INSPIRE SO Geopackage User Manual for compiling single features by means of QGis

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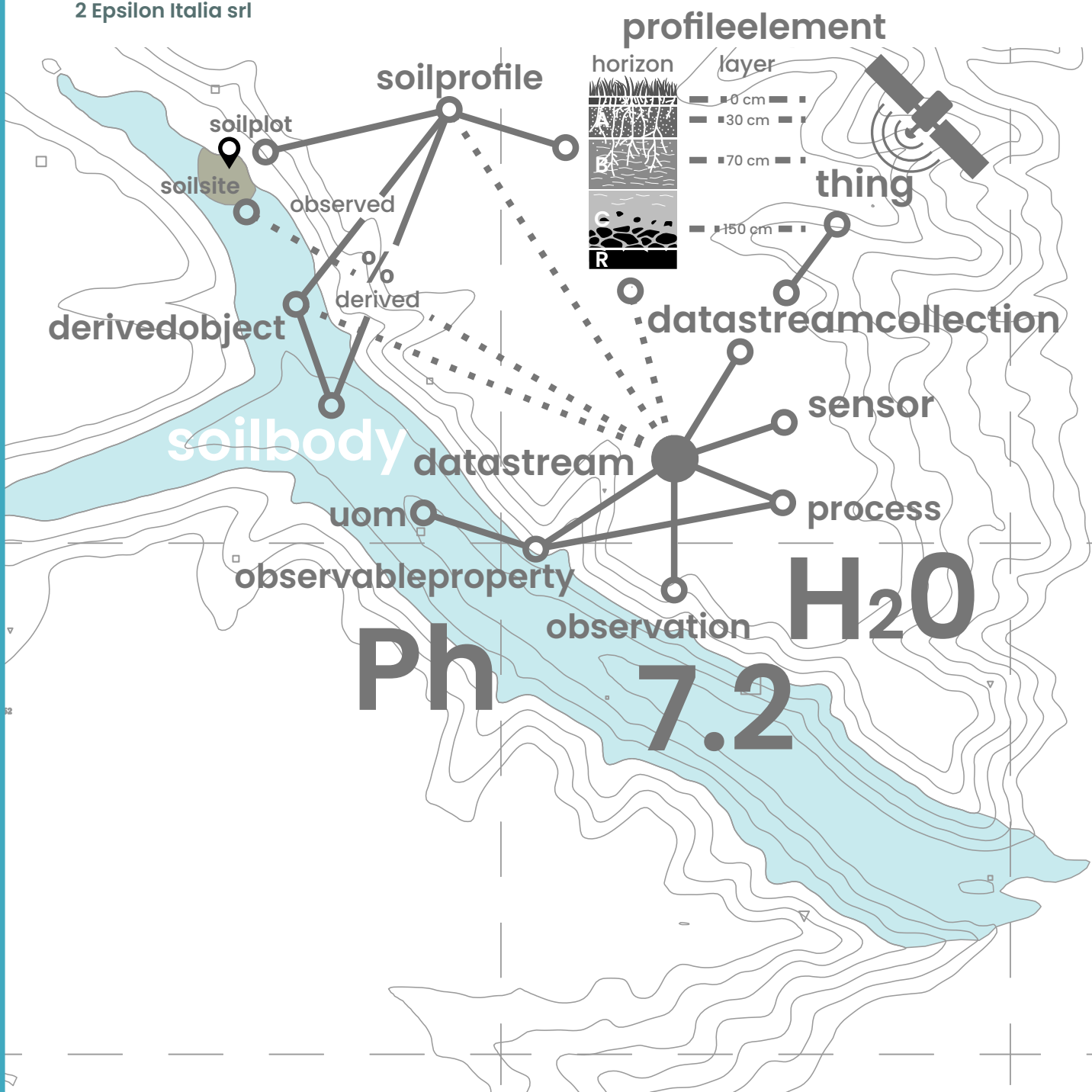

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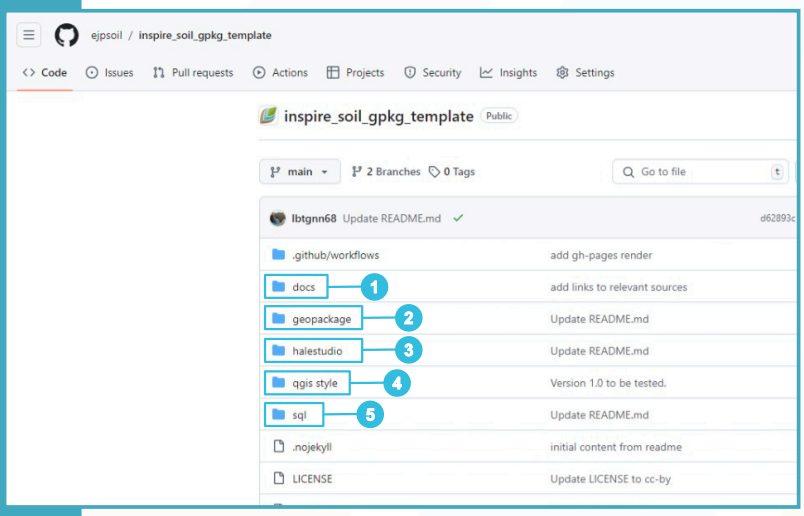
SUMMARY

INTRODUCTION

The INSPIRE Geopackage is the adaptation of the UML schema published at the page https://inspire-mif.github.io/uml-models/approved/html/index.htm?goto=2:3:17:1:9071 and the O&M schema available at https://inspire-mif.github.io/uml-models/approved/html/index.htm?goto=2:3:17:1:9075; the latter is also implemented with the Sensor Things schema (https://developers.sensorup.com/docs/#introduction).

The Geopackage file, along with the styles for Qgis, the Hale project for creating the corresponding GML, and many other files can be downloaded from the GitHub repository at https://github.com/ejpsoil/inspire_soil_gpkg_template/tree/main.

This repository hosts all the files necessary for managing a relational database capable of acquiring data according to the INSPIRE Soil model.



The available material is divided into topics:

Folder “docs”: (1)
Contains documentation and references to project-related materials.

Folder “geopackage”: (2)
Contains a series of ready-to-use INSPIRE Soil Geopackages.

Folder “halestudio”: (3)
Contains the HALE Studio project for transforming the INSPIRE Soil Geopackage into an INSPIRE GML.

Folder “qgis stile”: (4)
Contains the Style files for Qgis with customized data entry and visualization forms.

Folder “sql”: (5)
Contains the SQL code to create the INSPIRE Soil Geopackage starting from an empty Geopackage.

Please Note

This manual will not cover the definition of the various entities; these are extensively described in the document “D2.8.III.3 INSPIRE Data Specification on Soil – Technical Guidelines” which can be found at the following address: https://inspire-mif.github.io/technical-guidelines/data/so/dataspecification_so.pdf

Please Note

QGIS version 3.32.3-Lima or higher is required.

GEOPACKAGE

https://www.geopackage.org/

What is a Geopackage?
GeoPackage is an open standard file format for storing geospatial data.
It is based on SQLite database technology, which means that it is a single file format that can store different types of geospatial data, including vector data, raster data, and attribute data.
A GeoPackage is an SQLite Database file with a "gpkg" extension.

Why was the Geopackage format chosen for the INSPIRE Soil model?

- It is an open format.
- It is a standard of the Open Geospatial Consortium.
- It is platform-independent.
- It manages spatial information.
- It is based on a Relational Database.
- It supports Triggers.
- It is Portable; a single file.
- It is Compact.

SQLITE 3

https://www.sqlite.org/index.html

The Geopackage is a container managed by an SQLite3 database, so it can be opened with a Database Management System (e.g., DBeaver Community edition - https://dbeaver.io/) to view or edit the tables.
System tables have the suffix "gpkg" in their name, while other tables are named according INSPIRE Soil UML instances.
During the modeling process, SQLite3 tools were used to create a series of constraints, including:

- Keys
- Foreign Keys
- Generic integrity constraints using Checks
- Relationship and domain constraints using Triggers.

All these measures aim to make the relational model's behavior as close as possible to the logical UML model.

Please Note

In the "sql" folder of the GitHub repository, the "Readme.md" file contains a list of the created triggers with a brief description.

Please Note

To maintain data consistency, it is necessary to enable foreign key support using SQL with the command "PRAGMA foreign_keys = ON;" before any deletion operation, or in the extreme case of modifying the GUID keys.

QGIS

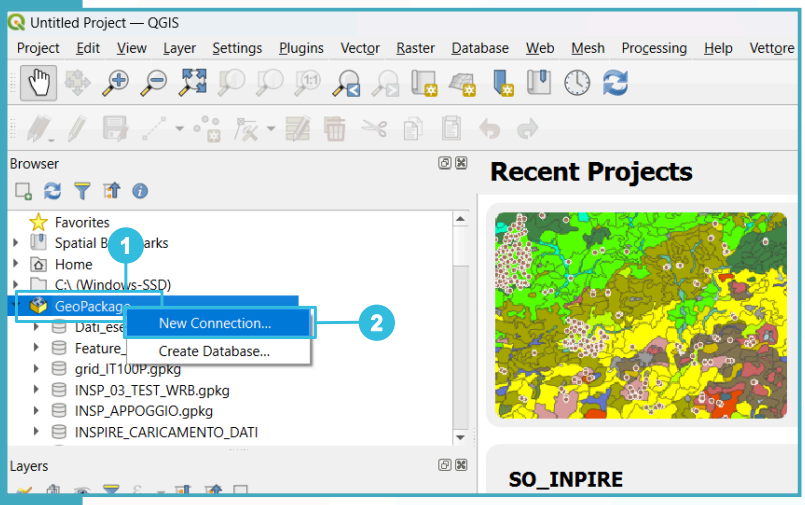
https://qgis.org/

Besides a Database Management System, the Geopackage can also be used through the GIS software, Qgis.

QGis is an excellent client whose main features include:

- It is an open format.
- It is platform-independent.
- It displays geographic formats.
- It has high compatibility with the Geopackage format.
- It is widely used in the market.
- It natively reads Geopackage relationships.
- It allows creating customized forms for data visualization and input.

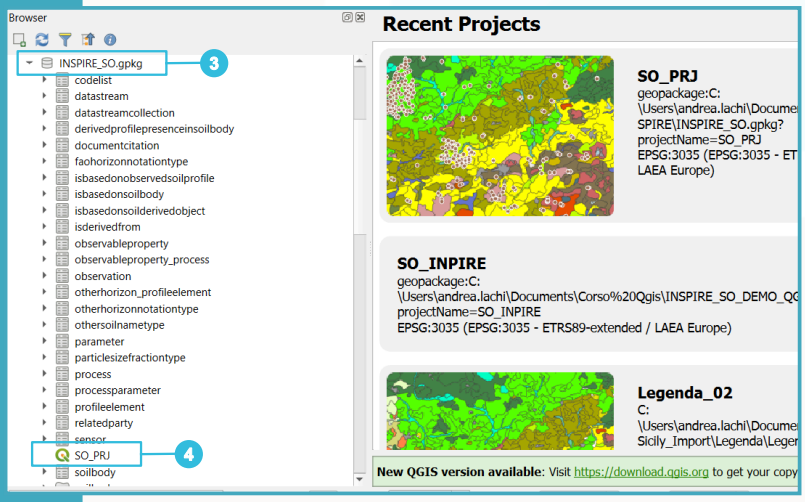
How to use the Geopackage with Qgis



Open Qgis.

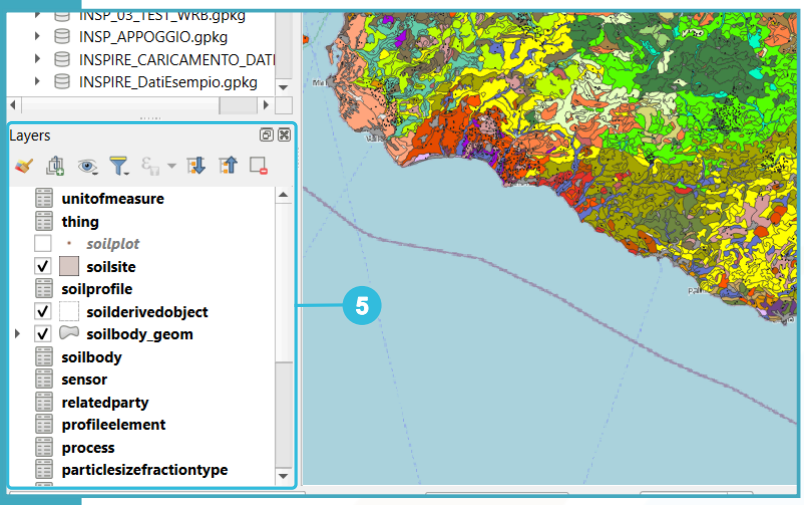
In the Browser Tab, right-click on the Geopackage icon (1) and click on "New Connection". (2)

Search the file system for the Geopackage file you want to use.

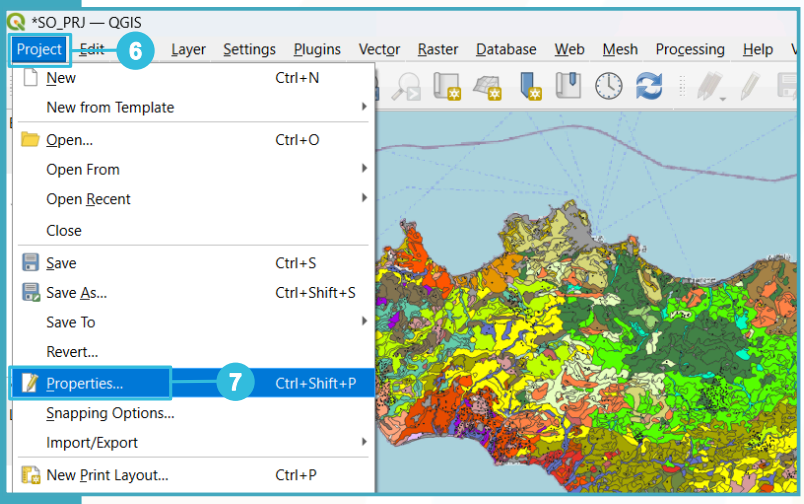


Inside the newly connected file, (3) you will find the SO_PRJ project.(4)

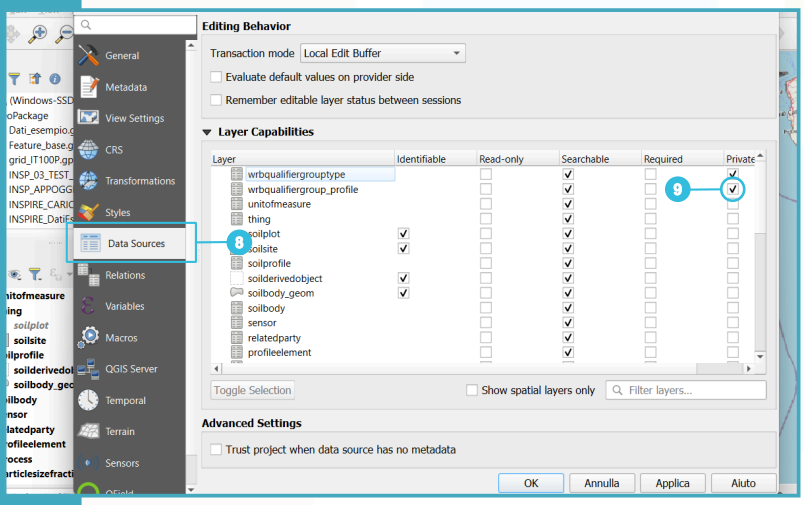
Double-click on it, and the project will open.



In the “Layers” panel, (5) you will find all the entities needed to describe the soil domain.



Clicking on “Project” (6) and then “Properties” (7) will open the project properties window.



In the “Data Source” tab, (8) you will see the layers that have been hidden to simplify the project.

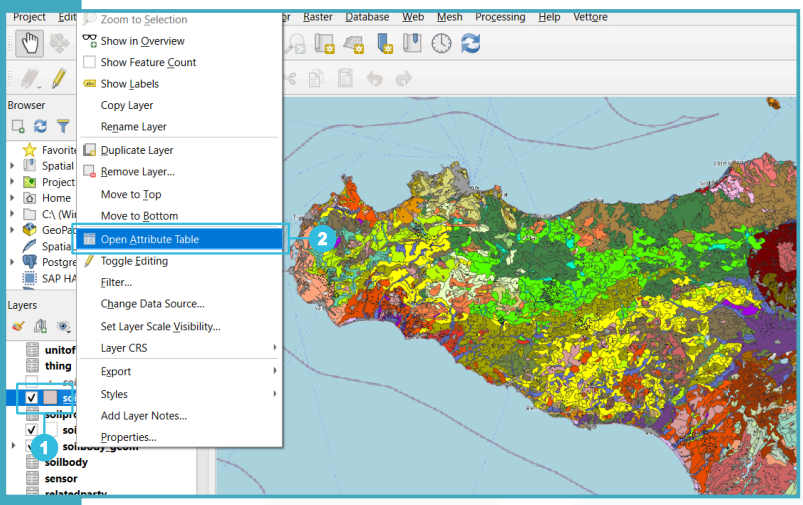
Each layer can be made visible in the “Layers” panel at any time by unchecking the private flag. (9)

Please Note

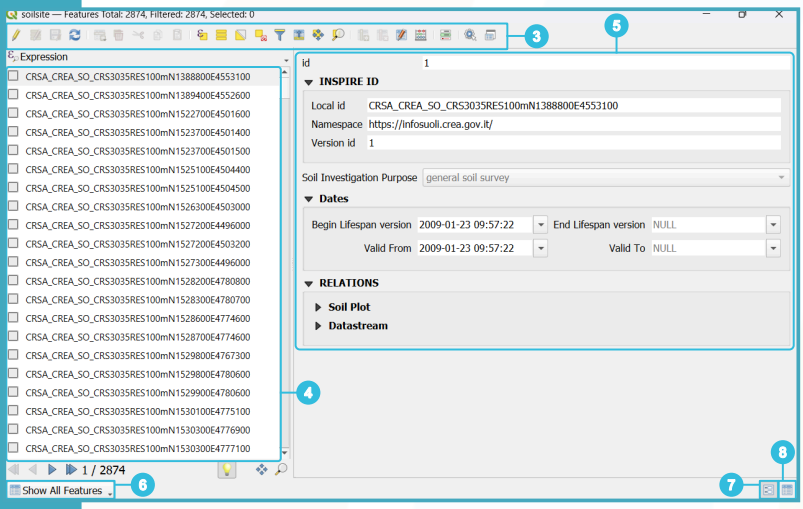
Here is the list of layers that have been hidden:

wrbqualifiergrouptype, processparameter, otherhorizon_profileelement, particlesizefractiontype, parameter, observation, observableproperty_process, isbasedonsoilbody, isderivedfrom, isbasedonobservedsoilprofile, isbasedonsoilderivedobject, derivedprofilepresenceinsoilbody, codelist.

Qgis Geopackage Forms



In the “Layers” panel, (1) right-click on one of the items and choose “Open Attribute Table” (2) from the menu.



All attribute tables, regardless of the open layer, have the same structure:

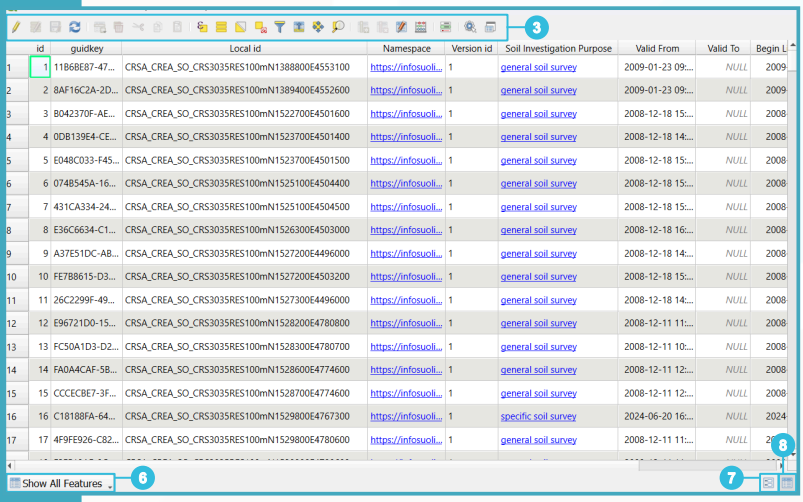
A toolbar (3).

A column listing the records in the table. (4)

A section with a form (5) for data entry and viewing. The form contains customized widgets that help the user with data entry.

A button (6) to access a menu allowing the use of Qgis tools to filter records.

Two buttons to switch between “Form” (7) and “Table” (8) views.



In table view, items (4) and (5) are replaced by Columns & Records..

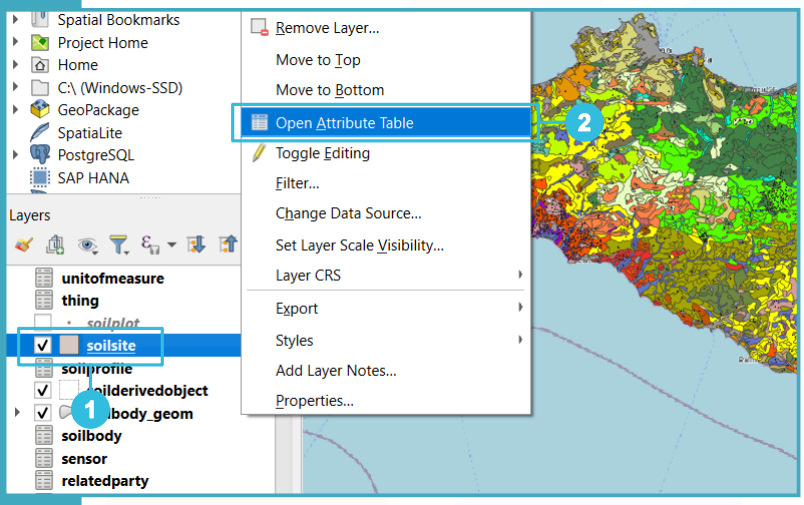
Please Note

Qgis was selected as the reference client for the project. Many custom forms have been created to facilitate data visualization and entry. The manual will refer to the use of Qgis.

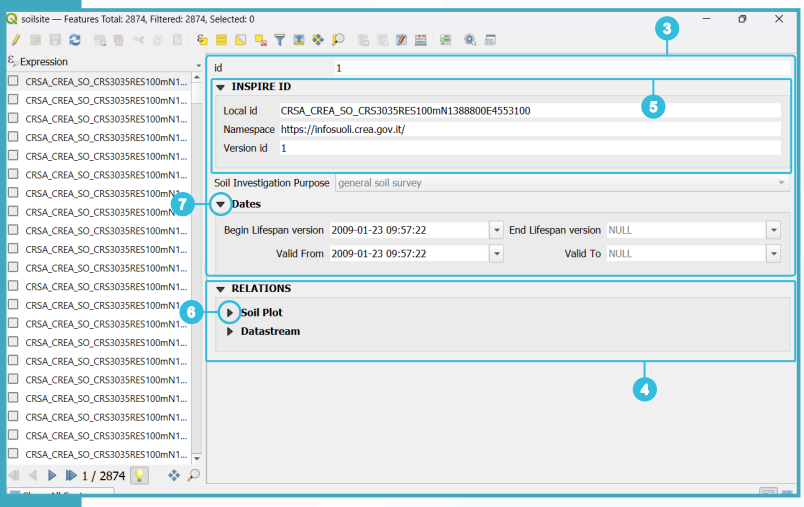
SOIL SITE

A “Soil Site” is considered as the surrounding of a soil profile, and/or the larger piece of land that is directly linked to and described by all soil investigations on one or more spots, called soil plots.

Soil Site Forms



In the "Layers" panel, right-click on the "soilsite", (1) and from the menu, select "Open Attribute Table". (2)



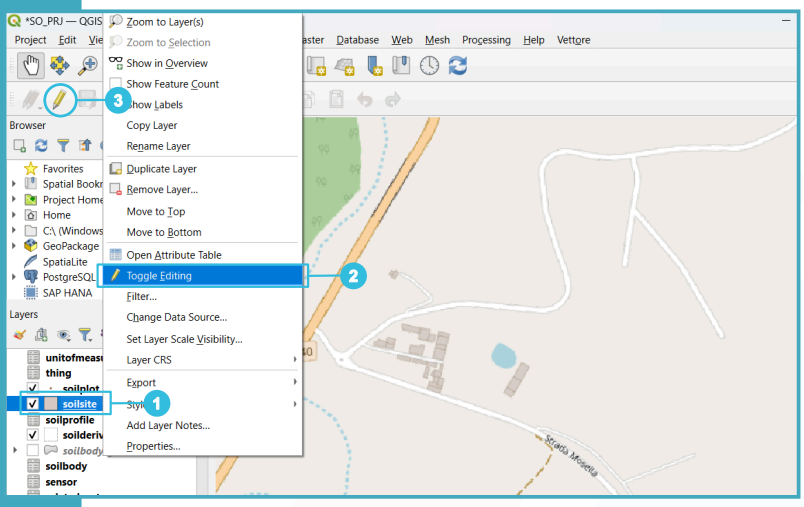
At the top (3), we have the fields required for its definition, while at the bottom (4), we have the related elements, in this case, the "Soil Plot", and the "Datastream", which will be discussed in more detail later.

As we can see, the form is divided into sections (5) that can be collapsed (6) or expanded (7) depending on the user's needs.

Please Note

When the form is opened, the related elements will always appear collapsed.

