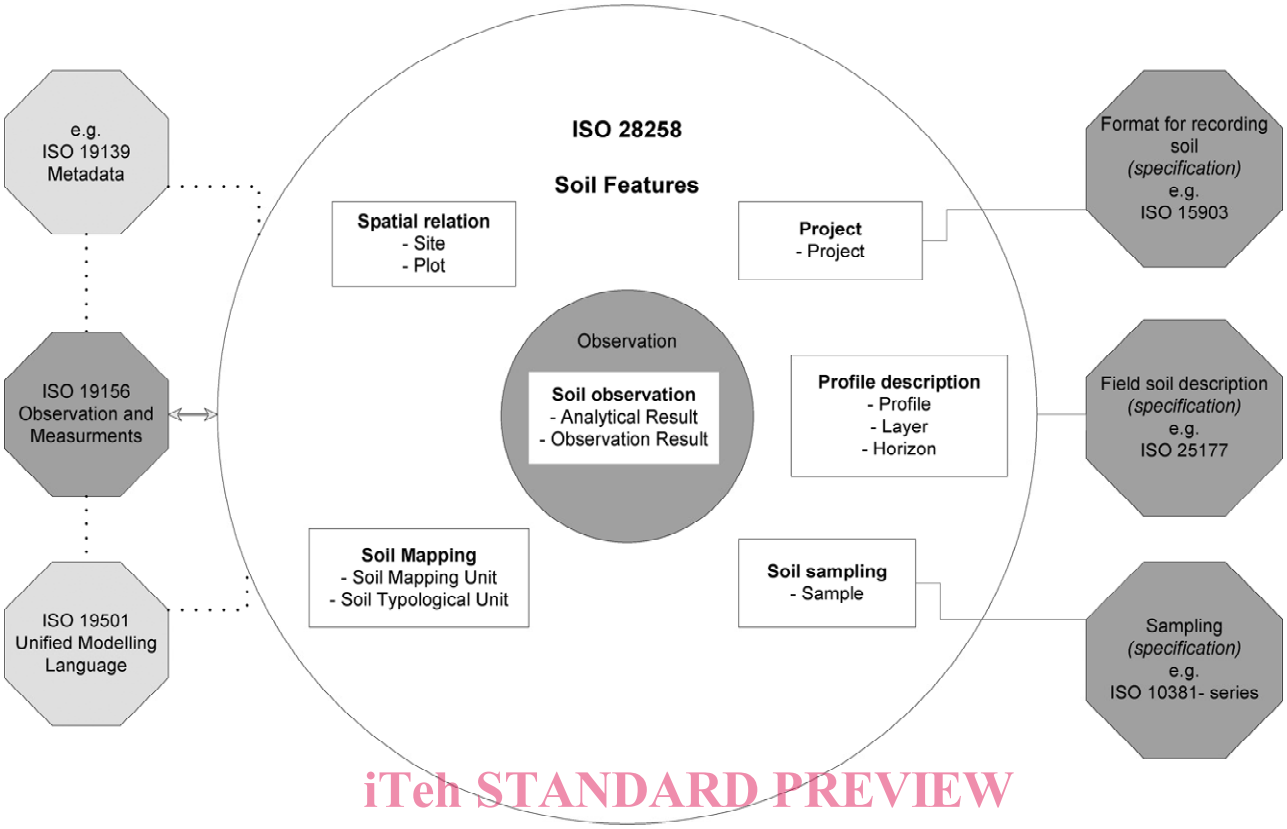

Figure 2 — Inner structure of soil information and its setting within other standards

5.2 General model for soil quality data exchange

5.2.1 General

As stated in Clause 4, soil quality data exchange shall be performed through an information model that is based on observations and measurements according to ISO 19156, which provides a generic way to exchange observations and measurements of any kind. With its general features and links to other International Standards it provides a logical and technical framework. This International Standard is an implementation of ISO 19156 in the field of soil science. Technically speaking, the UML model for soil data exchange is a profile, in accordance with ISO 19106, of ISO 19156. That means it concretizes the more general model of ISO 19156, particularly with the following restrictions.

a) The OM_Observation is restricted to *SoilObservation*.

b) The OM_Process is restricted to *ObservationProcess*.

c) The SF_SamplingFeature is restricted to *SoilSpecimen* (subclass of SF_Specimen) and *Plot* (subclass of SF_SpatialSamplingFeature).

d) The SF_Process is restricted to *PreparationProcess*.

e) FeatureType of Observation:featureOfInterest is restricted to *Site*, *Plot*, *Profile*, *ProfileElement*, and *SoilSpecimen* including all their subclasses. It means that only properties of these feature types may be observed.

f) FeatureType of SF_SamplingFeature: *sampledFeature* is restricted to *Site*, *Plot*, *Profile*, and *ProfileElement* including all their subtypes.

g) OM_ObservationContext and SF_SamplingFeatureCollection are not used.

The resulting model is an application schema of ISO 19156 for soil data exchange.

NOTE Names in UML models cannot have spaces. To make the names more readable the first character of every word in each name is written as a capital.

EXAMPLE required procedure in the submodel in 5.2.3 is written as RequiredProcedure.

5.2.2 Metadata

Information could be data or metadata, or both. For example, the information on projects as described in Figure 4 could be data or metadata.

In such a case, it is strongly recommended to at least describe the information as data in accordance with this International Standard.

5.2.3 Feature types and properties

The feature types listed in Table 1 are considered to be the soil feature types of this International Standard. Within the application schema no other feature types except those listed in Table 1 and their subtypes should be used. Nevertheless, it is possible to extend any of these domain feature types by adding properties specific to the data provider.

Table 1 — Domain feature types

Soil feature type	Origin
AnalysisRequest	Soil Quality
Borehole	Soil Quality, subtype of Plot
Horizon	Soil Quality
Layer	Soil Quality
ObservationProcess	Subtype of OM_Process
Plot	Subtype of OM_SpatialSamplingFeature
PreparationProcess	Subtype of OM_Process
Profile	Soil Quality
ProfileElement	Soil Quality
Project	Soil Quality
Site	Soil Quality
SoilMap	Soil Quality
SoilMappingUnit	Soil Quality
SoilMappingUnitCategory	Soil Quality
SoilObservation	Subtype of OM_Observation
SoilSpecimen	Subtype of SF_Specimen
SoilTypologicalUnit	Soil Quality
Surface	Soil Quality, subtype of Plot
TransportAndStorage	Soil Quality, subtype of PreparationProcess
TrialPit	Soil Quality, subtype of Plot

Each property, regardless of being introduced by this model or added by the data provider, shall be considered as being either observable or exact (see ISO 19156:2011, 6.1.1). It is generally possible that one feature has several values for each observable property. On the other hand, one feature has only one value for each exact property.