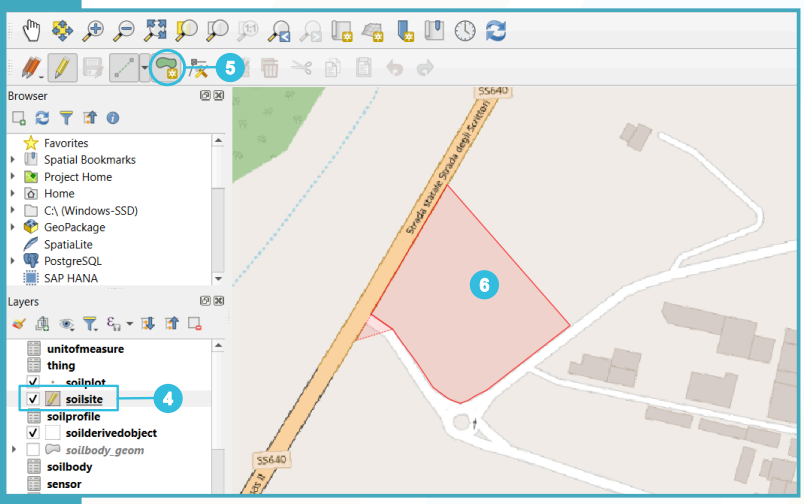
Creating a Soil Site



The "Soil Site" it's a polygonal geographic entity. The first step To create a new Soil Site feature is to define its geometry.

Right-click in the "Layers" panel on the "soilsite", (1) and from the menu, select "Toggle Editing", (2).

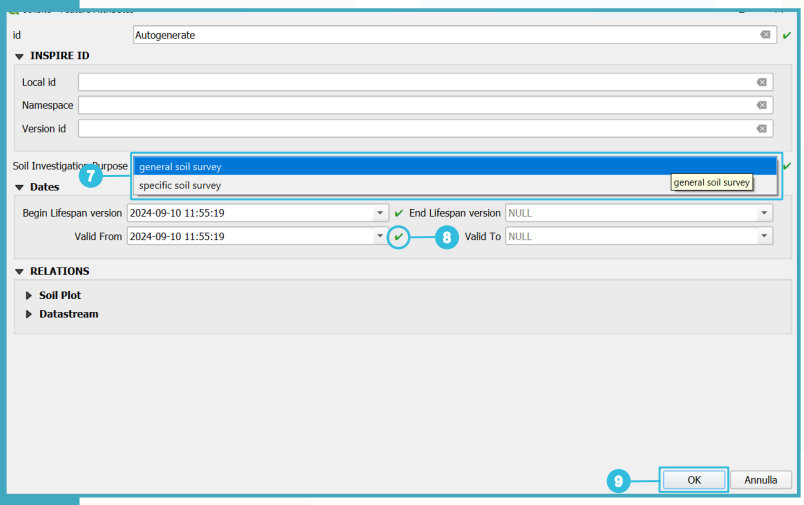
It is also possible to select only the "Soil Site" layer (1) and click the "Toggle Editing", (3) button in the toolbar.



A small pencil icon (4) will appear, indicating that the feature is in edit mode.

In the toolbar, select the "Add Polygon Feature" icon (5) and draw the geometry of the new "Soil Site", (6).

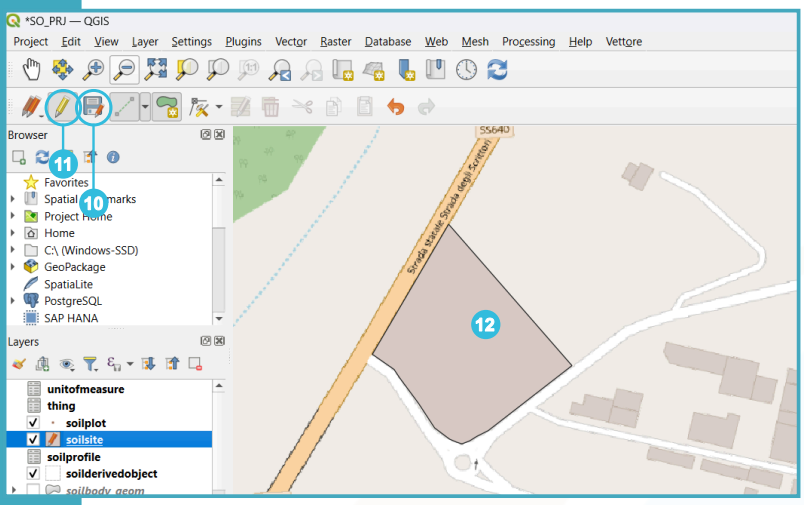
Right-click to close the geometry, and the data entry form will appear.



You can modify the data using the various widgets (7) provided by the form.

In this case, the three mandatory fields will already be filled with some default values; for example, for the dates, the system will save the day and time when the record is being created (8).

Complete other fields according to D2.8.III.3 INSPIRE Data Specification on Soil – Technical Guidelines and click "OK", (9) to close the window.



Click the "Save Layer Edits", (10) button to save the changes, and then the "Toggle Editing", (11) button to stop editing.

The new polygon feature will be created (12).

Constraints

The validfrom date should always be previous than or equal to validto.

Beginlifespanversion should always be previous than or equal to endlifespanversion.

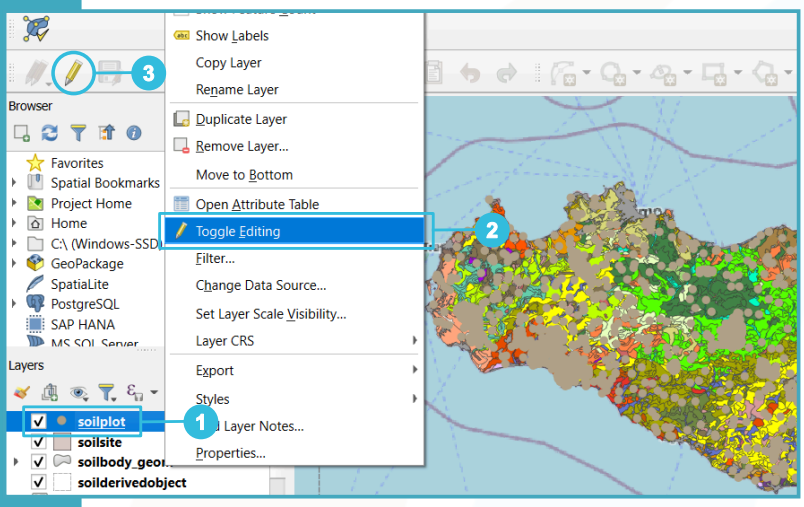
Only valid values from the CODELIST soilinvestigationpurposevalue are entered in the "soilinvestigationpurpose" field.

Upon updating the table, beginlifespanversion is updated to today.

SOIL PLOT

Is the location of a specific soil investigation

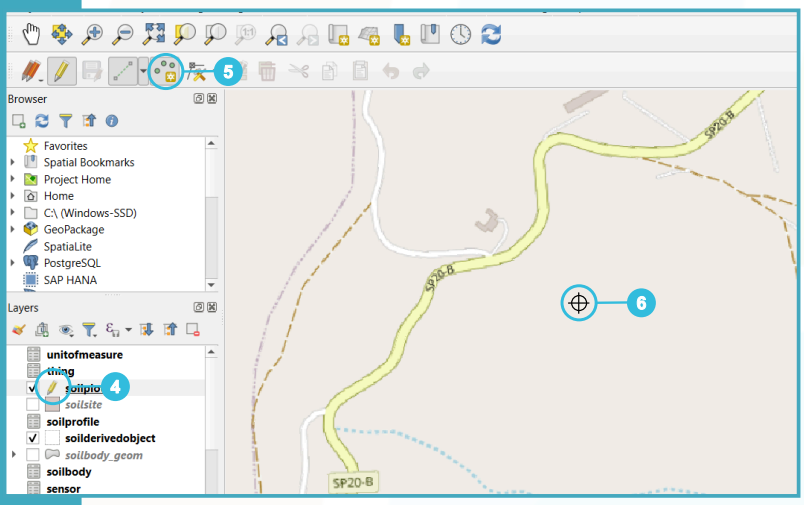
Creating a Soil Plot



The "Soil Plot" it's a point-based geographic entity. The first step To create a new Soil Site feature is to define its geometry.

Right-click in the "Layers" panel on the "soilplot", (1) and from the menu, select "Toggle Editing", (2).

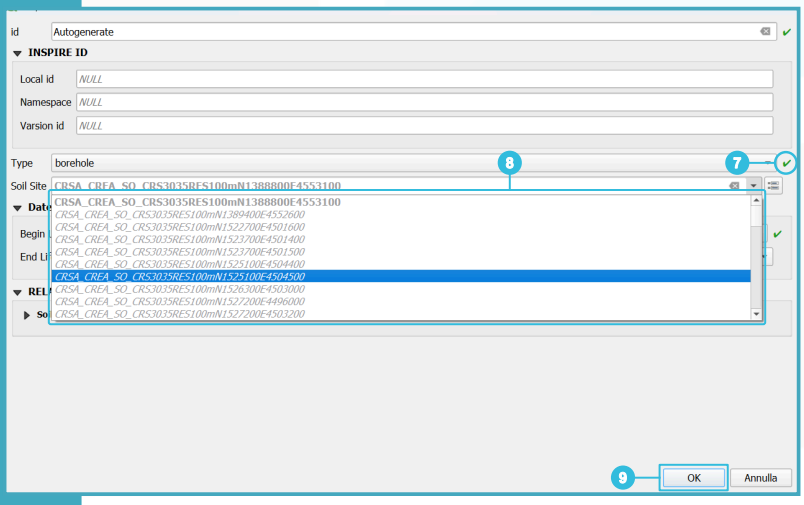
It is also possible to select only the "Soil Plot" layer (1) and click the "Toggle Editing", (3) button in the toolbar..



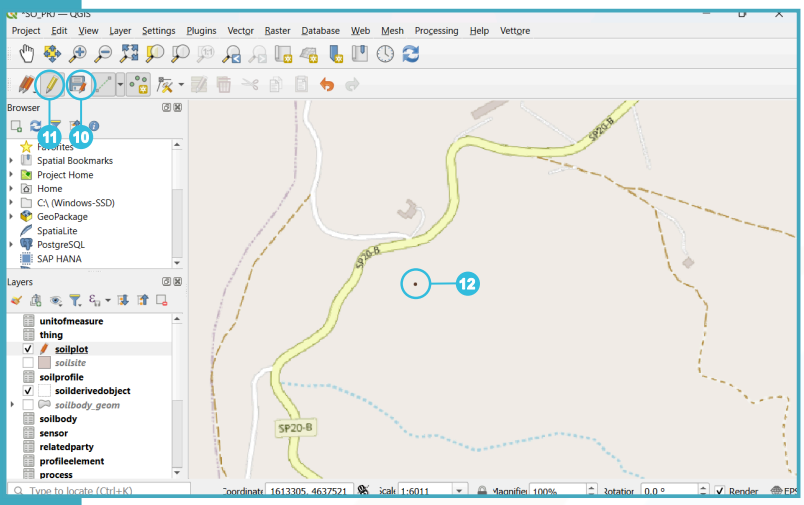
A small pencil icon will appear, indicating that the feature is in edit mode (4).

In the toolbar, select the "Add Point Feature" icon (5).

As soon as the point is created (6), the data entry form will open.



There are two mandatory fields: "Type", and "Begin Lifespan Version", and the system will suggests default values, which can be modified (7).
Associate the "Soil Plot" with the relative "Soil Site", (8) and close the window by clicking "OK". (9)



Click the "Save Layer Edits", (10) button to save the changes, and then the "Toggle Editing", (11) button to stop editing.

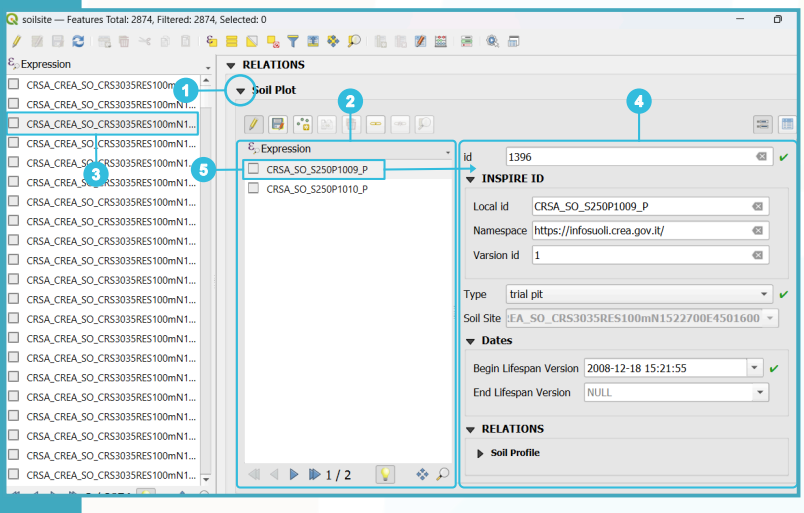
The new point will be created (12).

Relationship with the Soil Site

We can generally define the relationship between "Soil Site", and "Soil Plot", as a one-to-many (1-N) relationship, where the "Soil Site" is on the "one" side, and the "Soil Plot" is on the "many" side.

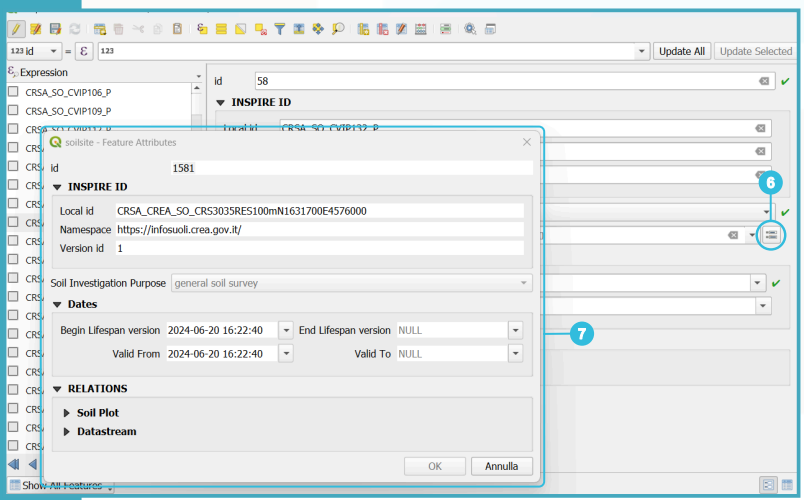
Thus, many "Soil Plot", can belong to a single "Soil Site", but only one "Soil Plot", can belong to a "Soil Site"

Viewing Relationships in QGIS Forms



In the "Soil Site", form, at the bottom of the window, within the "RELATIONS", section, click the triangle (1) to expand the "Soil Plot", section.

Here, on the left side (2), It is possible to see the "Soil Plot", records (N) related to the selected "Soil Site", record (3), while on the right side (4), the data related to the selected related record will be displayed (5).



In the "Soil Plot", form, notice the single associated "Soil Site", record; clicking the icon to the right of the field (6) allows to open the form of the associated record (7).

This enables quick access to information about relationships between different elements and allows users to navigate through them.

Please Note

All relationships in the Geopackage are represented in this way within the forms.

Constraints

Beginlifespanversion should always be previous than or equal to endlifespanversion.

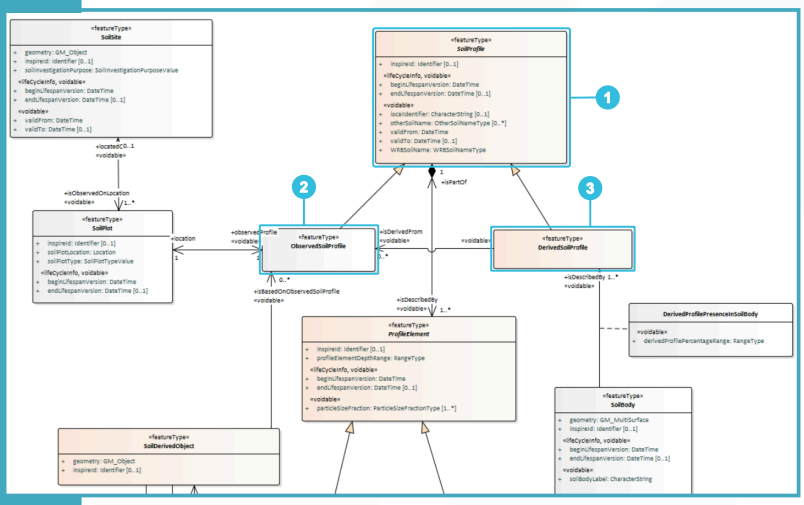
Only valid values from the CODELIST soilplottypevalue are entered in the "soilplottype" field.

Upon updating the table, beginlifespanversion is updated to today.

SOIL PROFILE

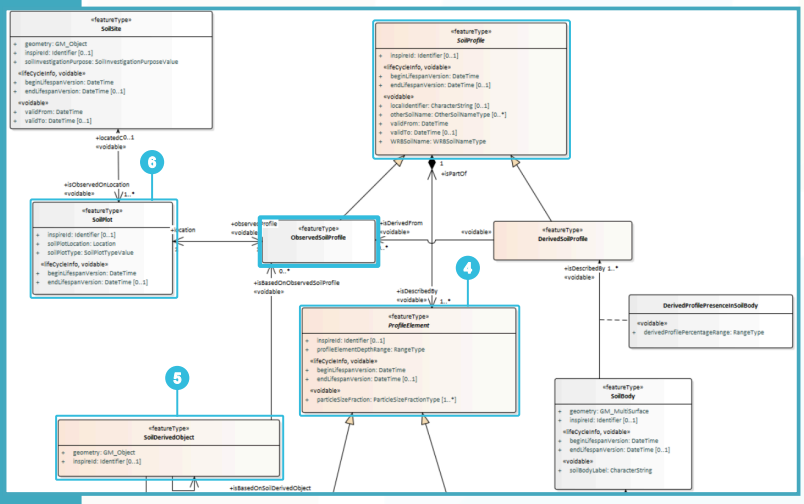
Soil Profile" can be defined as a cross-section of the soil from the surface down to and including the beginning of the fresh material unmodified by pedogenesis, consisting of various more or less horizontally oriented features formed by pedogenic processes called horizons.

Observed/Derived Distinction

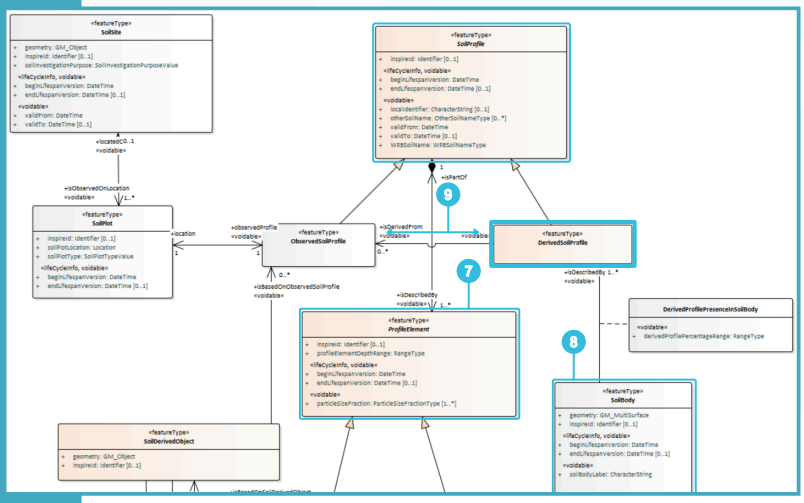


As shown in the UML model, a "Soil Profile", (1) can be either "Observed", (2) or "Derived", (3).

Both have the same attributes but different behaviors and relationships.

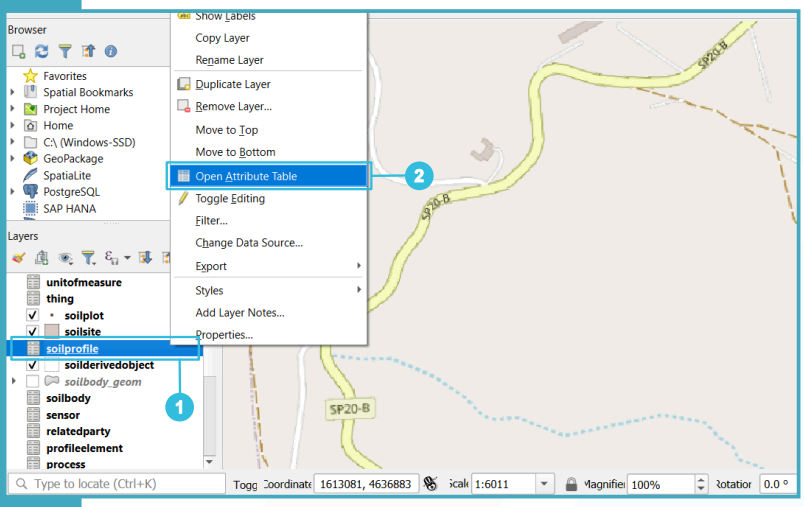


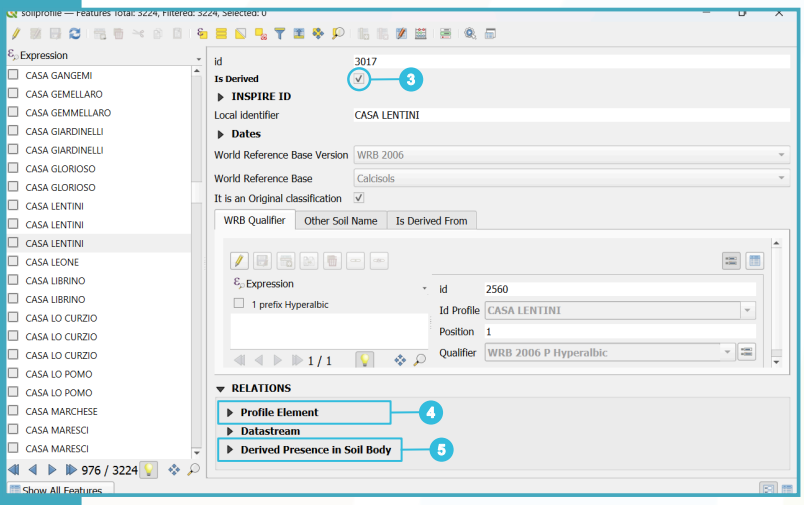
An "Observed Soil Profile", relates to "Profile Element", (4), "Soil Derived Object", (5) and "Soil Plot", (6).

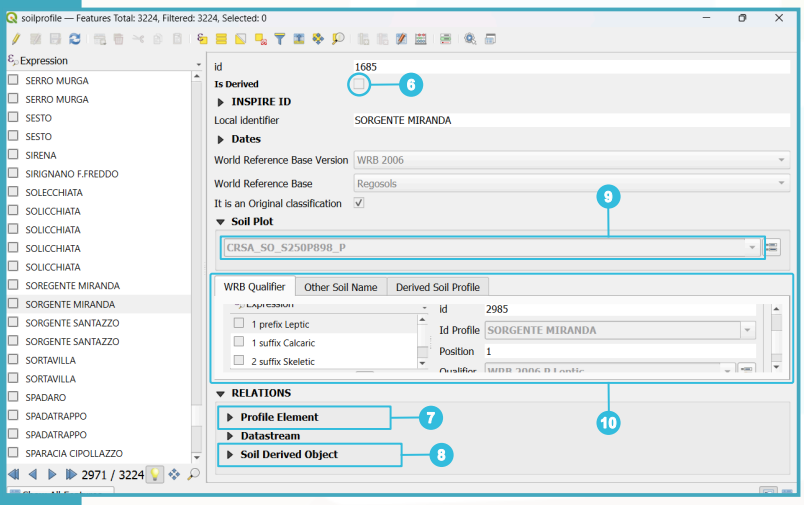


A Derived Soil Profile", relates to "Profile Element", (7) and "Soil Body", (8). "Observed", and "Derived", are also related to each other (9).

Soil Profile Form







Right-click in the "Layers" panel on the "soilprofile", (1) and from the menu, select "Open Attribute Table", (2).

To assign the "Soil Profile", as "Observed", or "Derived", use the "Is Derived", flag.

If the field is not checked, the "Soil Profile", will be of type "Observed", otherwise, it will be of type "Derived".

The customized form helps manage these two entities correctly.

Depending on whether the "Is Derived", field is checked or not, the form changes to show only the valid relationships for that entity type.

If the "Is Derived", checkbox is selected (3), the form will display the necessary elements for entering data for a "Derived", "Soil Profile", and only those.

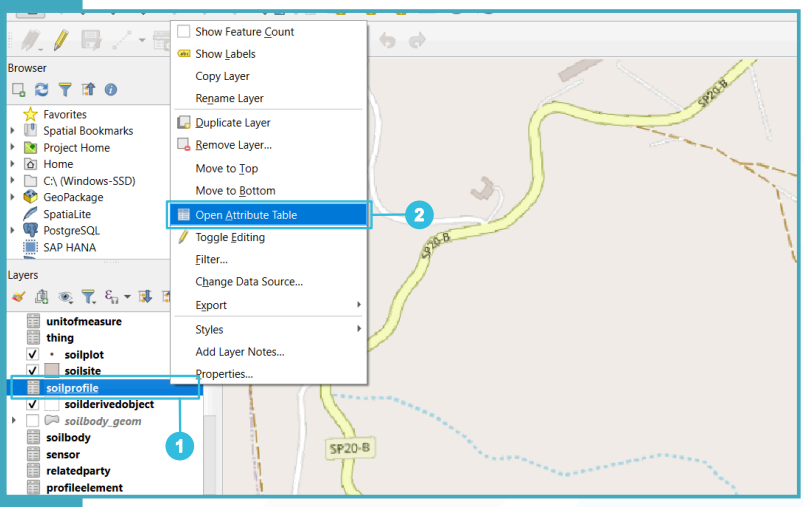
At the bottom of the form, in the "RELATIONS", section, we have tabs for linking to "Profile Element", (4) and "Soil Body", (5).

If the "Is Derived", checkbox is not selected (6), the form shows the necessary elements for entering data for an "Observed", "Soil Profile", and only those.

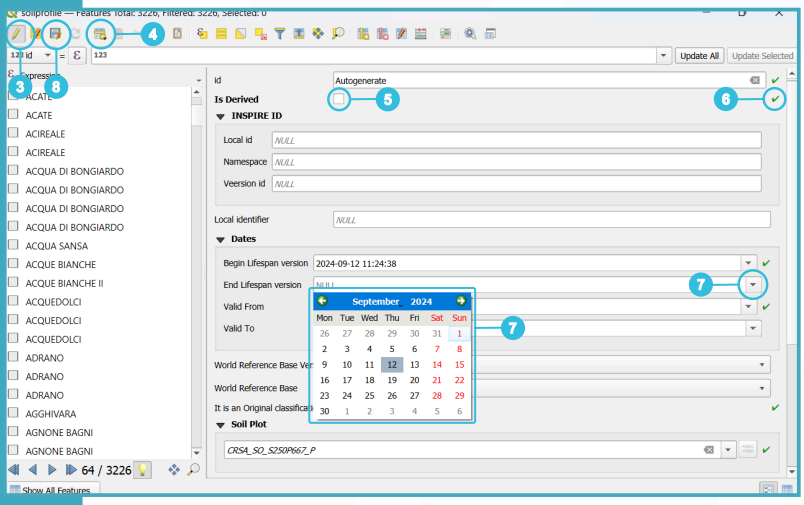
At the bottom of the form, in the "RELATIONS", section, we have tabs for linking to "Profile Element", (7) and "Soil Derived Object", (8), with the relationship to the "Soil Plot", slightly above (9).

Below the usual "RELATIONS", group, the lower part of the form displays additional tabs (10) that also show relationships with other database tables. However, unlike those in the "RELATIONS", group, these belong to the same UML entity as the "Soil Profile".

Creating a Soil Profile



To create a new "Soil Profile", of type "Observed", right-click in the "Layers" panel on the "soilprofile", (1) and select "Open Attribute Table", (2).

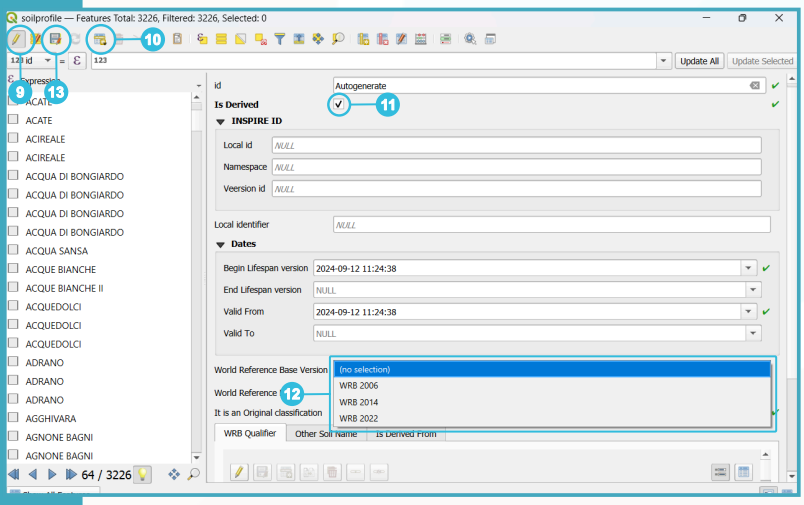


In the "Soil Profile", window, click the first icon on the left, "Toggle Edit Mode", (3), and then click the "Add Feature", icon (4).

To create a record of type "Observed", it is important not to check the "Is Derived", field (5); as shown, it is marked with a green checkmark (6) since "FALSE" is its default value.

Fill in the necessary fields using the widgets (7).

Click the "Save Layer Edits", (8) button to save the changes, and then the "Toggle Editing", button (3) to stop editing.



To create a new "Soil Profile", of type "Derived", right-click in the "Layers" panel (as shown above) on the "Soil Profile", (1) and select "Open Attribute Table", (2).

In the "Soil Profile", window, click the first icon on the left, "Toggle Edit Mode", (9), and then click the "Add Feature", icon (10).

To create a record of type "Derived", it is important to check the "Is Derived", field (11).

Fill in the necessary fields using the widgets (12).

Click the "Save Layer Edits", (13) button to save the changes, and then the "Toggle Editing", button (9) to stop editing.

Constraints

The validfrom date should always be previous than or equal to validto.

Beginlifespanversion should always be previous than or equal to endlifespanversion.

In the case of a Derived profile, the foreign key for soilplot is NULL.

In the case of an Observed profile, the foreign key for soilplot is NOT NULL.

Only valid values from the CODELIST of the version selected in the wrbversion field are entered in the "wrbreferencesoilgroup" field.

Upon updating the table, beginlifespanversion is updated to today.

At least one of profileelementdepthrange_uppervalue and profileelementdepthrange_lowervalue is not null.

Only valid values from the CODELIST wrbversion are entered in the "wrbversion" field.

The fields "wrbreferencesoilgroup" and "wrbreferencesoilgroup" are either both populated or both null.

IS DERIVED FROM

Introduction

As mentioned in the "Soil Profile", section, there is a relationship between "Observed Soil Profile", and "Derived Soil Profile".

"Derived Soil Profile", are composed of one or more "Observed Soil Profiles", while "Observed Soil Profiles", can belong to none, one, or more "Derived Soil Profiles".

Let's see how to view and create these relationships using the forms.

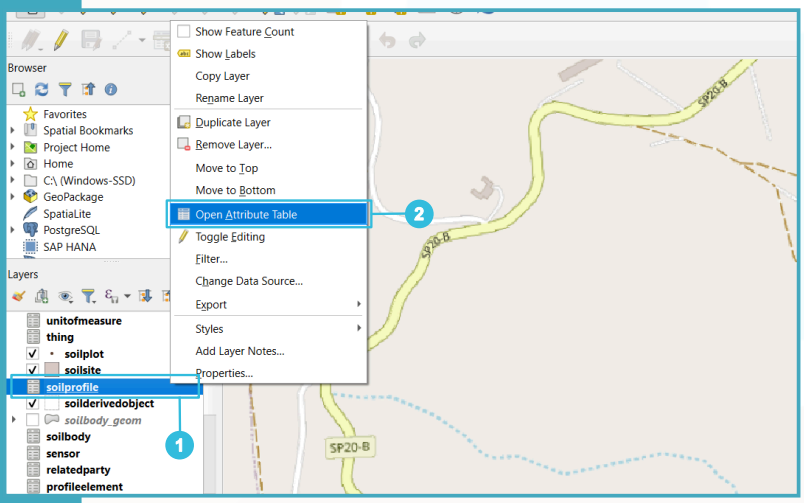
Please Note (Editing related elements in the parent form).

QGIS forms allow you to edit a related table directly from the containing form. For example, we can edit the "Is Derived", table without opening it directly, but within the "Soil Profile", form where it is contained. This feature applies to all forms with related tables in the Geopackage.

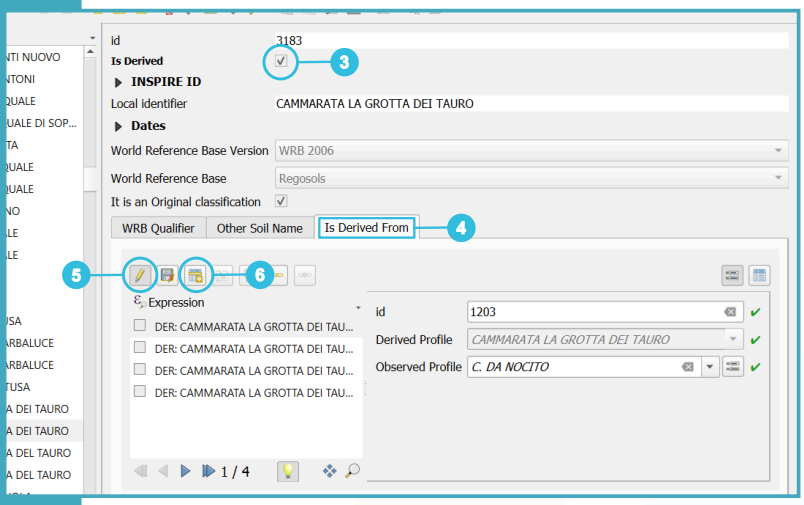
Please Note

QGIS forms allow you to edit a related table directly from the containing form. For example, we can edit the "Is Derived", table without opening it directly, but within the "Soil Profile", form where it is contained. This feature applies to all forms with related tables in the Geopackage.

Creating an "Is Derived" Relationship

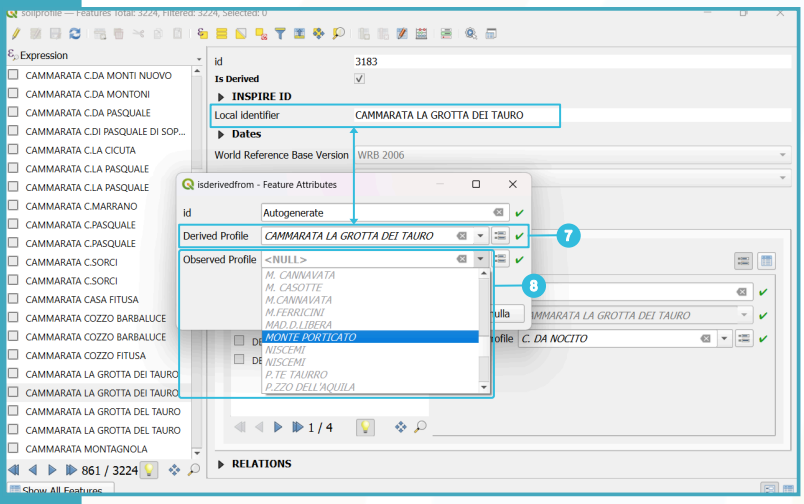


Right-click in the "Layers" panel on the "soilprofile", (1) and from the menu, select "Open Attribute Table", (2).

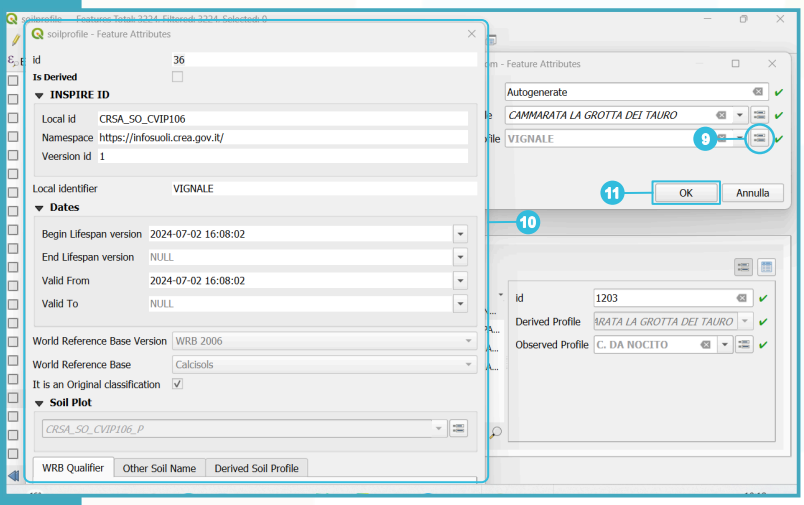


Open a "Soil Profile", of type "Derived", meaning the "Is Derived", field is checked (3).

Go to the "Is Derived From", tab (4), click the pencil icon, "Toggle Editing Mode for Child Layer", (5) to make the tab editable, and then click the "Add Child Feature", button (6).



A new window will open, where the "Derived Profile", field will already display the name of the "Derived Profile", we started from (7), while in the selector of the "Observed Profile", field, we can choose the "Observed", "Soil Profile", to associate (8).

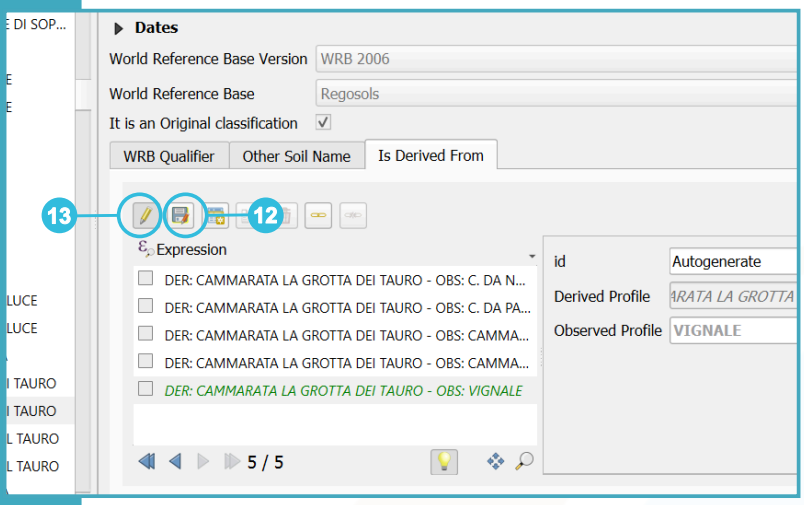


To verify that the correct "Soil Profile", has been selected, click the icon to the right of the field (9) to open the corresponding form (10).

Close the window by clicking "OK", (11).

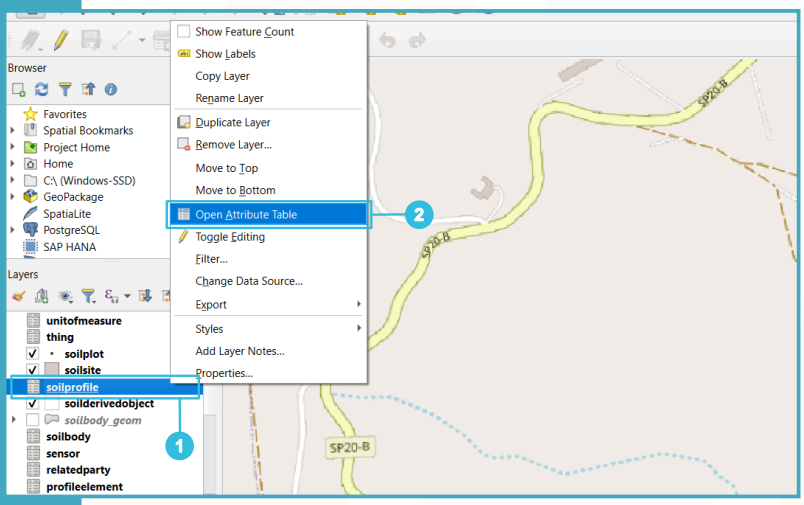
Please Note

Only "Observed Soil Profiles", will appear in the list for the "Observed Profile", field. You can filter the list by entering characters to search within the field.

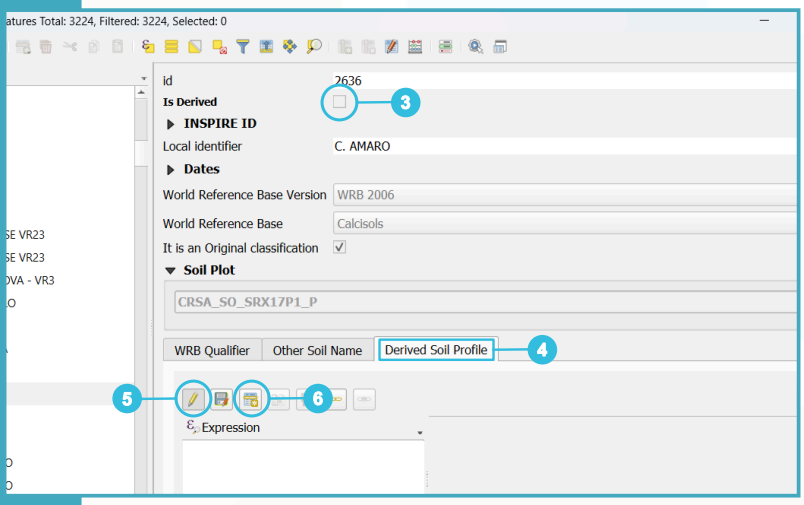


Click the "Save Child Layer Edits", (12) button to save the changes, and then the "Toggle Editing Mode for Child Layer", button (13) to stop editing.

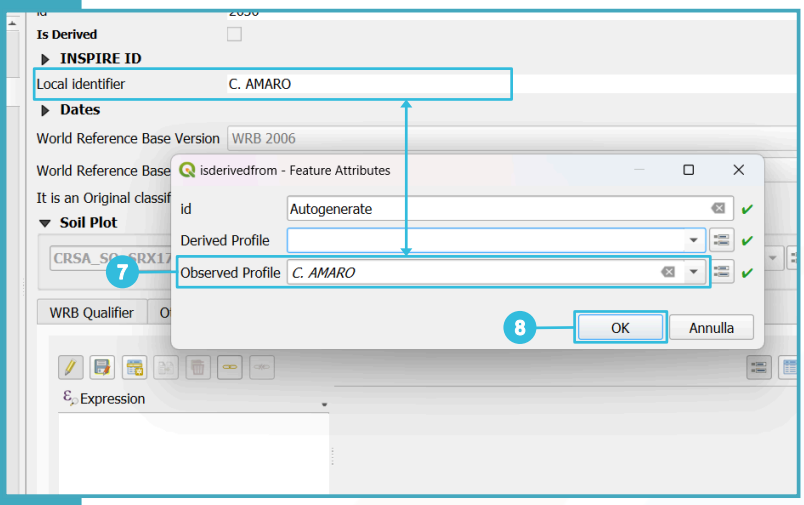
Creating a Derived Relationship



Right-click in the "Layers" panel on the "soilprofile", (1) and from the menu, select "Open Attribute Table", (2).



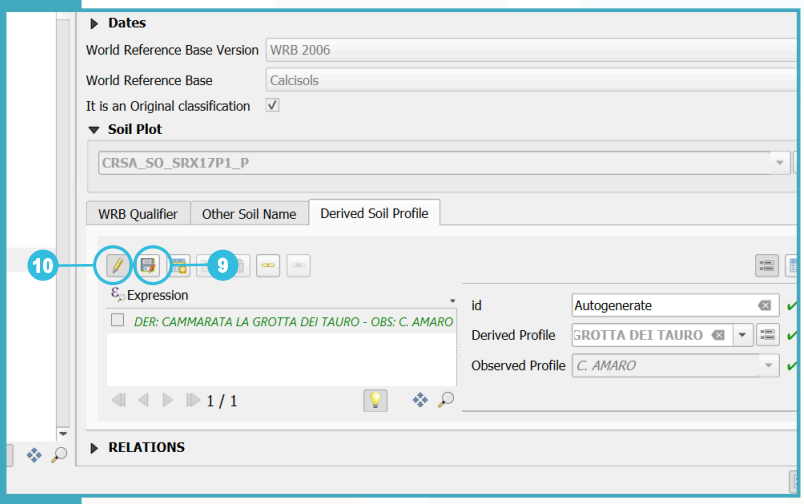
Navigate to the "Derived Soil Profile" tab (4), click the pencil icon "Toggle editing mode for child layer" (5) to make the tab editable, and then click the "Add Child Feature" button (6).



The same window seen in the "Creating an Is Derived Relationship" section will open, with the difference that in this case, the "Observed Profile" field (7) will have the name of the "Observed Profile" we started from, while in the "Derived Profile" field selector, you can choose the "Soil Profile" of type "Derived" to associate.

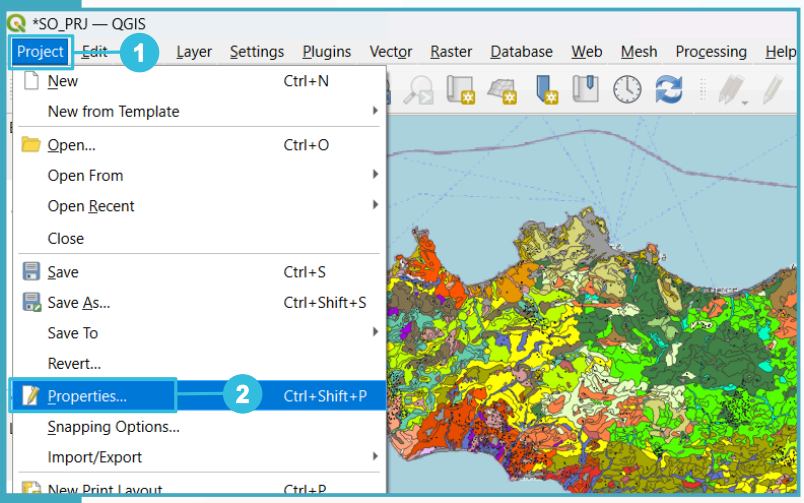
Again, only "Soil Profile" of type "Derived" will appear in the list.

Close the window by clicking the "OK" button (8).



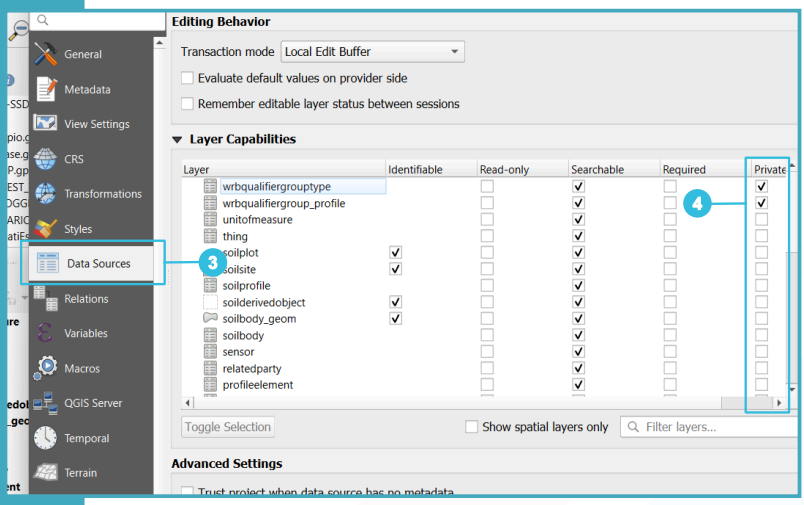
Click the "Save child layer edits" button (9) to save the edits, and then the "Toggle editing mode for child layer" button (10) to stop editing.

Hidden Layers

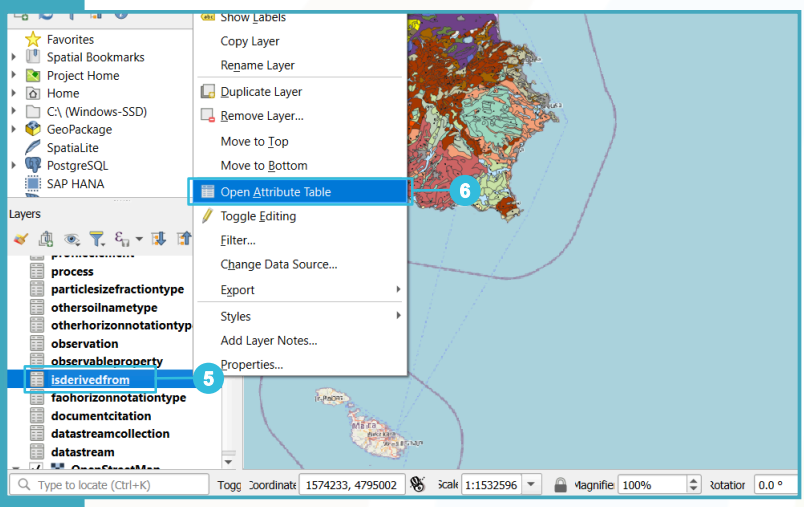


These relationships can also be created directly using the form for the "isderived" table.

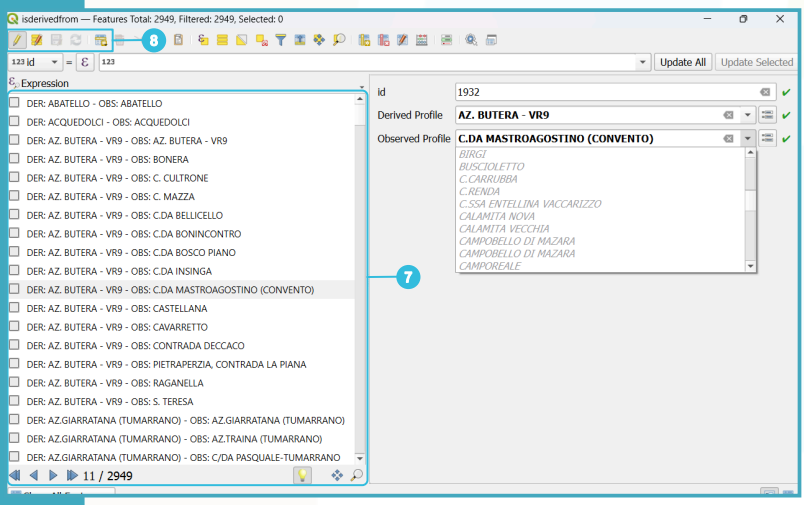
For simplicity, this form has been hidden in the QGIS project. To make it visible, click on "Project" (1) and then "Properties" (2).



Go to the "Data Source" tab (3), search for the "is derived" layer, and uncheck the flag (4).



In the "Layers" tab, right-click on "isderivedfrom" (5) and select "Open Attribute Table" (6).



The same window seen earlier will open, where on the left side (7), all the relationships between the two entities in the Geopackage will be shown.

Again, in case of editing (8), only "Derived Soil Profile" entries present in the Geopackage will appear in the "Derived Profile" field, while only "Observed Soil Profile" entries will appear in the "Observed Profile" field.

Constraints

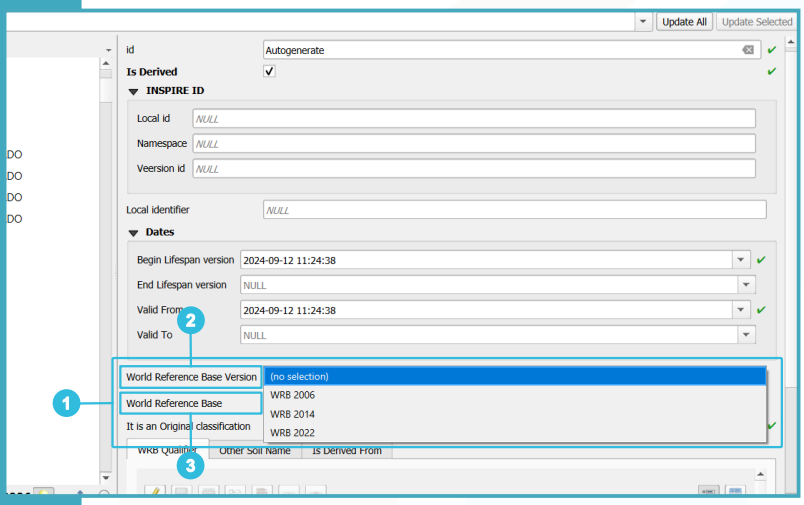
If the value of isderived in soilprofile is equal to 1 because the value of the "base_id" field in the "isderivedfrom" table cannot be inserted because profile is not of type “derived”.

If the value of isderived in soilprofile is equal to 0 because the value of the "related_id" field in the "isderivedfrom" table cannot be inserted because profile is not of type “observed”.

WRB QUALIFIER GROUP TYPE/PROFILE

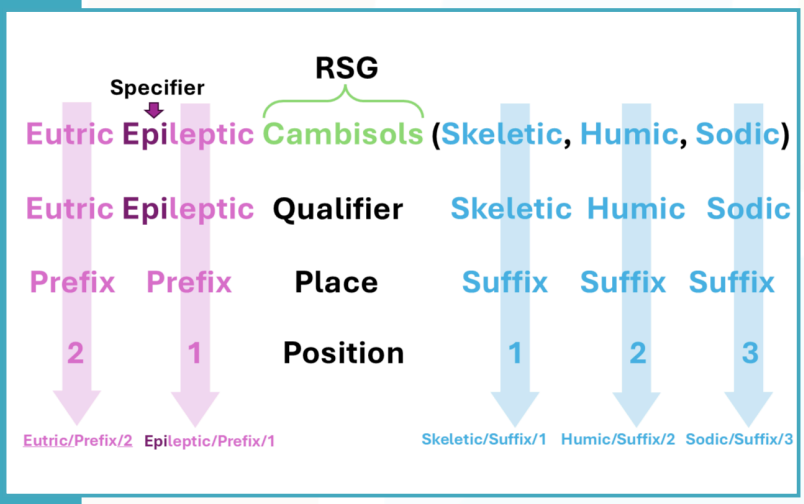
A data type to define the group of a qualifier and its possible specifier(s), its place and position with regard to the World Reference Base (WRB)

Introduction



Among the attributes of a "Soil Profile", whether it is of type "Observed" or "Derived", there is the option to insert the "World Reference Base" classification (1).

In the "Soil Profile" form, you can select the classification year (2) and the "Reference Soil Groups" (3).



As an example, to follow the workflow, let's take the following classification from the 2006 World Reference Base:

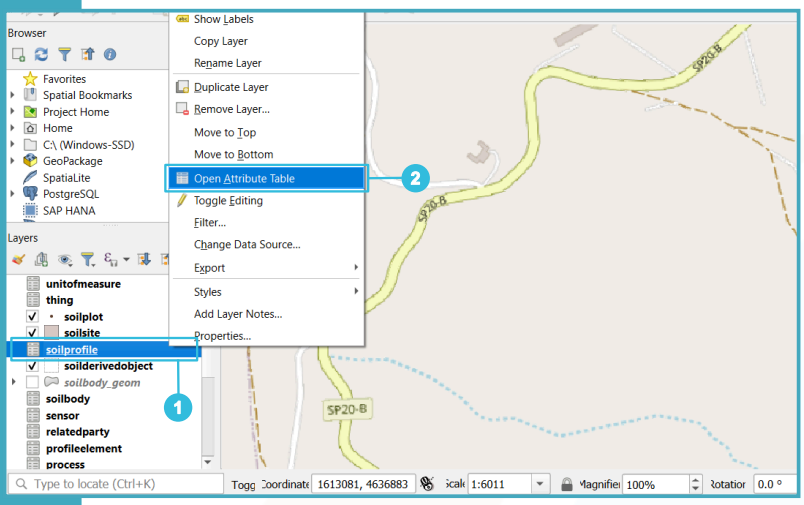
•Indicate the "Reference Soil Groups", which has already been described in the "Soil Profile".

•Specify the "Qualifier", and where applicable, the "Specifier".

•Specify the "Qualifier Place", whether it is a prefix or a suffix.

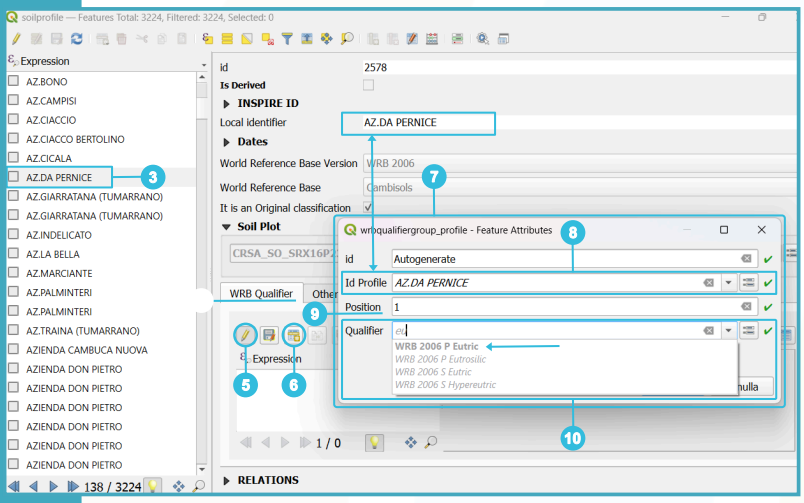
•Finally, define the "Position" of the qualifier within the classification.

Detailing the Classification from the Soil Profile Form



In this case as well, a related table is edited directly from the form containing it.

Right-click on the "Layers" panel on the "soilprofile" entry (1) and from the menu, select "Open Attribute Table" (2).



Select a "Soil Profile" (3).

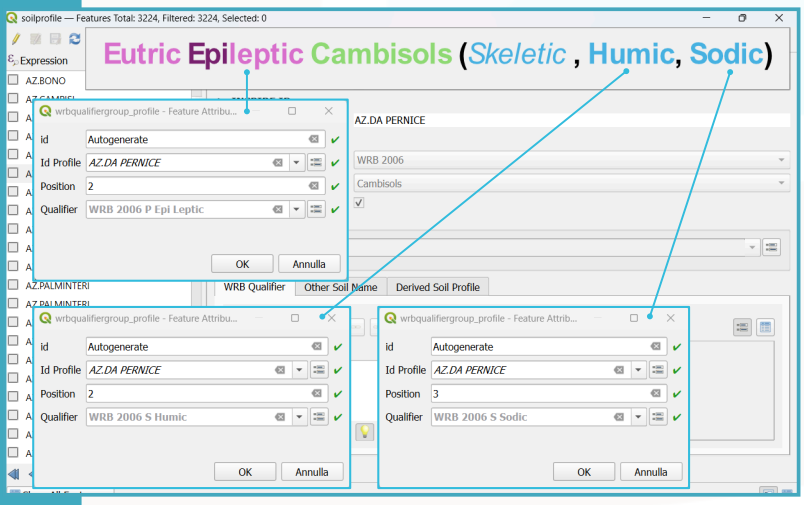
Navigate to the "WRB Qualifier" tab (4), click the pencil icon "Toggle editing mode for child layer" (5) to make the tab editable, and then click the "Add Child Feature" button (6).

A window will open (7) allowing you to insert both prefixes and suffixes and their position within the classification.

The "Id Profile" field (8) will already contain the name of the selected "Soil Profile".

Define the position (9) of the prefix or suffix within the classification.

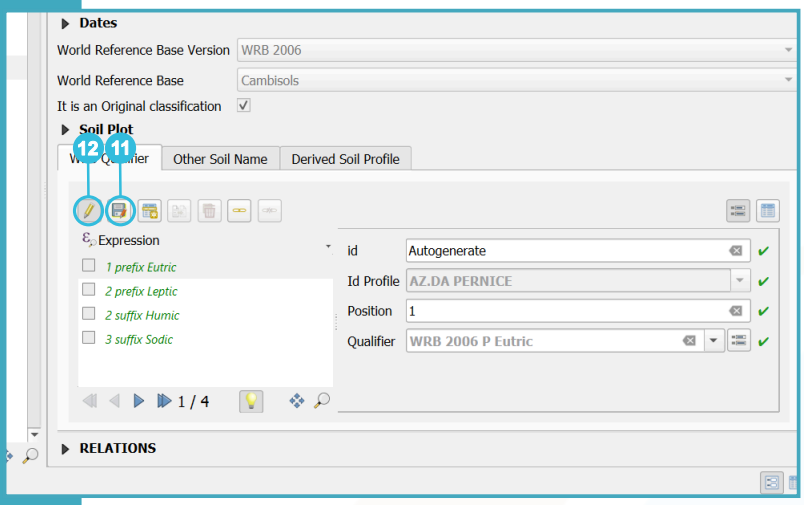
Search for the relevant prefix or suffix (10), paying attention to the WRB year as well.



It is possible to filter the list values by typing within the field. The letter "P" indicates a "Prefix", and "S" indicates a "Suffix".

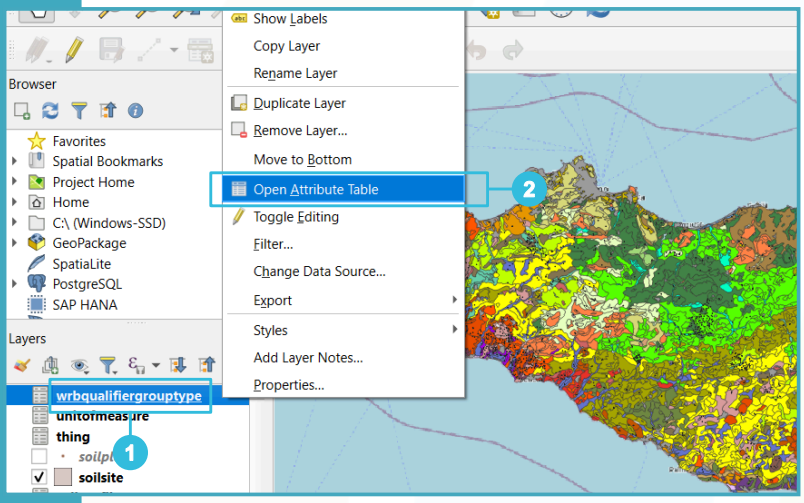
Close the window by clicking the "OK" button.

Continue until the classification is completed by inserting all necessary prefixes and suffixes, starting again from step (6).



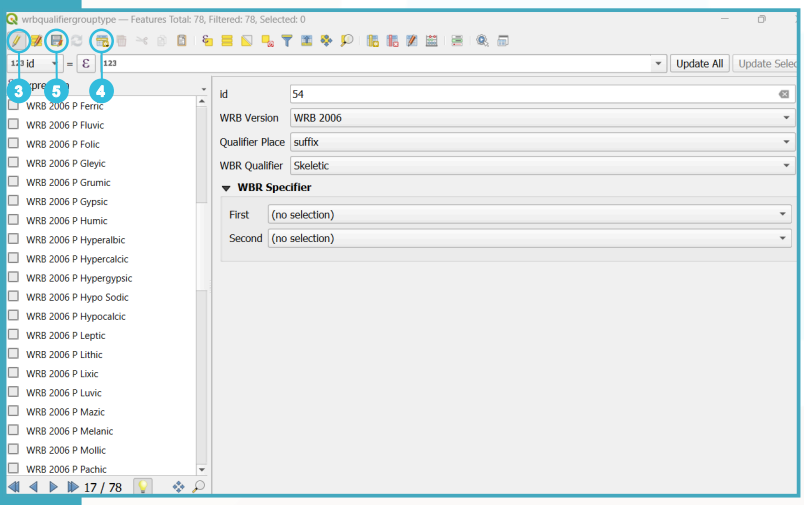
Click the "Save child layer edits" button (11) to save the edits, and then the "Toggle editing mode for child layer" button (12) to stop editing.

Creating a new WRB Qualifier Group Type



We could not complete the classification in the example because the "dropdown menu" in the "Qualifier" field did not contain "WRB 2006 S Skeletic", so we need to create it.

Right-click on the "Layers" panel on the "wrbqualifiergrouptype" entry (1) and from the menu, select "Open Attribute Table" (2).



In the "WRB Qualifier Group Type" window, click the first icon on the left named "Toggle Edit Mode" (3), and then click the "Add Feature" icon (4).

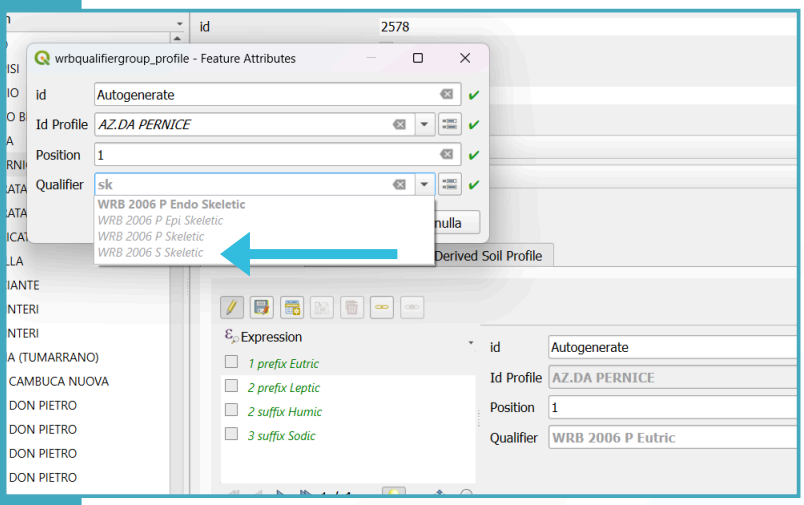
Fill in the fields.

It is also possible to define up to two specifiers.

Click the "Save Layer Edits" button (5) to save the edits, and then the "Toggle Editing" button (3) to stop editing.

Please Note

Selecting the WRB year will modify the values in the underlying selectors, providing the relevant options for the chosen classification type.



You can now complete the classification by adding the newly created suffix by returning to the "Soil Profile" form.

Constraints

Only valid values from the CODELIST of the version selected in the wrbversion field are entered in the "wrbqualifier" field.

Only valid values from the CODELIST wrbqualifierplacevalue are entered in the "qualifierplace" field.

Only valid values from the CODELIST of the version selected in the wrbversion field are entered in the "wrbspecifier_1" field.

Only valid values from the CODELIST of the version selected in the wrbversion field are entered in the "wrbspecifier_2" field.

Only valid values from the CODELIST wrbversion are entered in the "wrbversion" field.

There are no duplicate rows.

wrbspecifier_1 and wrbspecifier_2 are not equal and that if wrbspecifier_2 is not NULL, wrbspecifier_1 must also not be NULL.

For each row that soilprofile and wrbqualifiergrouptype have the same version as WRB.

If an idwrbqualifiergrouptype and qualifierposition record already exists for the same soilprofile.

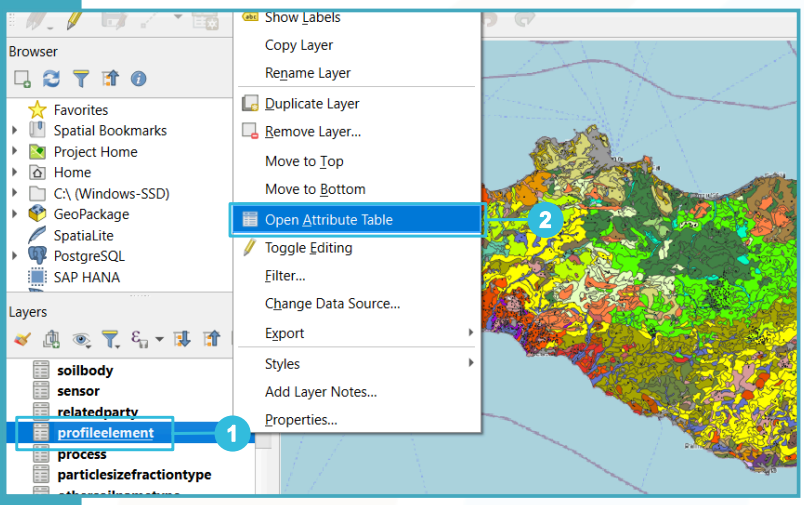
Ensure that only one record exists with the same combination of the fields "wrbversion", "qualifierplace", "wrbqualifier", "wrbspecifier_1", "wrbspecifier_2" in the table "wrbqualifiergrouptype".

Ensure that only one record exists with the same combination of the fields "idsoilprofile", "idwrbqualifiergrouptype" in the table "wrbqualifiergroup_profile".

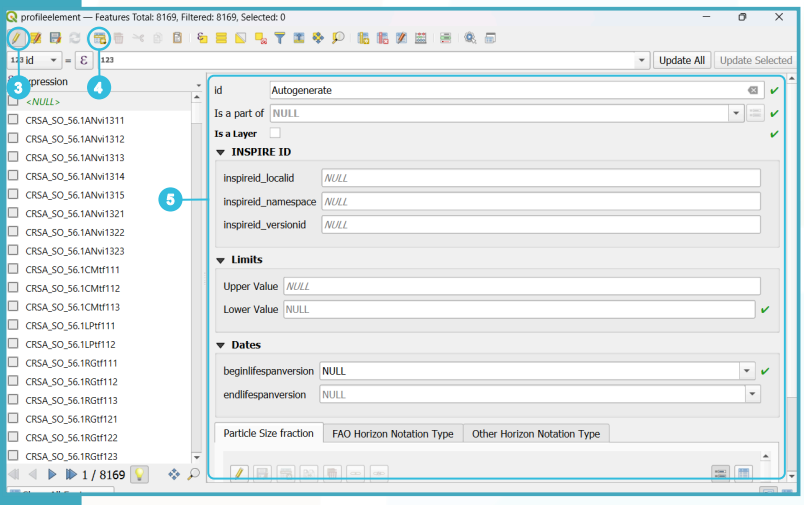
PROFILE ELEMENT

An abstract spatial object type grouping soil layers and / or horizons for functional/ operational aims.

Form Profile Element



Right-click on the "Layers" panel on the "profileelement" entry (1) and from the menu, select "Open Attribute Table" (2)..



Click the pencil icon "Toggle editing mode" (3) to make the tab editable, and then click the "Add Feature" button (4).

This will display an empty form on the right side (5), where you can input new data.

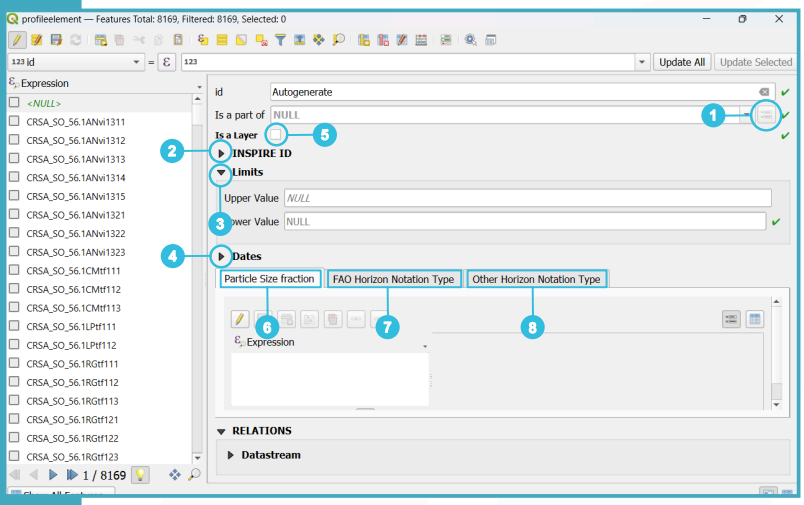
This table contains two types of elements: "Soil Horizon" and "Soil Layer".

To assign the Profile Element the role of Horizon or Layer, use the "Is a Layer" field. If the field is unchecked, the "Profile Element" will be of type "Horizon"; otherwise, it will be of type "Layer".

The customized form helps manage these two entities properly. Depending on whether the "Is a Layer" field is checked, the form adjusts to allow input for fields relevant to the selected entity type.

Horizon

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

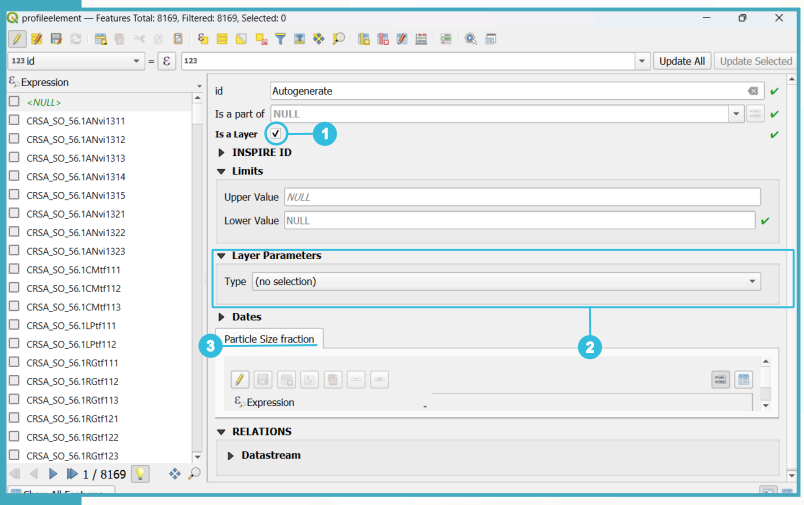


Some attributes are common to both types, such as "Is a Part Of" (1), which indicates the connection to the reference "Soil Profile", "Inspire ID" (2), "Limits" (3), and "Dates" (4).

If the "Is a Layer" field is not checked (5), the form displays, in addition to the "Particle Size Fraction" tab (6) (shared by both types), the "Fao Horizon Notation Type" (7) and "Other Horizon Notation Type" (8) tabs.

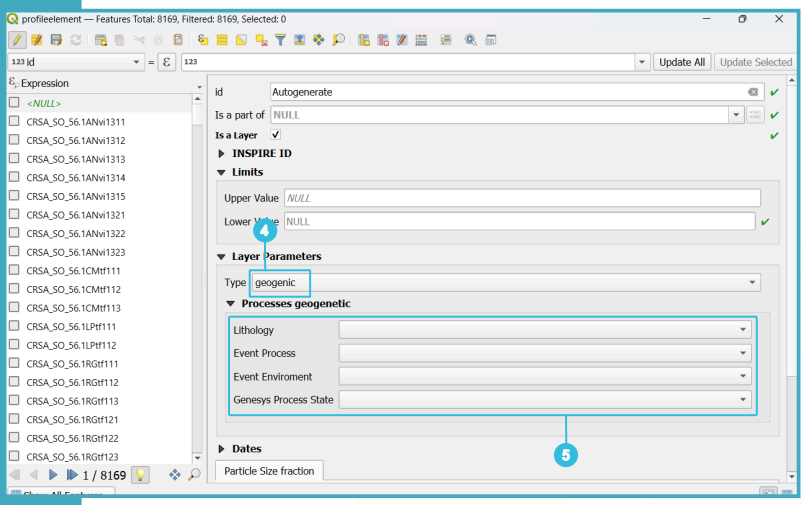
Layer

Domain of a soil with a certain vertical extension developed through nonpedogenic processes, displaying a change in structure and/or composition to possibly over- or underlying adjacent domains, or a grouping of soil horizons or other sub-domains with a special purpose.



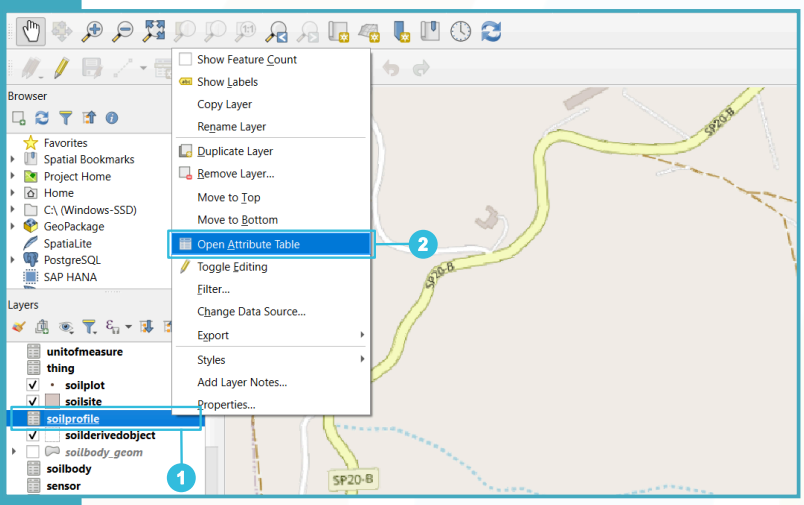
If the "Is a Layer" field (1) is checked, the form shows the "Type" (Layer Parameters) field (2).

The "Fao Horizon Notation Type" and "Other Horizon Notation Type" tabs are no longer displayed (3).



If the Layer is of type "Geogenic" (4), additional information can be entered (5).

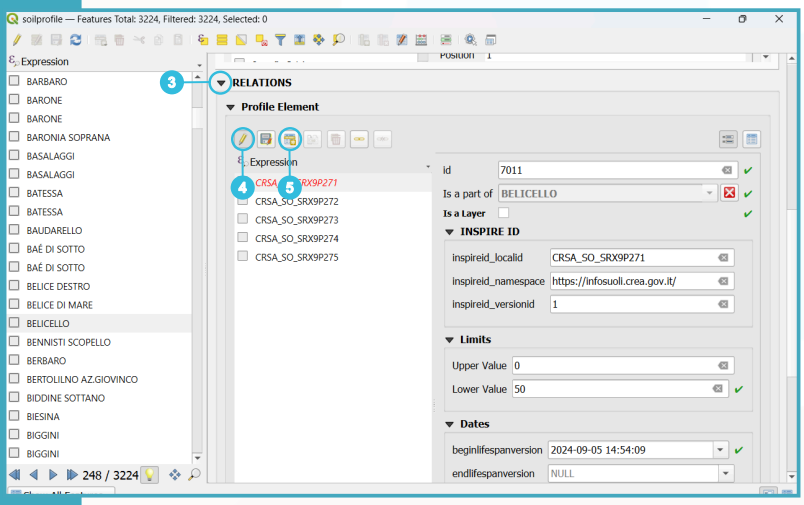
Creating a Profile Element



In this example, we will create a "Profile Element" of type "Horizon".

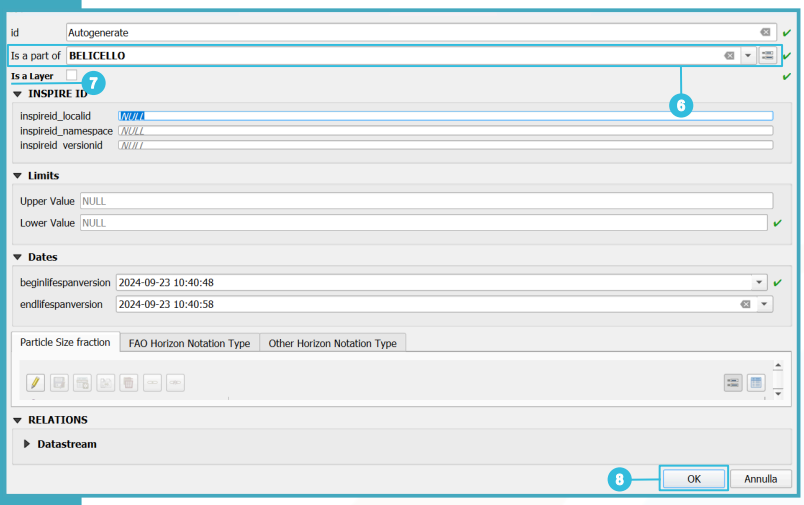
The most efficient way to create a "Profile Element" is by starting from the "Soil Profile" table.

Right-click on the "Layers" panel on the "soilprofile" entry (1) and from the menu, select "Open Attribute Table" (2).



Within "Relations", open "Profile Element" (3).

Click the pencil icon "Toggle editing mode for child layer" (4) to make the tab editable, and then click the "Add Child Feature" button (5).

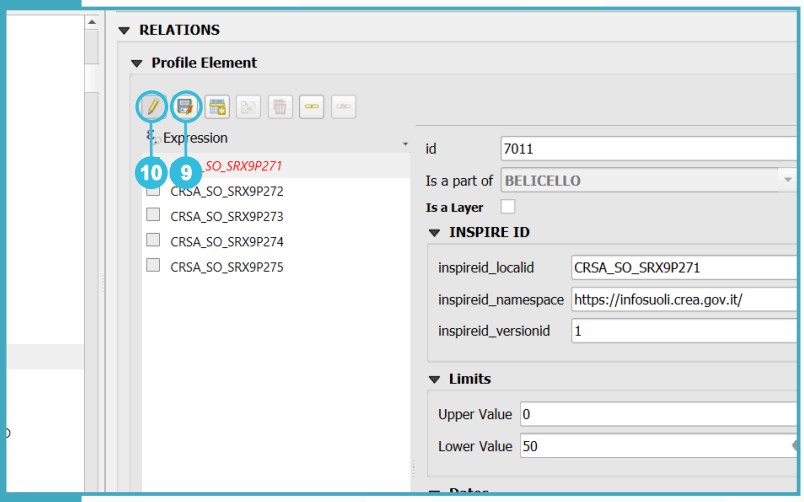


Enter the data into the "Profile Element" form that appears.

By editing the "Profile Element" as a Child Feature of the "Soil Profile", it will automatically be linked (6).

Do not check the "Is a Layer" field, as we are editing a "Horizon" (7).

After completing the form, click OK (8).



Click the "Save child layer edits" button (9) to save the edits, and then the "Toggle editing mode for child layer" button (10) to stop editing.

Constraints

If we have a HORIZON, the values of the fields "layertype," "layerrocktype," "layergenesisprocess," "layergenesisenviroment," and "layergenesisprocessstate" must be NULL.

Beginlifespanversion should always be previous than or equal to endlifespanversion.

The value of profileelementdepthrange_uppervalue is always less than the value of profileelementdepthrange_lowervalue.

Only valid values from the CODELIST layertypevalue are entered in the "layertype" field.

Only valid values from the CODELIST eventenvironmentvalue are entered in the "layergenesisenviroment" field.

Only valid values from the CODELIST eventprocessvalue are entered in the "layergenesisprocess" field.

Only valid values from the CODELIST layergenesisprocessstatevalue are entered in the "layergenesisprocessstate" field.

Only valid values from the CODELIST lithologyvalue are entered in the "layerrocktype" field.

Upon updating the table, beginlifespanversion is updated to today.

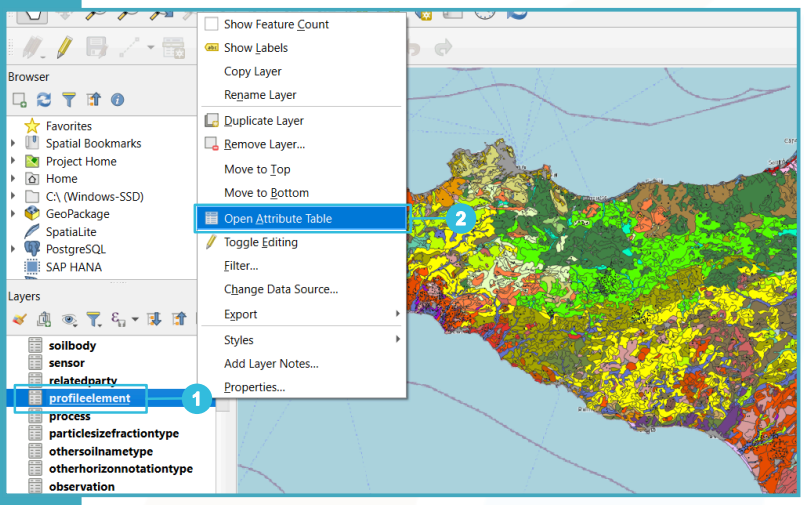
Upon updating, endlifespanversion is after today.

Endlifespanversion is after today.

Checks that if in the “layertype” field the value is different from “geogenic” the values in the “layerrocktype”, “layergenesisprocess”, “layergenesisenviroment” and “layergenesisprocessstate” fields are null.

PARTICLE SIZE FRACTION

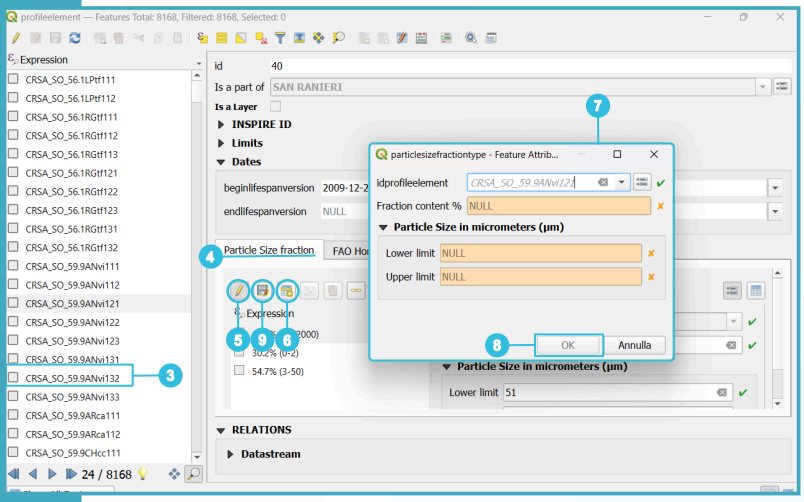
Mineral part of the soil, fractioned on the basis of size (diameter), limits of the particles. It indicates how much of the mineral soil material is composed of soil particles of the specified size range.



It is advisable to start from the "Soil Profile Element" table so that the "Particle Size Fraction" entries are already linked to the corresponding "Horizon" or "Layer".

Creating a Particle Size Fraction

Right-click on the "Layers" panel on the "profileelement" entry (1) and from the menu, select "Open Attribute Table" (2).



Select a record from the "Profile Element" list (3) and go to the "Particle Size Fraction" tab (4).

Click the pencil icon "Toggle editing mode for child layer" (5) to make the tab editable, and then click the "Add Child Feature" button (6).

The "particlesizefractiontype" window will open (7).

After completing the form, click OK (8).

Click the "Save child layer edits" button (9) to save the edits, and then the "Toggle editing mode for child layer" button (5) to stop editing.

Please Note

The particle size must be expressed in micrometers (µm).

Constraints

The sum of "fractioncontent" does not exceed 100.

The new range should not overlap or touch an existing range for the same idprofileelement.

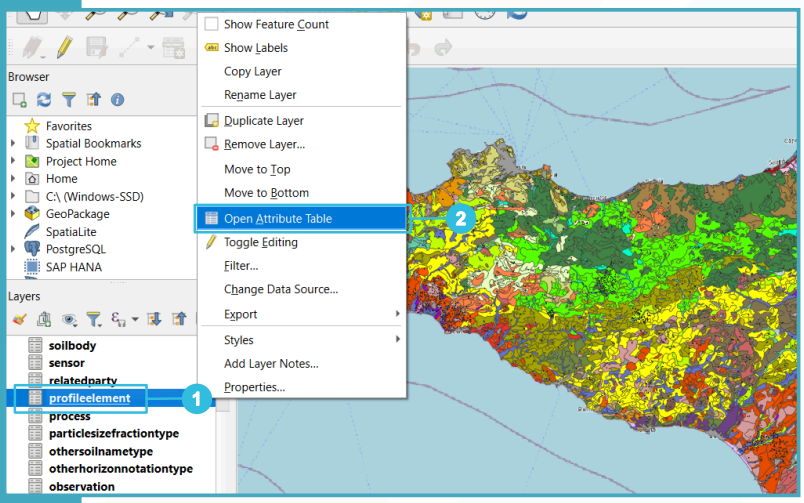
particlesize_lower and particlesize_upper values must be between 0 and 2000.

particlesize_lower must be less than particlesize_upper.

FAO HORIZON NOTATION TYPE

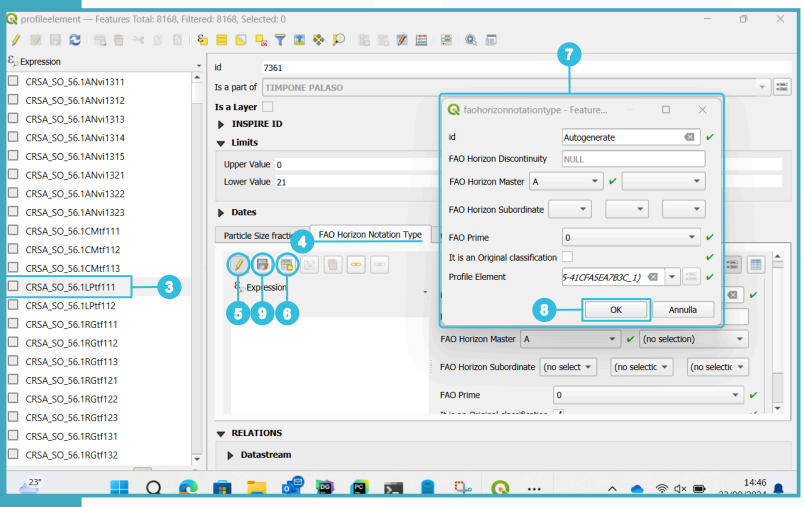
Part of the soil cover that is delineated and that is homogeneous with regard to certain soil properties and/or spatial patterns. The soils present in the soil body are characterized by one or more derived soil profiles that are found together in the area specified by the "geometry" attribute of the SoilBody.

Form FAO Horizon Notation Type



It is advisable to start from the "Soil Profile Element" table so that the "FAO Horizon Notation Type" entries are already linked to the corresponding "Horizon" or "Layer".

Right-click on the "Layers" panel on the "profileelement" entry (1) and from the menu, select "Open Attribute Table" (2).



Select a record from the "Profile Element" list (3) and go to the "FAO Horizon Notation Type" tab (4), which will only be available if the "Profile Element" is of type "Horizon".

Click the pencil icon "Toggle editing mode for child layer" (5) to make the tab editable, and then click the "Add Child Feature" button (6).

The "faohorizonnotationtype" window will open (7).

After completing the form, click OK (8).

Click the "Save child layer edits" button (9) to save the edits, and then click the "Toggle editing mode for child layer" button (5) to stop editing.

Please Note

The relationship between "Profile Element" and "FAO Horizon Notation" is one-to-one (1:1). Unfortunately, QGIS forms treat all relationships as one-to-many (1-N).

QGIS will allow the entry of multiple "FAO Horizon Notation" records for a single "Profile Element", but when saving, the system will report a FOREIGN KEY error.

Constraints

To attribute FAO HORIZON NOTATION, the Profile Element should be set as Horizon type (1), if set with 0 means the Profile Element being a Layer type.

Only valid values from the CODELIST faohorizonmastervalue are entered in the "faohorizonmaster" field.

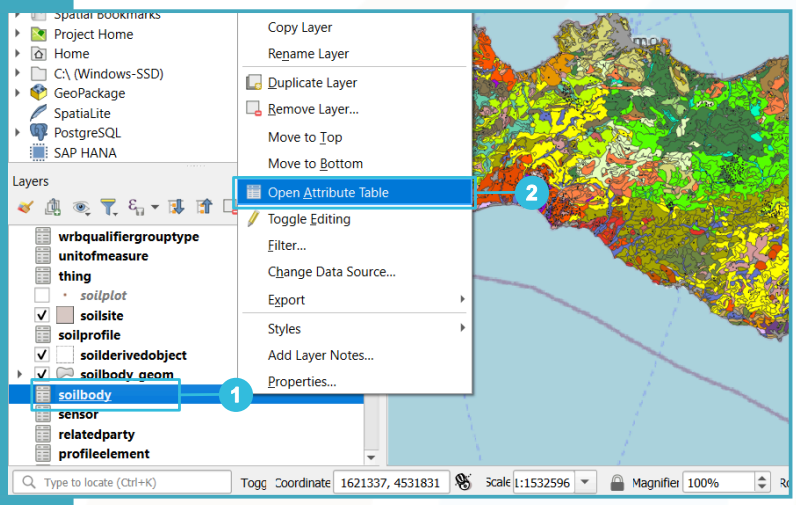
Only valid values from the CODELIST faohorizonsubordinatevalue are entered in the "faohorizonsubordinate" field.

Only valid values from the CODELIST faoprimevalue are entered in the "faoprime" field.

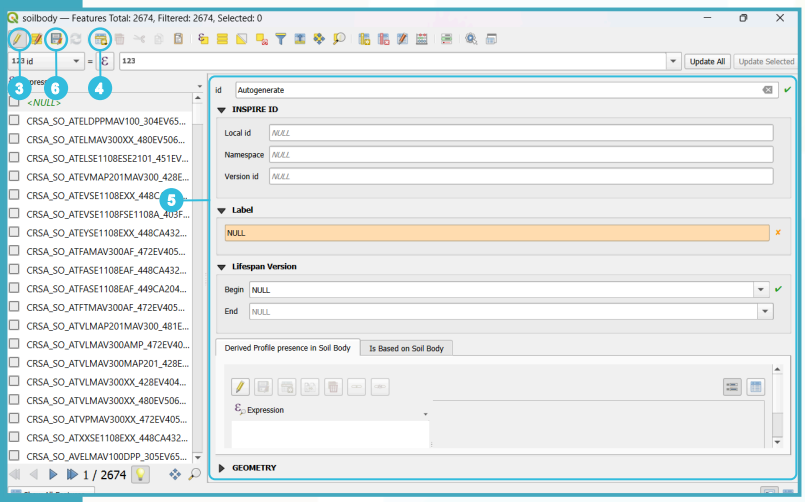
SOIL BODY

Part of the soil cover that is delineated and that is homogeneous with regard to certain soil properties and/or spatial patterns. The soils present in the soil body are characterized by one or more derived soil profiles that are found together in the area specified by the "geometry" attribute of the SoilBody.

Creating a Soil Body



Right-click on the "Layers" panel on the "soilbody" entry (1) and from the menu, select "Open Attribute Table" (2).



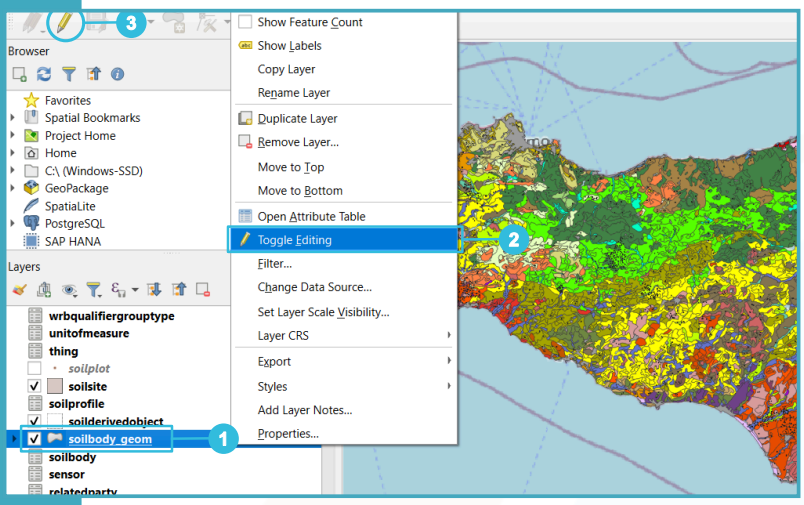
Click the pencil icon "Toggle editing mode" (3) to make the tab editable, and then click the "Add Feature" button (4).

This will display an empty form on the right side (5), where you can input the new "Soil Body" data.

Fill out the form with the "Soil Body" data.

Click the "Save Layer Edits" button (6) to save the edits, and then click the "Toggle Editing" button (3) to stop editing.

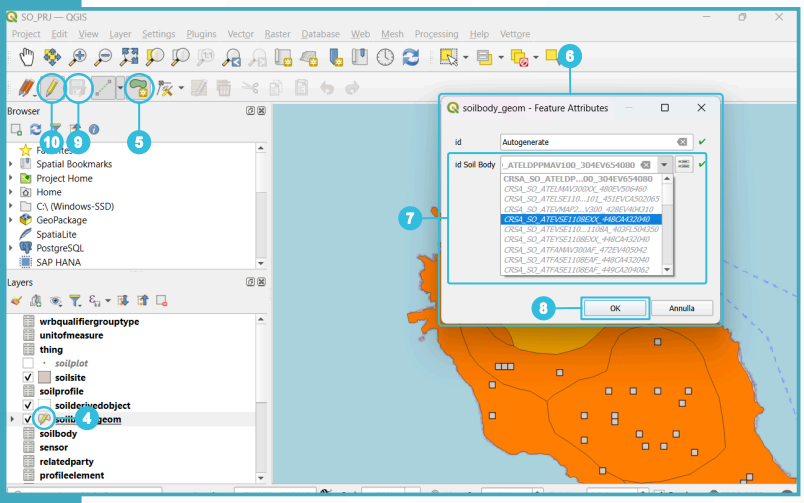
Creating the Geometry of a Soil Body



To create a new "soilbody_geom", since it is a geographic polygonal entity, it is necessary to define the geometry first.

Right-click on the "Layers" panel on the "soilbody_geom" entry (1) and from the menu, select "Toggle Editing" (2).

Alternatively, you can select just the "Soil Site" layer (1) and click the "Toggle Editing" button (3) in the toolbar.



A small pencil icon (4) will appear, indicating that the feature is being edited.

In the toolbar, select the "Add Polygon Feature" icon (5) and draw the geometry for the new "soilbody_geom".

Right-click to finish the geometry, and the form for data input will appear (6).

Select the "Soil Body" to associate with the newly created geometry (7).

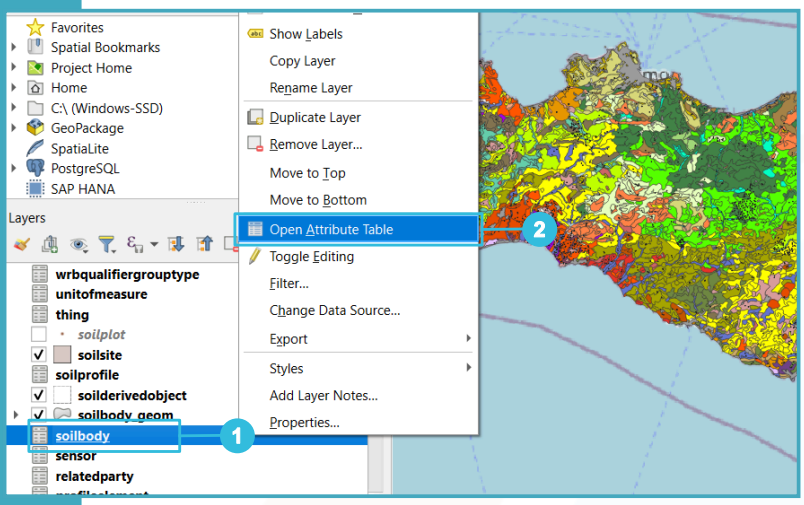
After completing the form, click OK (8).

Click the "Save Layer Edits" button (9) to save the edits, and then click the "Toggle Editing" button (10) to stop editing.

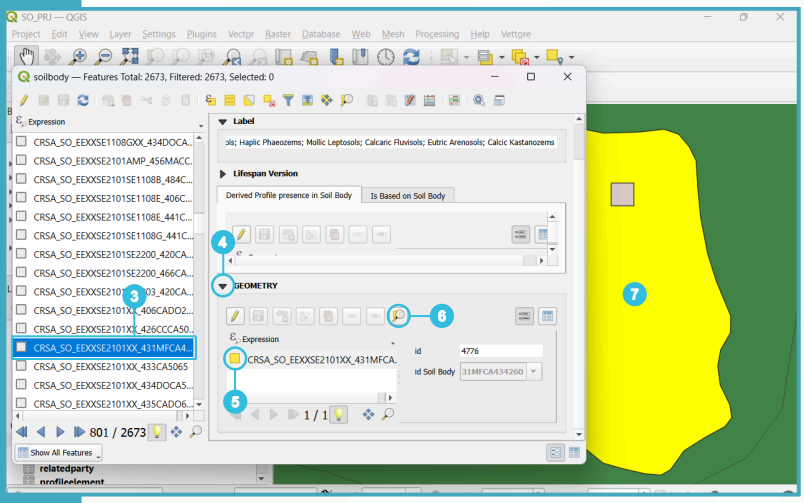
Please Note

The geometry of a "Soil Body", unlike other features, is stored in an external table. This is because it is possible to associate multiple geometries at different scales to the "Soil Body" table by creating additional "Soil Body Geom" tables.

Identifying the Geometry of a Soil Body



To identify the geometry of a "Soil Body" on the map, right-click on the "Layers" panel on the "soilbody" entry (1) and from the menu, select "Open Attribute Table" (2).



Select a "Soil Body" from the list (3), and open the Geometry section (4).

Select the geometry (5) and click the "Zoom to selected child feature" button (6).

The geometry associated with that "Soil Body" will be highlighted on the map (7).

Constraints

Beginlifespanversion should always be previous than or equal to endlifespanversion.

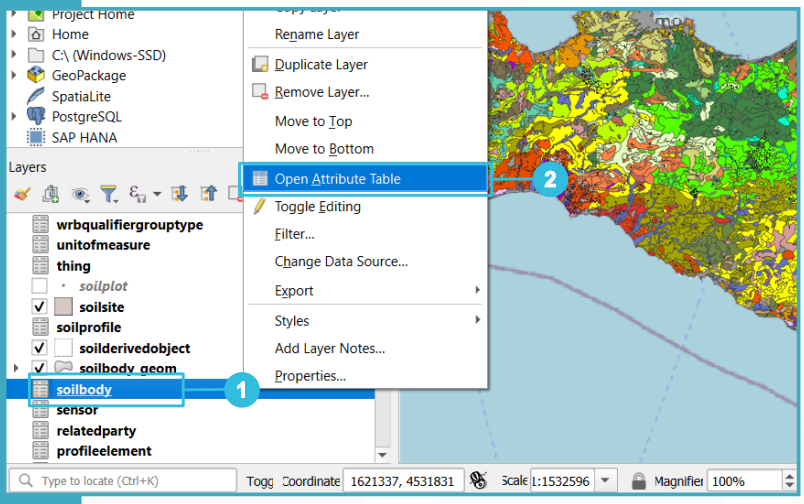
Upon updating the table, beginlifespanversion is updated to today.

Upon updating, endlifespanversion is after today.

DERIVED PROFILE PRESENCE IN SOIL BODY

Indicates the percentages (lower and upper boundary) that the derived profile takes part in the Soil body. When the soil body is characterized by more than one derived profiles, the distribution area of these derived soil profiles is not spatially defined, but their presence is indicated by a range of percentages.

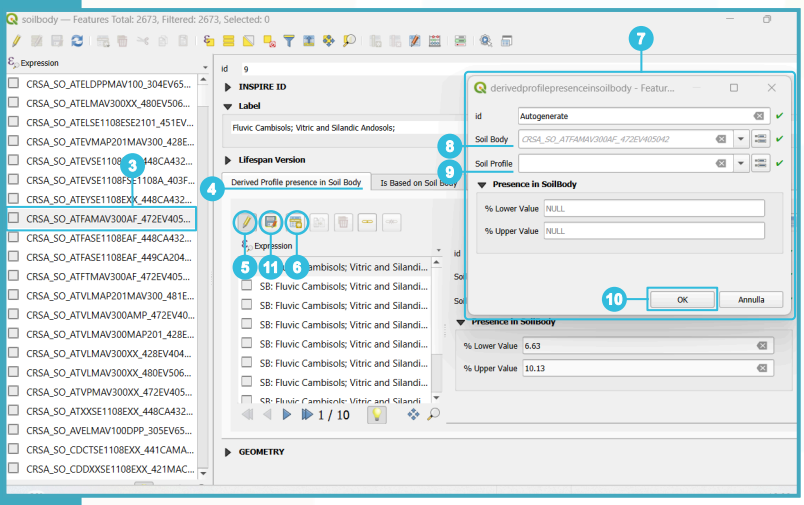
Creating a Derived Profile Presence In SoilBody



It is advisable to start from the "Soil Body" table so that the "Derived Profile Presence In SoilBody" is already linked to its respective "Soil Body".

Steps to Create a Derived Profile Presence In SoilBody

Right-click on the "Layers" panel on the "soilbody" entry (1) and from the menu, select "Open Attribute Table" (2).



Select a record from the "Soil Body" list (3) and navigate to the "Derived Profile Presence In SoilBody" tab (4).

Click the pencil icon "Toggle editing mode for child layer" (5) to make the tab editable, then click the "Add Child Feature" button (6).

The "derivedprofilepresenceinsoilbody" window will open (7).

In the "Soil Body" field (8), the feature from which we started will already be indicated.

Use the "Soil Profile" selector (9) to identify the component element of the "Soil Body".

Indicate the percentage of presence.

After completing the form, click OK (10).

Click the "Save child layer edits" button (11) to save the edits, and then click the "Toggle editing mode for child layer" button (5) to stop editing.

Please Note

In the "Soil Profile" field list, only "Soil Profile" entries of the "Derived" type will appear.

It is possible to filter the list by entering search characters in the field.

To get evidenceof the selected "Derived" Soil Profile, click the icon on the right of the field to open the corresponding form.

Constraints

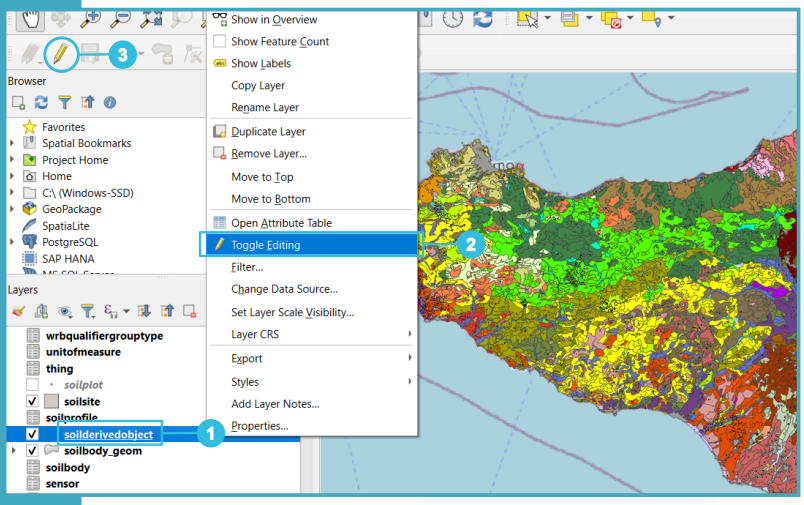
The sum of "lowervalue" for a soilbody does not exceed 100%.

The soilprofile is of type Derived.

SOIL DERIVED OBJECT

Spatial object with soil-related property derived from one or more soil and possibly other non soil properties. Soil thematic maps can be derived directly from the involved soil database (organic matter content, pH, texture, etc.) or they can be derived by using pedotransfer functions or pedotransfer rules (e.g. plant available water in the rooting depth). Derivation can be simple extraction from a single data field, or a complex combination of different kind of data and application of e.g. mathematical or expert knowledge-based procedures.

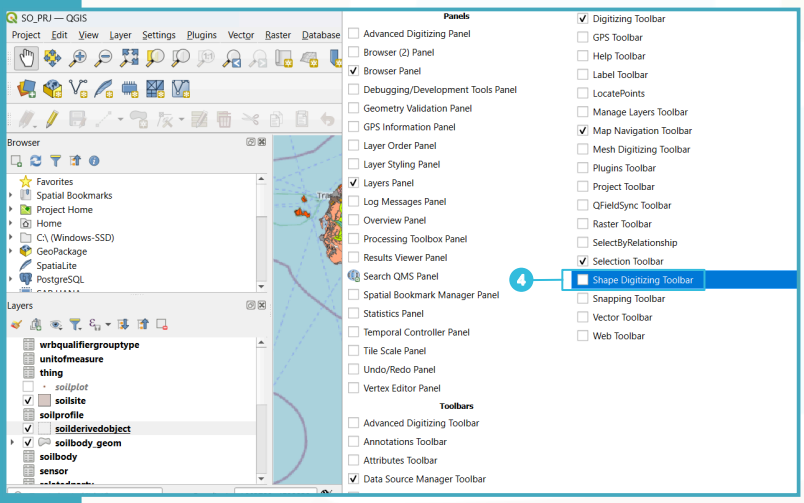
Creating a Soil Derived Object



It is rapresented by a polygonal geographic entity, To create a new Feature first define the geometry that represents its bounding box.

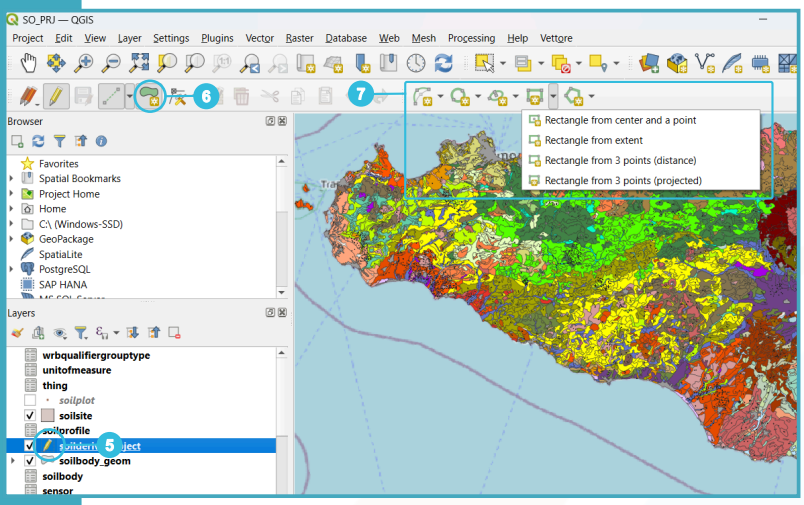
Right-click on the "Layers" panel on the "soilderivedobject" entry (1) and from the menu, select "Toggle Editing" (2).

Alternatively, you can select only the "soilderivedobject" layer (1) and click the "Toggle Editing" button (3) in the toolbar.



To assist in constructing the bounding box, you can use the "Shape Digitizing Toolbar" provided by QGIS.

If it is not already present in your toolbar, right-click on the toolbar and check the option for "Shape Digitizing Toolbar" (4).

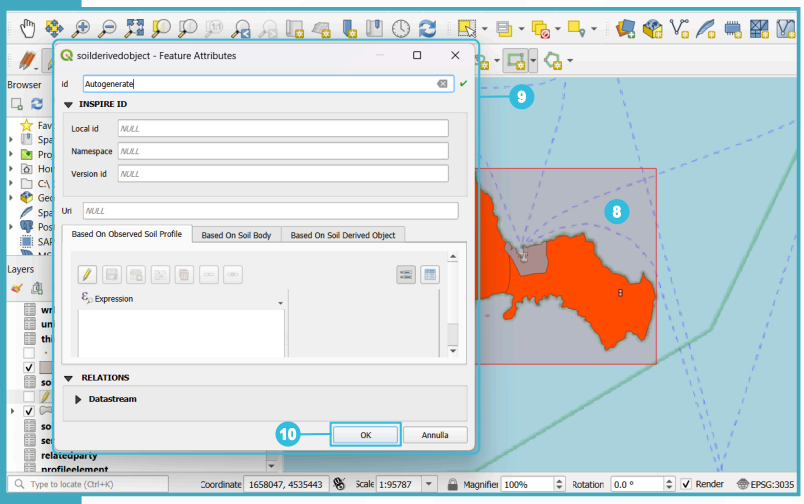


A small pencil icon will appear, indicating that the feature is being edited. (5).

In the toolbar, select the "Add Polygon Feature" icon (6)

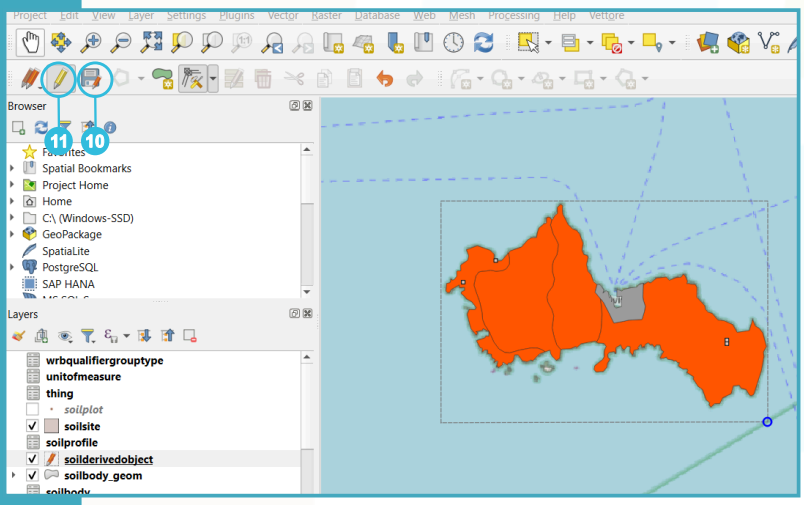
From the new toolbar, use one of the tools to create a rectangle. (7)

Draw the geometry of the new "Soil Derived Object".



Right-click to close the geometry (8), and a form for data input will appear (9).

Fill in the other fields and click OK (10) to close the window.



Click the "Save Layer Edits" button (11) to save the edits, and then click the "Toggle Editing" button (12) to stop editing.

Please Note

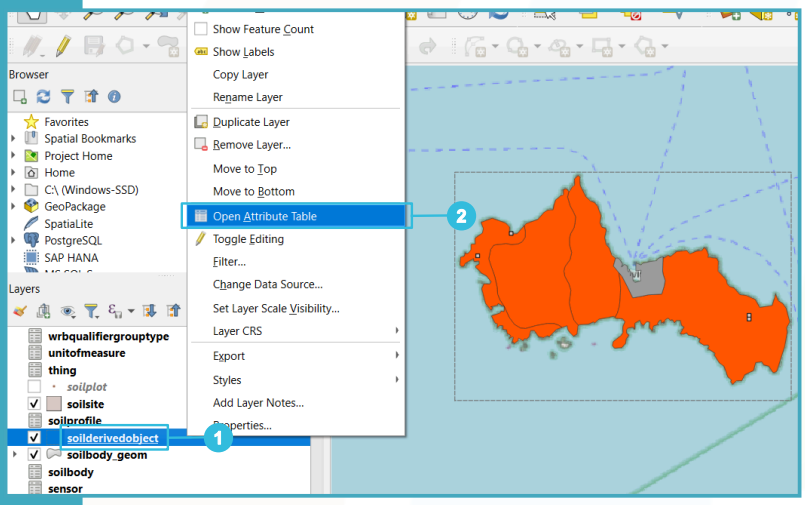
In addition to the usual data regarding the INSPIRE ID, there is a URI field where you can enter a reference to the object if it exists outside the Geopackage.

IS DERIVED FROM

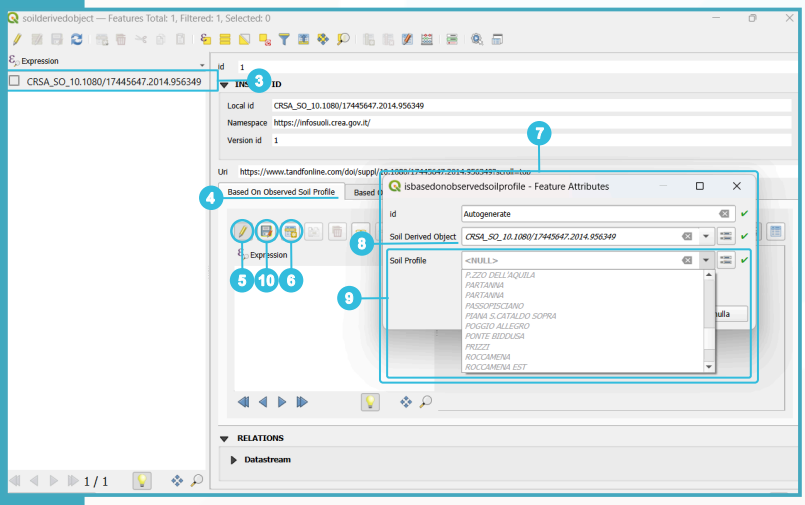
Introduction

After creating the "Soil Derived Object", it should be defined its source. The model provides three possibilities:
It can be derived from a "Soil Profile of type Observed", from a "Soil Body", or from another "Soil Derived Object".
Before starting this operation, ensure that the "Soil Derived Object" has been saved.
In this case, we edit a related table directly from the form that contains it.

Steps to Define the Source



Right-click on the "Layers" panel on the "soilderivedobject" entry (1) and from the menu, select "Open Attribute Table" (2).



Select a "Soil Derived Object" (3).

Go to the "Based On Observed Soil Profile" tab (4), click the pencil icon "Toggle editing mode for child layer" (5) to make the tab editable, and then click the "Add Child Feature" button (6).

A window will open (7), allowing you to link the "Soil Profile" from which the "Soil Derived Object" is derived.

The "Soil Derived Object" field (8) will already contain the name of the selected "Soil Derived Object".In the "Soil Profile" field (9), you can select the "Soil Profile of type Observed" from which your object is derived.

After completing the form, click OK.Click the "Save child layer edits" button (10) to save the edits, and then click the "Toggle editing mode for child layer" button (5) to stop editing.

Only "Observed" type Soil Profiles will appear in the list. You can filter the list by entering search

characters in the field.To ensure you have selected the correct "Observed" Soil Profile, you can click the icon to the right of the field to open the corresponding form.

Please Note

It is possible to perform the same process with the other two tabs: "Based on Soil Body" and "Based on Soil Derived Object".

OBSERVATIONS AND MEASUREMENTS

Introduction

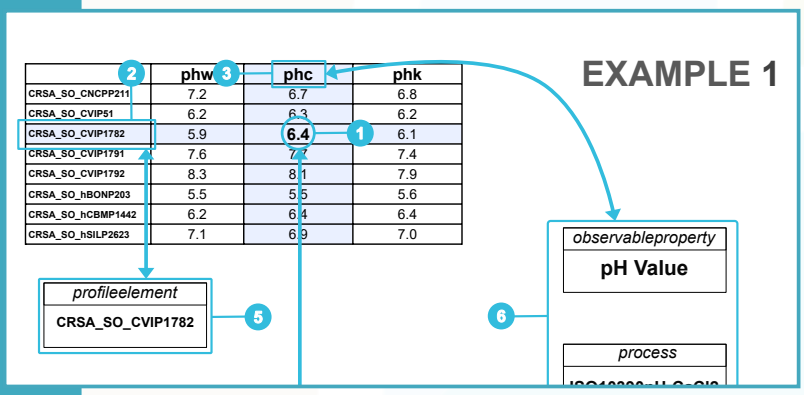
In Relational Database, the attributes of an element, are often expressed by means of multiple columns, each identified by a name (the attribute name). The attribute value is identified by a number or a code within the created matrix.

The INSPIRE SO UML model does not rely on this constrained system for describing the Physical, Chemical, and Biological characteristics of the several Features , instead it allows the association of any attribute, accurately described, to any Feature type.

This flexibility enables to model the system according to different pourpose or needs, adopting just the attributes that are relevant to any different survey pourpouse, allowing the introduction of new attributes if necessary, without (observable properties) requiring structural changes.

Please reference to INSPIRE O&M package: Guidelines for the use of Observations & Measurements and Sensor Web Enablement-related standards in INSPIRE [DS-D2.9](https://knowledge-base.inspire.ec.europa.eu/system/files/2023-12/inspire-tg-d2.9-om-swe-3.0.pdf); Observations and Measurements 2.0 (https://www.ogc.org/publications/standard/om/) and SensorThingsApi (https://www.ogc.org/it/publications/standard/sensorthings/) to acquire an in dept view of this standards.

Example 1



In this example, we will see how to store values within the Geopackage.

If we want to enter the value "6.4" (1) for the attribute "phc" (2) of the element (record) "CRSA_SO_CVIP1782" (3) in the Geopackage, we must decompose the information and save it in multiple tables.

The value "6.4" will be recorded in the "observation" table (4), which is designed to collect all values for any attribute we want to store.

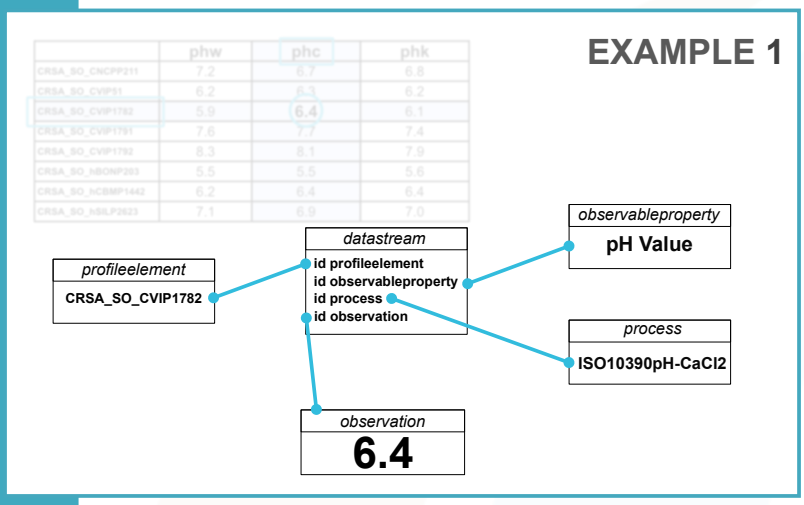
The element for which we have the value will be defined by a record already present in our Geopackage, representing a "Feature of Interest" whose property we want to describe.

The UML model provides four "Feature of Interest" options for which we can define properties:
"Soil Site"
"Soil Profile"
"Profile Element"
"Soil Derived Object"

In our example, the "profileelement" table (5) (Feature of Interest - Profile Element) will contain the record "CRSA_SO_CVIP1782".

The attribute must be described using two tables: the "observableproperty" table and the "process" table (6).

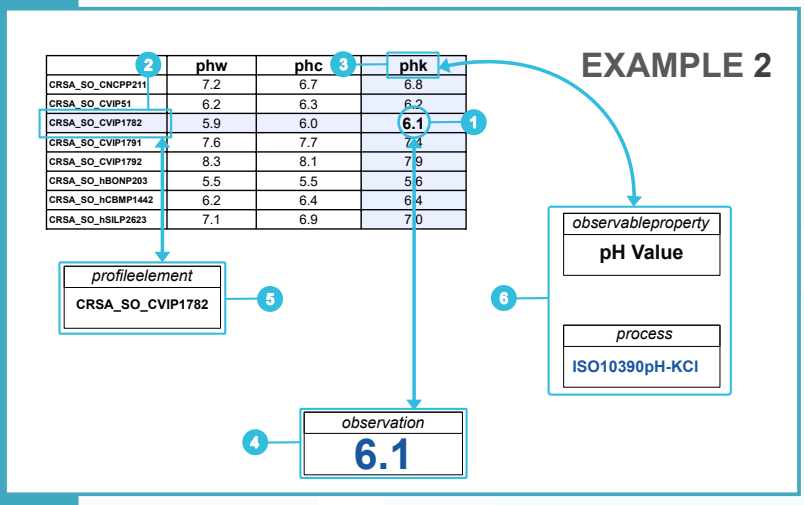
In the "observableproperty" table, the property is described, its base phenomenon identified, and its value domain and unit of measure defined.In the "process" table, a process is described with reference to official documentation.



To summarize, to store an attribute value referring to a specific Feature of Interest, we need to find a way to link all these components together; components which, apart from the value (which is unique), are mostly already defined.

This is performed by means of the Datastram table, a linking table that correctly connects the elements by using the row IDs from the various tables: the "Datastream" table.

Example 2

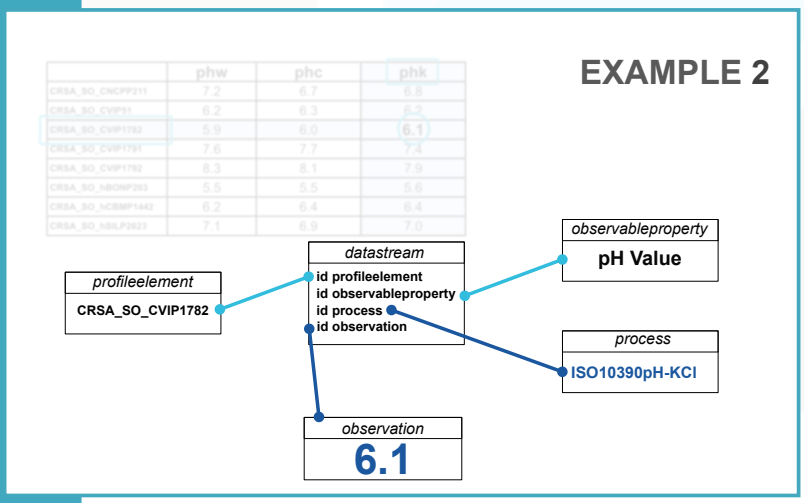


In this second example, the aim is to store the value "6.1" (1) for the attribute "phk" (2) of the same element (record) "CRSA_SO_CVIP1782" (3) in the Geopackage.

The value "6.1" will be recorded in the "observation" table (4).

The same record "CRSA_SO_CVIP1782" (5) from the "profileelement" table is to be used.

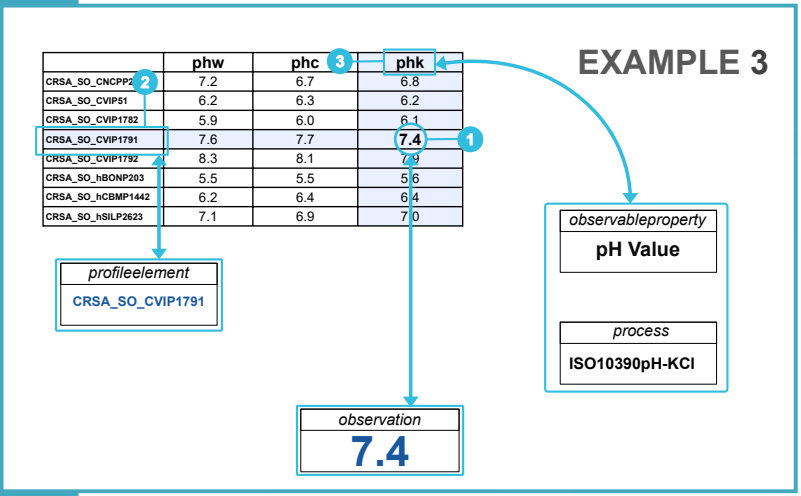
The attribute will still need to be described using the "observableproperty" and "process" tables (6).



While the "observableproperty" remains the same as in the first example, the "process" will differ.

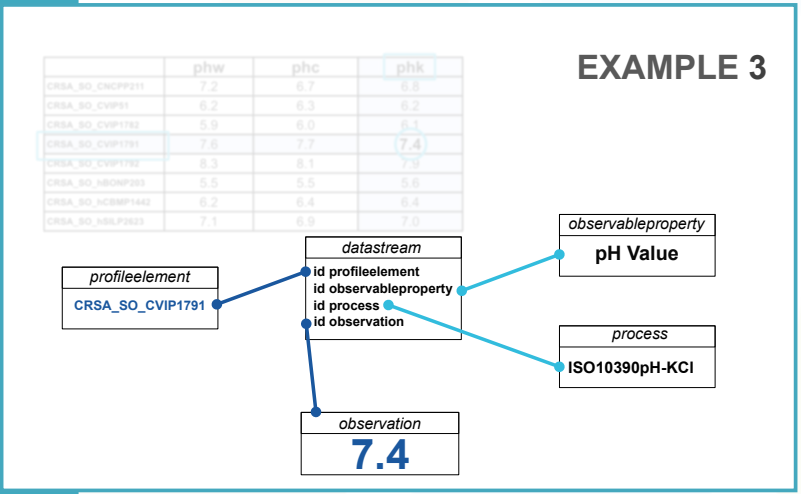
The "Datastream" table will use the IDs of the various elements to link the information.

Example 3



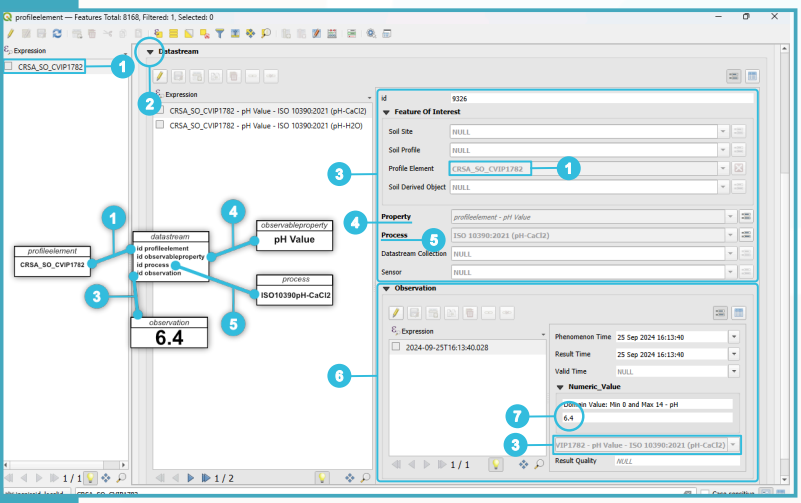
In this final example, we store the value "7.4" (1) for the same attribute (2) from Example 2, but it refers to a different record of the same Feature of Interest: "CRSA_SO_CVIP1791" (3).

In this final example, we store the value "7.4" (1) for the same attribute (2) from Example 2, but it refers to a different record of the same Feature of Interest: "CRSA_SO_CVIP1791" (3).



Once again, the "Datastream" table will use the element IDs to link the information.

Identifying Relationships in QGIS



Let's take "profileelement" "CRSA_SO_CVIP1782" (1) as the Feature of Interest from Example 1.

In the lower part of the form, expand "Datastream" (2) to view the associated "Datastream" entries for that "profileelement" record.

In the "Datastream" form (3), you can see the links to the Profile Element (1), the Property (4), and the Process (5).

The value (7) will be displayed in the "Observation" form (6), located below the "Datastream", where you will also find the link to the "Datastream" itself (3).

OBSERVABLE PROPERTY

The Observable Property represents a single observable property e.g. 'temperature'. It may have associations to additional constraints or measures that make it more complex e.g. 'daily mean temperature'.

Base Phenomenon

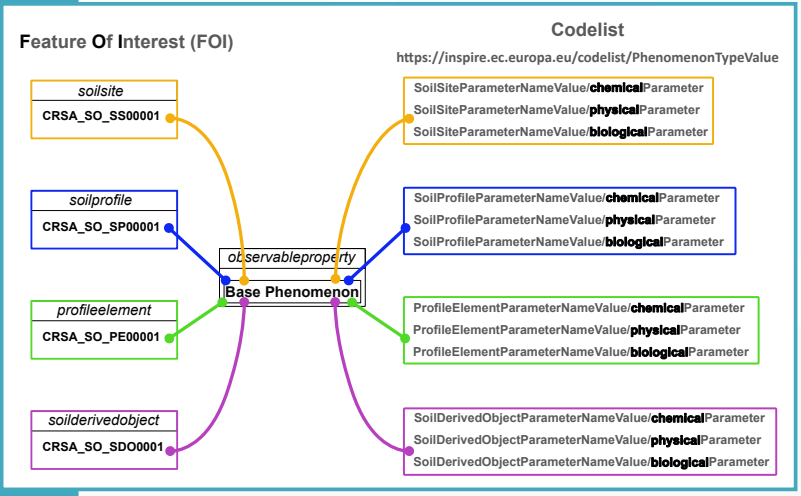
Here is a brief description of how "Base Phenomenon" should be associated with properties. As seen in the introduction to "Observations and Measurements", we associate an "Observable Property" with a "Feature of Interest" through the "Datastream" table.

For each "Feature of Interest", only properties whose "Base Phenomenon" belongs to a specific code list can be associated. For each "Feature of Interest", the European Registry (https://inspire.ec.europa.eu/codelist/PhenomenonTypeValue) defines three distinct code lists:

One for **Chemical Parameters**
One for **Physical Parameters**
One for **Biological Parameters**

The model includes four "Feature of Interest" types to which you can associate "Observable Property" entries:

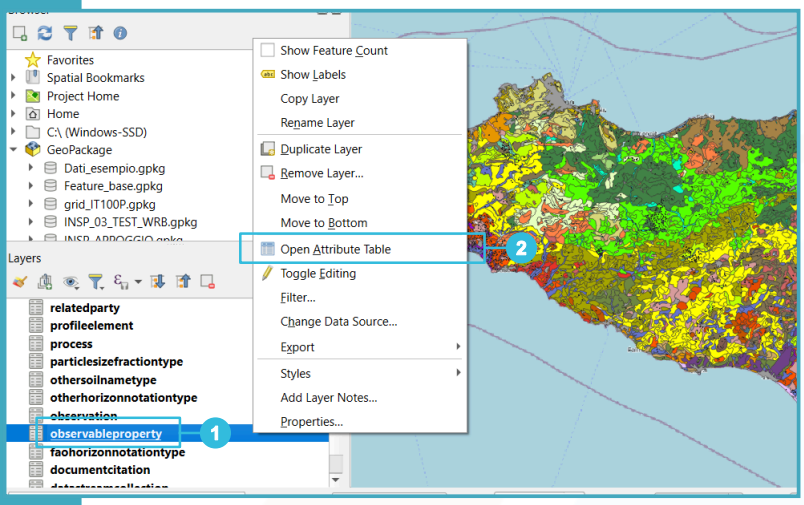
"Soil Site"
"Soil Profile"
"Profile Element"
"Soil Derived Object"



Each "Feature of Interest" has three code lists for its "Base Phenomenon", resulting in a total of **12 codelists** to use.

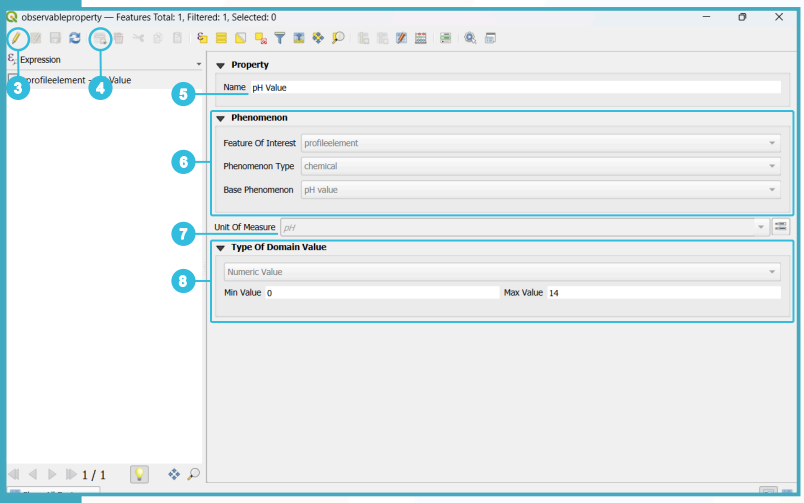
So, to create an "Observable Property" for the "Soil Site" Feature with a Chemical Base Phenomenon, you would refer to the SoilSiteParameterNameValue/ chemicalParameter code list.

Creating a new Observable Property



Steps to Create an Observable Property

Right-click on the "Layers" panel on the "observableproperty" entry (1) and from the menu, select "Open Attribute Table" (2).



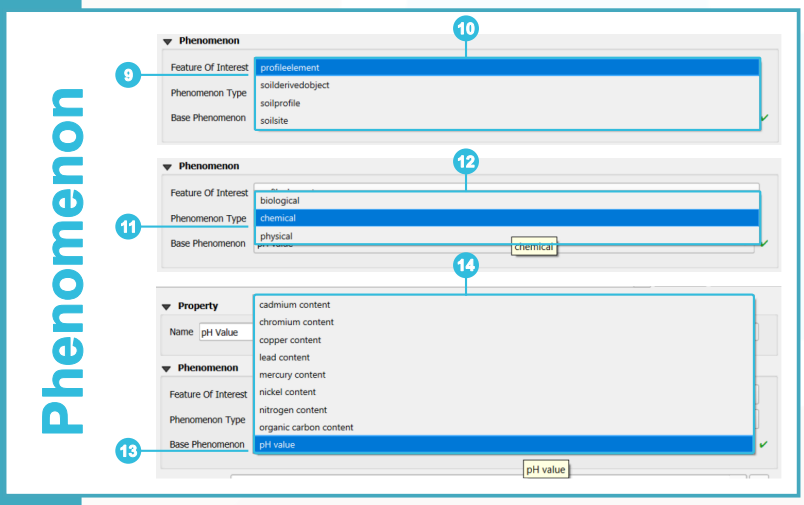
Click the pencil icon "Toggle editing mode" (3) to make the table editable, then click the "Add Feature" button (4).

You will need to enter a name that briefly describes the Property (5),

Specify the "Phenomenon" type (6),

The Unit Of Measure (UOM) (7),

And the "Type of Data", whether numeric or coded (8).



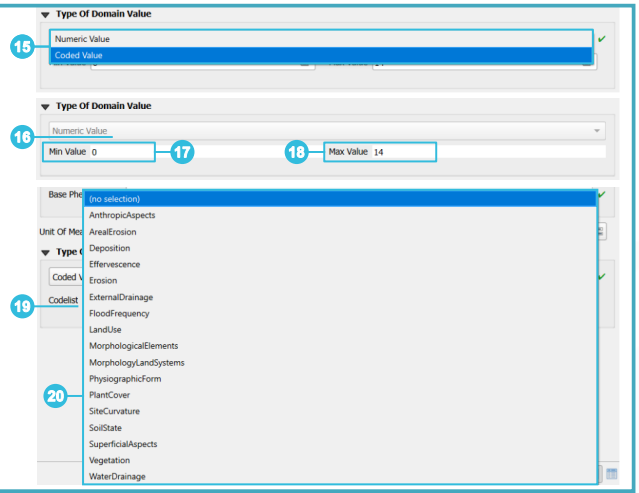
To define the "Phenomenon", specify to which "Feature Of Interest" (9) the Property will be associated, choosing from the four proposed Features (10).

Next, select the "Phenomenon Type" (11), which can be Chemical, Physical, or Biological (12).

Finally, select one of the "Base Phenomenon" (13) options from the list (14), which will contain only the phenomena filtered by the previous choices.

Only the correct code list will be shown, selected from the 12 possible options.

Type Of Domain



To define the "Type of Data", indicate whether it is Numeric or Coded (15).

For a Numeric Value (16), you can specify the Minimum (17) and Maximum (18) of the possible value range for that property.

For a Domain Value (19), the form will change to display the "Codelist" field (20), from which you can select the list of possible codes for that Property.

Click the "Save Layer Edits" button to save the edits, and then click the "Toggle Editing" button to stop editing.

Please Note

For Numeric Value, entering a range of possible values via the Min Value and Max Value fields will prevent the system from accepting values outside this range in the "observation" table when the record is linked to that "Observable Property" through the "Datastream" table.

The UOM table comes with the main units of measure already included. Additional units can be added by editing the "unitofmeasure" table, which is located among the hidden tables.

Constraints

Only valid values from the FOIType are entered in the "foi" field, identifying which type of Feature Of Interest that particular ObservableProperty should be associated with.

Only valid values from the CODELIST "PhenomenonType" are entered in the "phenomenontype" field.

Only valid values from the CODELIST are entered in the "basephenomenon" field, with respect to the values entered in the "foi" and "phenomenontype" fields.

The "domain_max" field is always greater than the "domain_min" field.

In case the "domain_typeofvalue" field takes the value 'result_value', the value of the "domain_code" field is null.

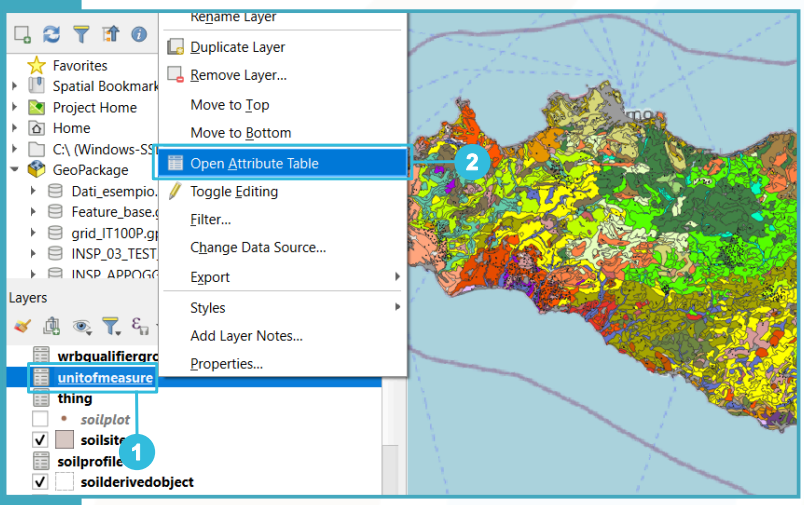
In case the "domain_typeofvalue" field takes the value result_uri, the values of the "domain_min" and "domain_max" fields are null.

The fields "domain_min" and "domain_max" are either both populated or both null.

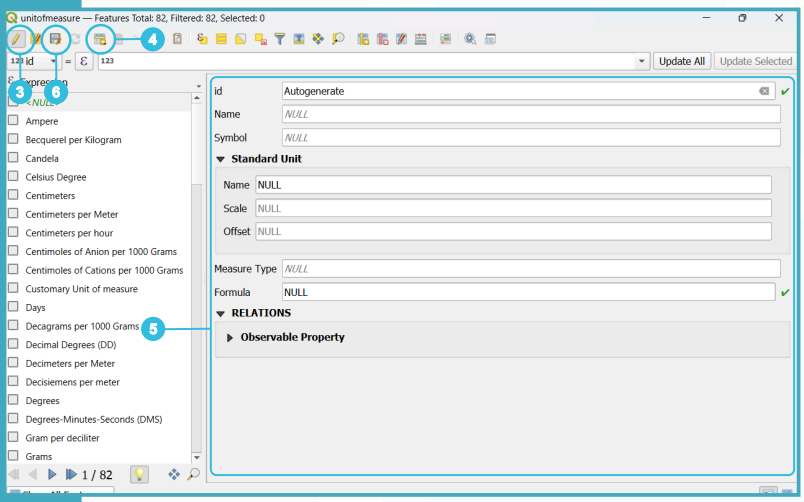
UNIT OF MEASURE

All measurement values shall be expressed using SI units or non-SI units accepted for use with the International System of Units, unless specified otherwise for a specific spatial data theme or type. See also Unified Code for Units of Measure – System of codes for unambiguously representing measurement units (https://ucum.org/).

Creating a Unit Of Measure



Right-click on the "Layers" panel on the "unitofmeasure" entry (1) and select "Open Attribute Table" from the menu (2).



Click the pencil icon "Toggle Editing Mode" (3) to make the table editable, then click the "Add Feature" button (4). This will open an empty form on the right-hand side (5) where you can enter the new data.

Fill out the form with the "Unit Of Measure" data.

Click the "Save Layer Edits" button (6) to save the changes, and then click "Toggle Editing" (3) to stop editing.

PROCESS

The Process class allows for the lightweight provision of procedural information.

The detailed Process feature catalogue is available in chapter “Annex C: INSPIRE Process” along with a standardised mapping to SensorML 1.0.1.

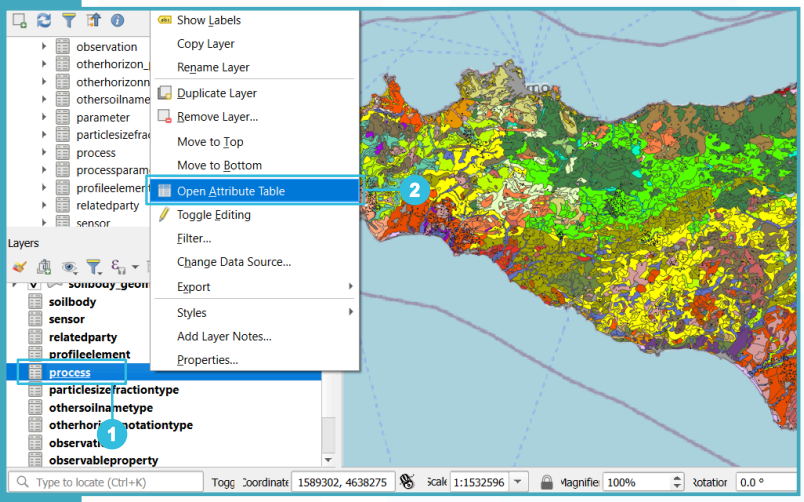
Either the Process Featuretype or its mapping to SensorML SHOULD be used to describe the procedure used in an OM_Observation.

Within the observation procedure (OM_Process) is considered as an algorithm, sensor type, or time series type, but not as an individual, physical device (sensor instance).

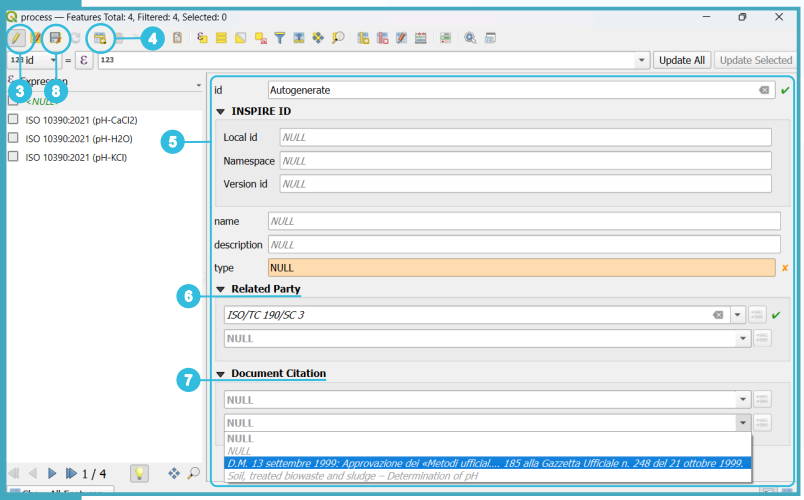
The procedure SHOULD be a reference to a community managed vocabulary exposed according to /rec/inspire-om-core/procedure/process.

See D2.9 Guidelines for the use of Observations & Measurements and Sensor Web Enablement-related standards in INSPIRE (https://knowledge-base.inspire.ec.europa.eu/system/files/2023-12/inspire-tg-d2.9-om-swe-3.0.pdf)

Creating a Process



Right-click on the "Layers" panel on the "process" entry (1) and select "Open Attribute Table" from the menu. (2)



Click the pencil icon "Toggle Editing Mode" (3) to make the table editable, then click the "Add Feature" button (4). This will open an empty form on the right-hand side (5) where you can enter the new data.

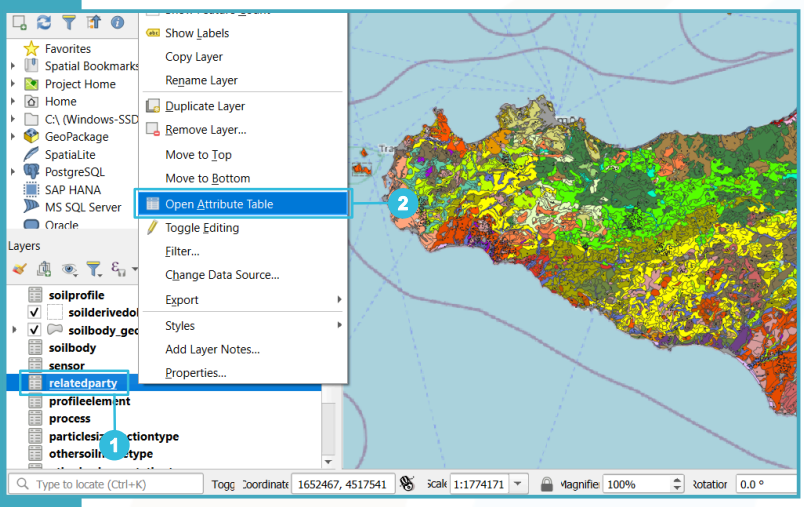
Fill out the form with the relevant "Process" data and use the widgets to link the corresponding "Related Party" (6) and "Document Citation" (7).

Click the "Save Layer Edits" button (8) to save the changes, and then click "Toggle Editing" (3) to stop editing.

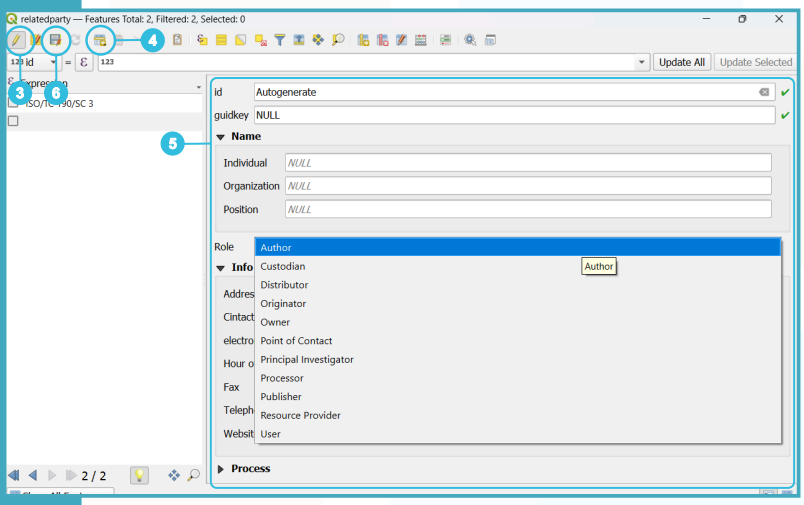
RELATED PARTY

An organisation or a person with a role related to a resource.

Creating a Related Party



Right-click on the "Layers" panel on the "relatedparty" entry (1) and select "Open Attribute Table" from the menu (2).



Click the pencil icon "Toggle Editing Mode" (3) to make the table editable, then click the "Add Feature" button (4). This will open an empty form on the right-hand side (5) where you can enter the new data.

Fill out the form with the "Related Party" data.

Click the "Save Layer Edits" button (6) to save the changes, and then click "Toggle Editing" (3) to stop editing.

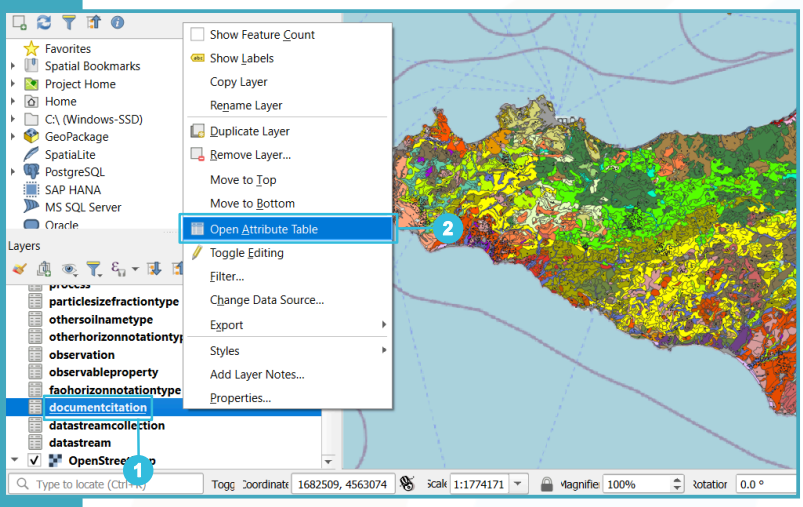
Constraints

Only valid values from the CODELIST "ResponsiblePartyRole" are entered in the "role" field.

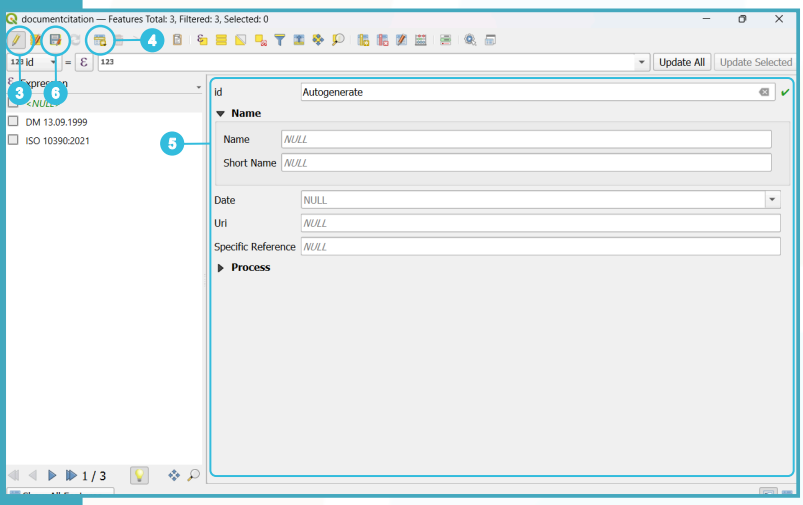
DOCUMENT CITATION

Individual or organisation related to the process.

Creating a Document Citation



Right-click on the "Layers" panel on the "documentcitation" entry (1) and select "Open Attribute Table" from the menu (2).



Click the pencil icon "Toggle Editing Mode" (3) to make the table editable, then click the "Add Feature" button (4). This will open an empty form on the right-hand side (5) where you can enter the new data.

Fill out the form with the "Document Citation" data.

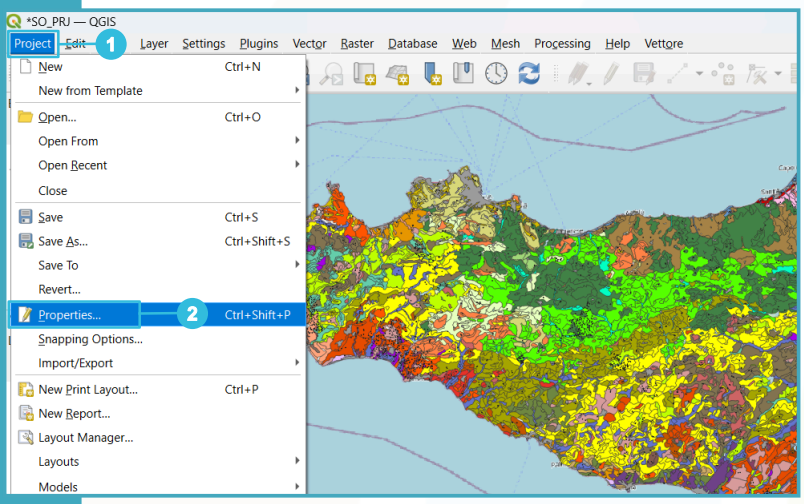
Click the "Save Layer Edits" button (6) to save the changes, and then click "Toggle Editing" (3) to stop editing.

OBSERVABLE PROPERTY/PROCESS

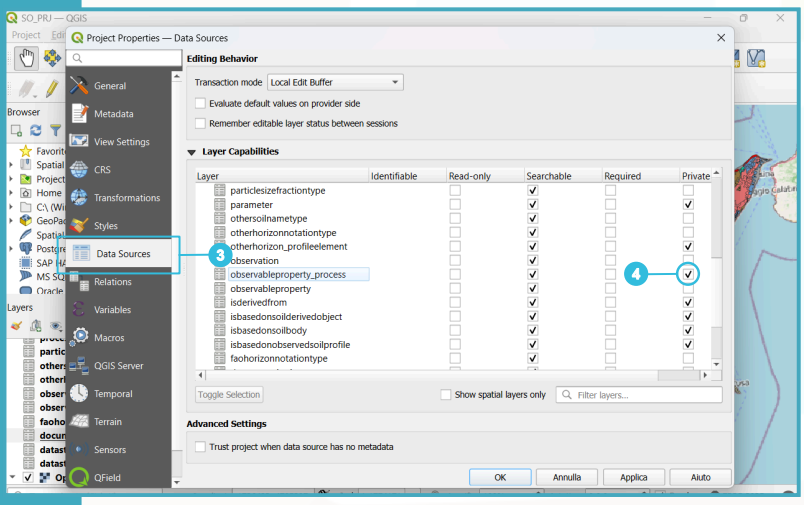
Introduction

To prevent incorrect data input, in addition to all existing constraints, a table has been created to hold a list of valid Observable Property - Process pairs. Only the pairs present in this table can be associated in the "Datastream" table without causing a system error.

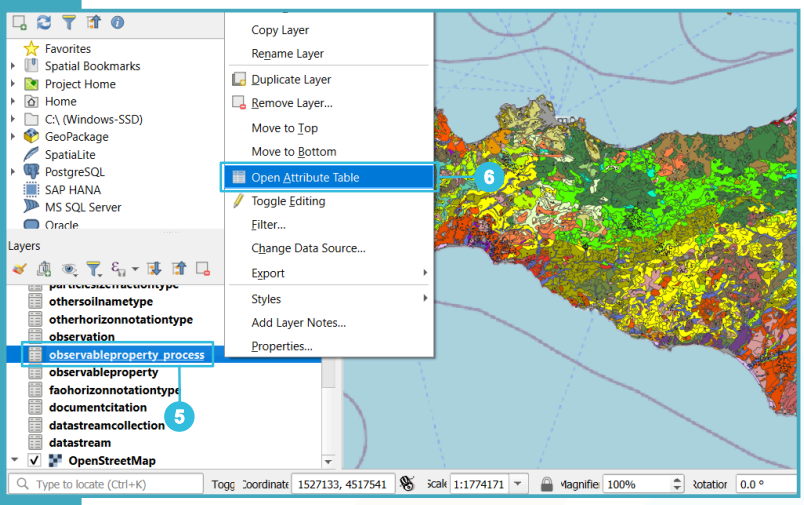
Creating an Observable Property/Process



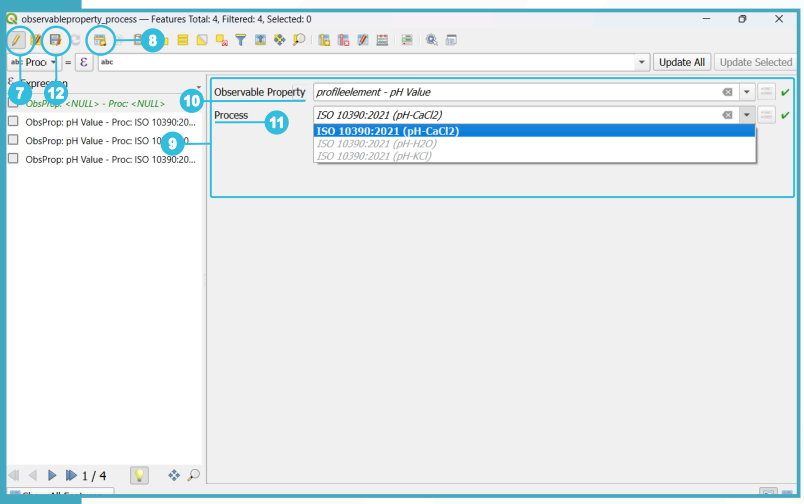
For simplicity in the QGIS project, the form was hidden. To make it visible, click "Project" (1), then "Properties" (2)



Go to the "Data Source" tab (3). Find the "observableproperty_process" layer and uncheck the flag (4).



Right-click on the "Layers" panel on the "observableproperty_process" entry (6) and select "Open Attribute Table" from the menu (6).



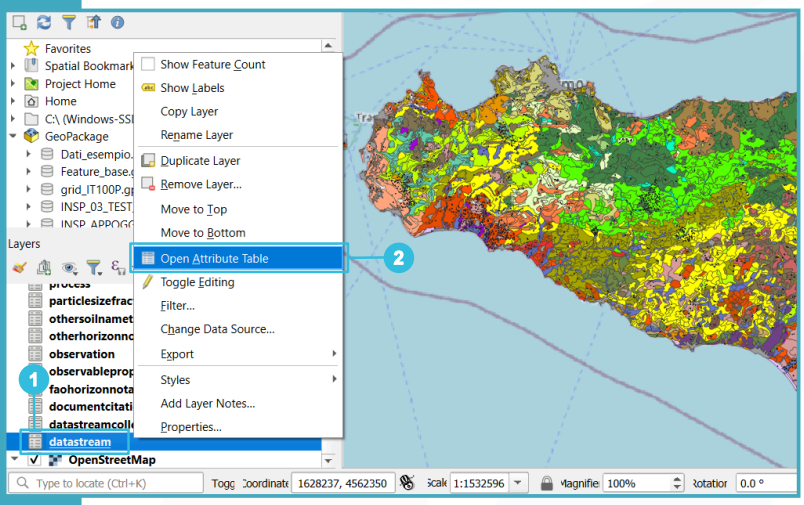
Click the pencil icon "Toggle Editing Mode" (7) to make the table editable, then click the "Add Feature" button (8). This will open an empty form on the right-hand side (9) where you can enter the new data.

Fill out the form using the widgets to select the "Observable Property" (10) and "Process" (11) from the Geopackage.

Click the "Save Layer Edits" button (12) to save the changes, and then click "Toggle Editing" (7) to stop editing.

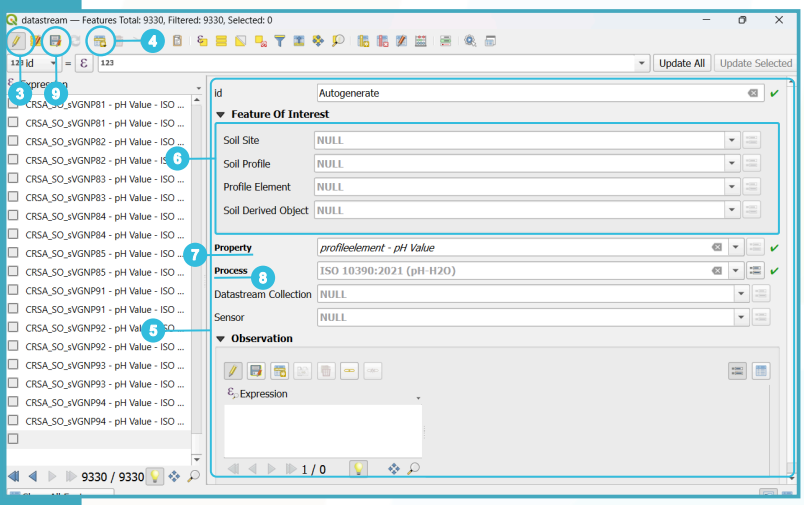
DATASTREAM

Introduction



As described in the chapter "Observations and Measurements", it is possible, to open the relationship to the "Datastream" through the "Relations" section of one of the four "Feature Of Interest" to which it is linked ("Soil Site", "Soil Profile", "Profile Element", "Soil Derived Object").

Hereby is described how to open the "Datastream" table directly and fill it out. Right-click on the "Layers" panel on the "datastream" entry (1) and select "Open Attribute Table" from the menu (2).



Click the pencil icon "Toggle Editing Mode" (3) to make the table editable, then click the "Add Feature" button (4). This will open an empty form on the right-hand side (5) where you can enter new data.

The "Datastream" table is a link table, meaning that all the fields in the form consist of widgets with lists of records that need to be linked.

You should fill out the form by finding the links to the "Feature Of Interest" (6), the "Property" (7), and the "Process" (8).

Click the "Save Layer Edits" button (9) to save the changes, and then click "Toggle Editing" (3) to stop editing.

Constraints

Only one among Soil Site, Soil Profile, Profile Element, and Soil Derived Object can be populated.

Only a unique series of property/process/sensor/datastreamcollection can belong to a single feature.

Only specific property/process pairs can exist.

Only one property/process pair can belong to a single feature.

In the "foi" field of the "observableproperty" defined by the inserted link, there is the value "soilprofile."

In the "foi" field of the "observableproperty" defined by the inserted link, there is the value "soilsite."

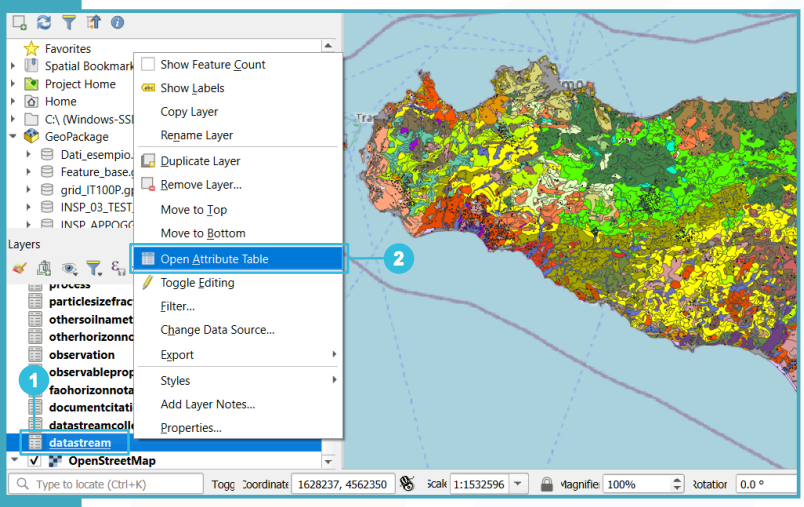
In the "foi" field of the "observableproperty" defined by the inserted link, there is the value "profileelement."

In the "foi" field of the "observableproperty" defined by the inserted link, there is the value "soilderivedobject."

OBSERVATION

Observation representing the measurement of a property at a single time instant.

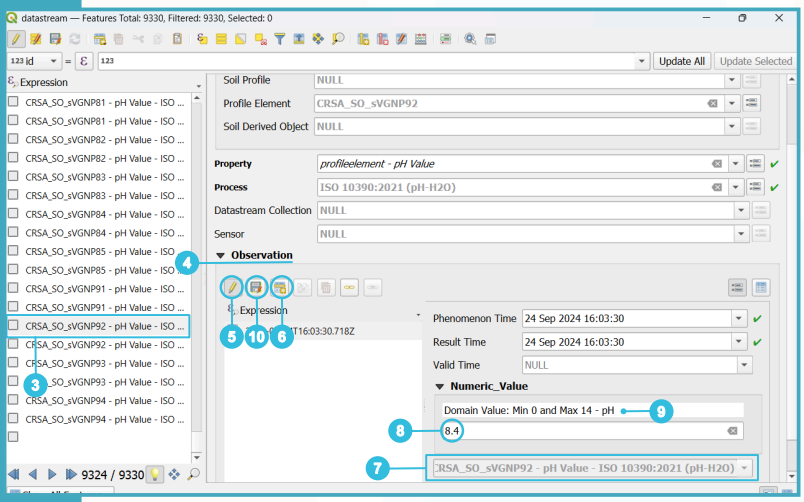
Creating an Observation



To enter the value of an Observation, It is possible to open the "Observation" table directly and link the new record to the correct Datastream.

Since even in a small Geopackage there can be many "Datastream" records, it is always recommended to start from the "Datastream", or even better from the "Feature of Interest".

In this example, we will start from the "Datastream". Right-click on the "Layers" panel on the "datastream" entry (1) and select "Open Attribute Table" from the menu (2).



Select a "Datastream" record (3).Go to the "Observation" section (4).

Click the pencil icon "Toggle Editing Mode for child layer" (5) to make the table editable, then click the "Add Child Feature" button (6).

The link to the "Datastream" (7) is automatically inserted by default.Fill out the form, including the value (8), paying attention to the domain values listed in the upper field (9). These are the "Min" and "Max" values defined in the "Observable Property", linked to this Observation via the "Datastream".

Click the "Save Child Layer Edits" button (10) to save the changes, and then click "Toggle Editing Mode for child layer" (5) to stop editing.

Constraints

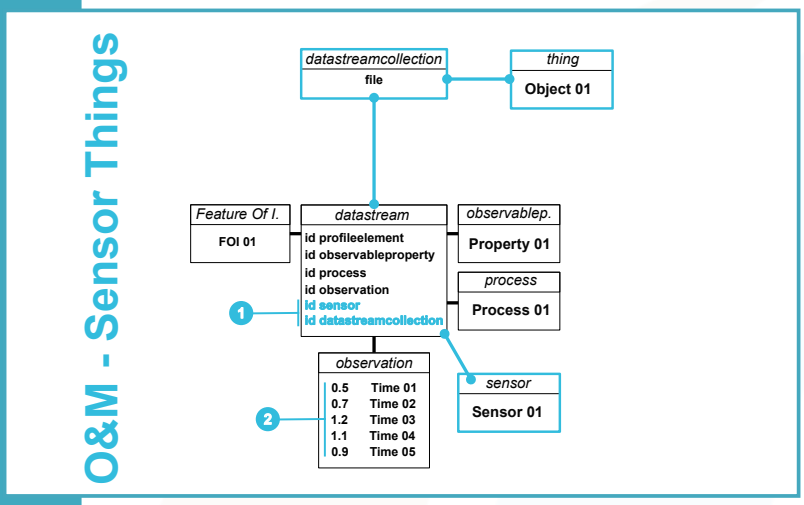
The result time is earlier than the valid time.

The value is within the Min and Max of the domain specified in the properties.

Only one of the fields "result_value" and "result_uri" is populated.

SENSOR THING

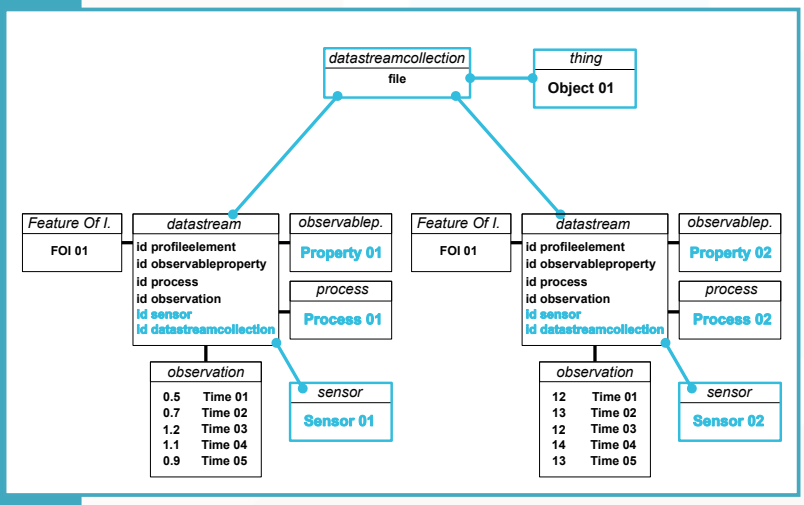
Introduction



The initial UML model was modified to store data from sensors. In order to implement ST-API three tables: "Thing", "Datastream Collection", and "Sensor" have been added to the original O&M model.

The "Datastream" table (1) was modified to include the "Datastream Collection" table, represent an instatialization of "RelatedDatastream" (see https://github.com/hylkevds/FROST-Server.Plugin.WaterQualityIE/blob/main/Datamodel-SensorThingsApi-WaterQualityIE-implemented.drawio.png)

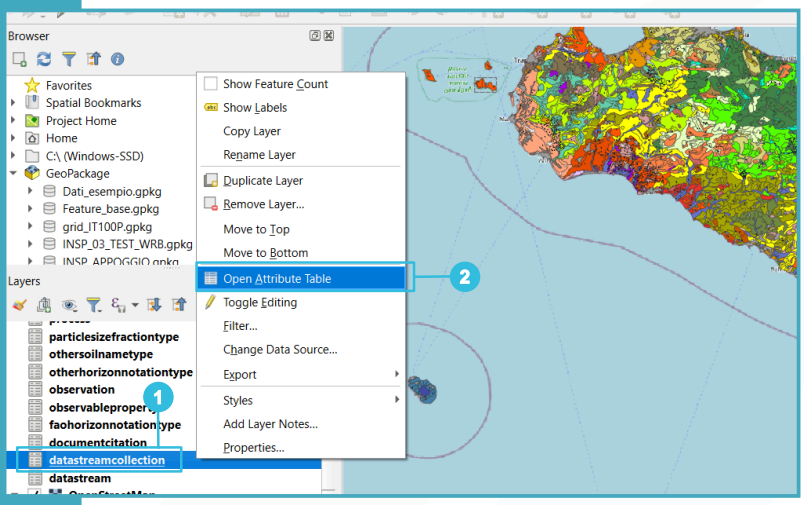
which stores the data file produced by the "Thing", i.e., any device that produces a data stream, and the "Sensor" table, which contains information about the sensor type that produced the data stream. The data stream values are stored into the "Observation" table, and identified by the moment they were recorded (2).



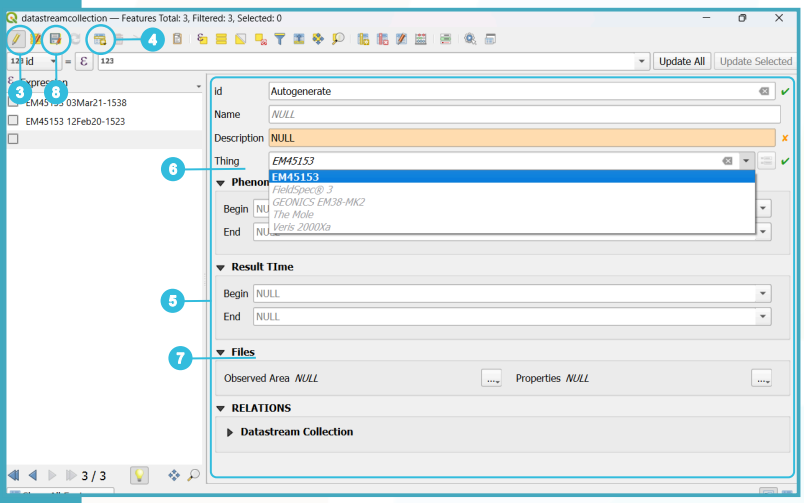
Since a Thing is often composed by multiple sensors, it produces files that collect multiple properties. We can use the same "Datastream Collection" and link it to multiple Datastream records to store the complete dataset produced by the Thing sensors.

DATASTREAM COLLECTION

Creating a Datastream Collection



Right-click on the "Layers" panel on the "datastreamcollection" entry (1) and select "Open Attribute Table" from the menu (2).



Click the pencil icon "Toggle Editing Mode" (3) to make the table editable, then click the "Add Feature" button (4). This will open an empty form on the right-hand side (5) where you can enter new data.

Select one of the Things (6) present in the Geopackage.

You can also insert (7) the data stream file into the Geopackage.

Fill out the form with the "Datastream Collection" data.

Click the "Save Layer Edits" button (8) to save the changes, and then click "Toggle Editing" (3) to stop editing.

Constraints

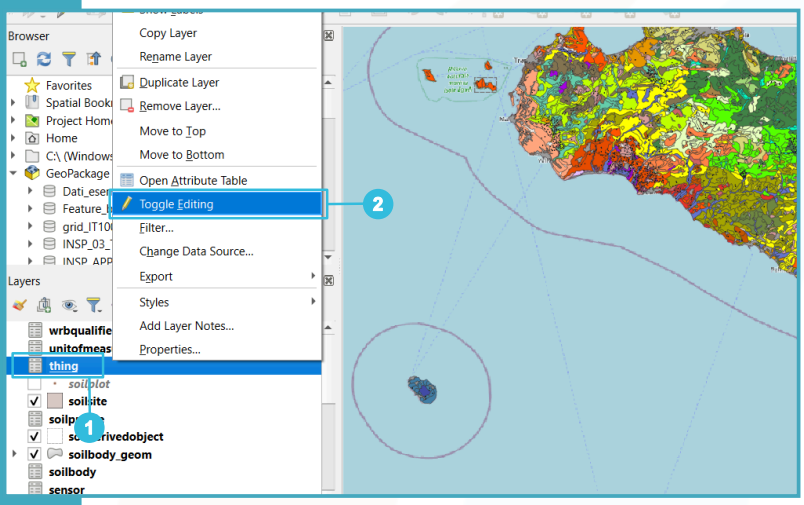
The "beginphenomenontime" field is earlier than the "endphenomenontime" field.

The "beginresulttime" field is earlier than the "endresulttime" field.

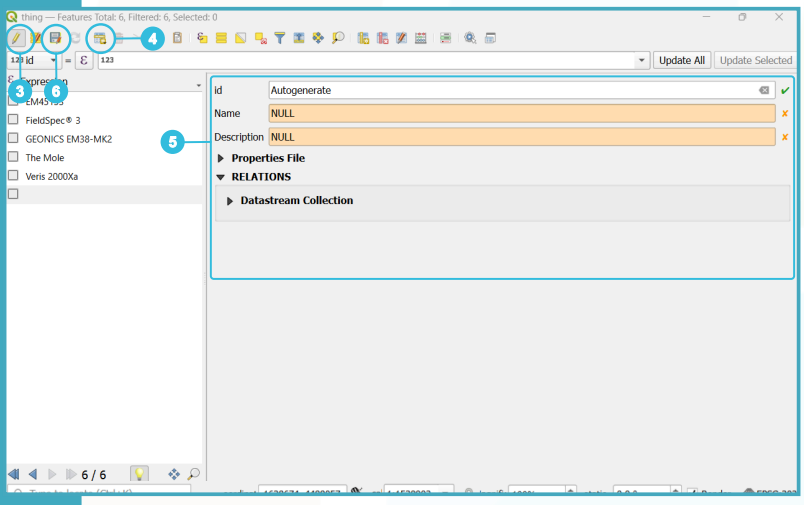
THING

A Thing is an object of the physical world (physical Things) or the information world (virtual Things) that is capable of being identified and integrated into communication networks.

Creating a Thing



Right-click on the "Layers" panel on the "thing" entry (1) and select "Open Attribute Table" from the menu (2).



Click the pencil icon "Toggle Editing Mode" (3) to make the table editable, then click the "Add Feature" button (4). This will open an empty form on the right-hand side (5) where you can enter new data.

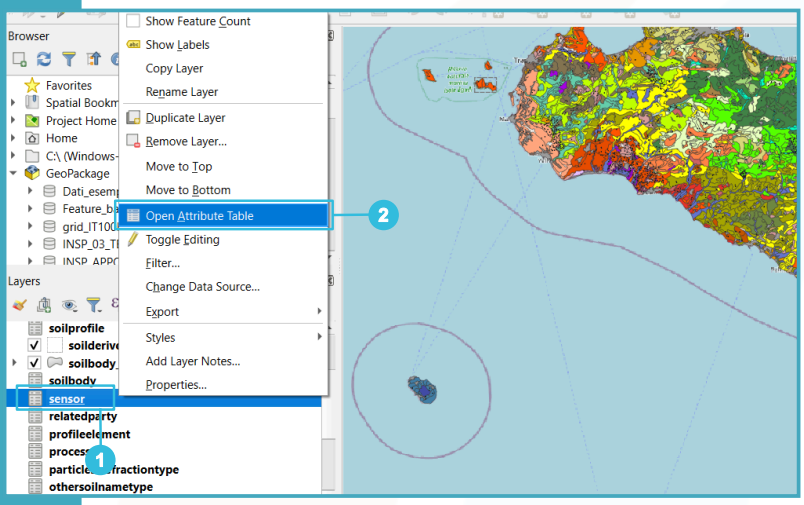
Fill out the form with the "Thing" data.

Click the "Save Layer Edits" button (6) to save the changes, and then click "Toggle Editing" (3) to stop editing.

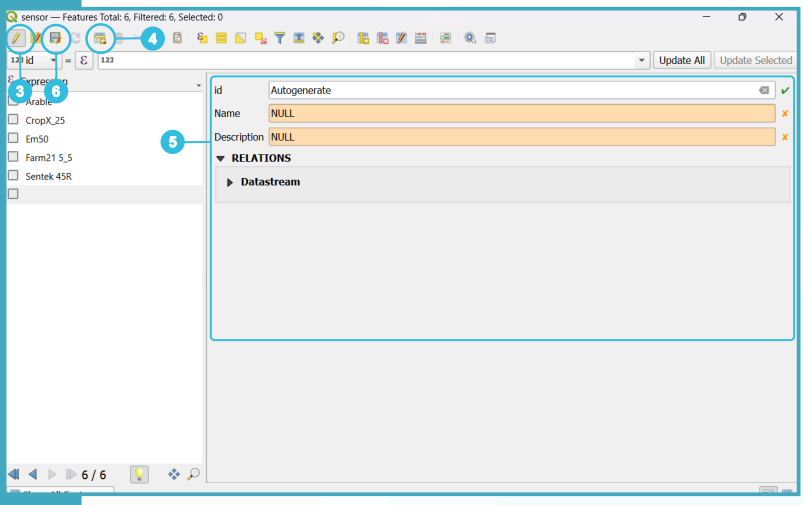
SENSOR

A Sensor is an instrument that observes a property or phenomenon with the goal of producing an estimate of the value of the property.

Creating a Sensor



Right-click on the "Layers" panel on the "sensor" entry (1) and select "Open Attribute Table" from the menu (2).



Click the pencil icon "Toggle Editing Mode" (3) to make the table editable, then click the "Add Feature" button (4). This will open an empty form on the right-hand side (5) where you can enter new data.

Fill out the form with the "Sensor" data.

Click the "Save Layer Edits" button (6) to save the changes, and then click "Toggle Editing" (3) to stop editing.